

# Gamebird 2006 - A Joint Conference

Quail VI and Perdix XII

Abstract Book

Managing Gamebirds in the 21st Century

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University of Georgia, Athens, Georgia

30 May – 4 June 2006



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## **A Note on the Text**

This abstract booklet was created using the magic of technology. Abstracts, carefully entered by each author into html forms available on the web, were stored using PHP within a relational database, extracted from the database using a program written in Python, and programmatically formatted in the  $\text{\LaTeX}$  typesetting language using Python. Hand edits to abstracts were then conducted, where necessary. The text has been typeset in a combination of Palatino and Helvetica fonts.

For each author's help in this process, we offer our gratitude.

-The Gamebird Team

**Wednesday, 31 May 2006**

**Opening Session**

**10:00 AM Taking the Northern Bobwhite Conservation Initiative to the Next Level**

Donald F. McKenzie<sup>1</sup>

The Northern Bobwhite Conservation Initiative (NBCI) is the first national, ecologically-based, landscape-scale recovery plan for northern bobwhites (*Colinus virginianus*; hereafter, bobwhite). It was formally published in March 2002, but unveiled publicly in January 2002 at Quail V in Corpus Christi, Texas, USA. The NBCI was developed by more than 50 biologists associated with the Southeast Quail Study Group (SEQSG) in response to the 1998 charge of the Directors of the Southeastern Association of Fish and Wildlife Agencies. During its infancy, the NBCI was an unqualified success, catalyzing an unprecedented level of enthusiasm, activity and accomplishments at local, state and national levels. The NBCI has been the impetus to restoring bobwhites throughout their range via habitat manipulation and improvement. The SEQSG Steering Committee recognized, up front, that the NBCI would need continual refinement to stay relevant as a driving force for bobwhite restoration. Indeed, four years of implementation already have revealed numerous needs and opportunities to update, refine and expand the NBCI. For example, the NBCI addressed the 22 core states of the historic range, yet additional states have expressed interest. Further, the needs to refine population assumptions, address additional land-use types, include geospatial landscape analyses and involve an even broader contingent of bobwhite experts have become apparent. The SEQSG have formulated a revision strategy, received a grant to hire a revision coordinator, and launched the early phase of this process. As such, the revised edition is expected to transpire by 2008.

<sup>1</sup>Wildlife Management Institute, 2396 Cocklebur Road, Ward, AR 72175, USA

**10:30 AM Management of Southern African Gamebirds: Opportunities and Threats**

Tim M. Crowe<sup>1</sup>

Three evolutionarily quite distinct groups of galliforms contribute to a healthy wingshooting industry in southern Africa: guineafowl (*Numida* spp.), francolins (*Scleroptila* spp.) and spurfowls (*Pternistis* spp.). Some species, such as the helmeted guineafowl (*N. meleagris*), Swainson's spurfowl (*P. swainsonii*) and greywing francolin (*S. africanus*), thrive in moderate to heavily disturbed landscapes, mainly agriculture. In fact, helmeted guineafowl and Swainson's spurfowl increased both in abundance and range during the 20th century. Others, such as the redwing (*S. levaillantii*) and Orange River francolins (*S. levaillantoides*) are very sensitive to certain types of land use. These strikingly different responses to land use require equally diverse strategies in order to develop truly sustainable management strategies and policies. These are discussed in detail for each of these five species of gamebirds.

<sup>1</sup>Gamebird Research Programme, Percy FitzPatrick Institute of African Ornithology, University of Cape Town, Private Bag, Rondebosch, 7701, South Africa

**11:00 AM Restoring a Partridge (*Perdix perdix*) Population and the Future of Predation Control**

G. R. (Dick) Potts<sup>1</sup>

For the past quarter century, the author's partridge (*Perdix perdix*) population simulation model has been a useful guide, incorporating annual variation in chick survival rate, nesting habitat quality, nest predation, pesticides affecting the supply of insect food for the chicks and shooting. The 2 most important variables, density dependent nest predation and effect of insect food supply have been experimentally verified and all parts of the model have been extensively validated. However some very high densities achieved in northern France have not been fully explained. An ongoing conservation research project within the Sussex Downs Study (U.K.) area is described. The area is small (155-ha) but the numbers of partridges have increased ten-fold since 2003, with 57 per 100-ha in the autumn of 2005. Despite a very high density of pheasants no adverse effect of a caecal nematode (*Heterakis gallinarum*) has been detected. This project has been successful so far, but it has involved the removal of large numbers of meso-predators. Although legal, this predation control is unpopular and difficult. Moreover the smaller raptors are increasing and cannot be controlled. The question of whether the return of some top-predators could improve the situation for the partridge is explored by reference to experience in the USA and other countries. Few species have been studied more than the partridge yet, even more vigorous research will be necessary in future to meet the many challenges ahead.

<sup>1</sup>Twynham Cottage, Rockbourne, Fordingbridge, Hampshire, SP6 3NH, UK

**11:30 AM Integrating Monitoring, Research, and Management: Leveling the 3 Legged Stool**

Michael J. Conroy<sup>1</sup>, James T. Peterson<sup>1</sup>

Research and monitoring programs are often thought of as competing with on the ground management for attention and funding. This is false dichotomy; instead, we think it is more appropriate to view research, monitoring, and management as complementary endeavors, in which loss of any 1 of the 3 is disruptive to the remaining 2. In our experience, there is often significant or even profound uncertainty about the systems likely response to management, beyond environmental and other sources of uncontrolled variation. Sometimes this uncertainty can be reduced through directed research studies, including experimentation. However, management decisions usually cannot await the completion of elaborate, multiple-year studies. Adaptive resource management (ARM) provides managers a way to make optimal decisions (with respect to resource objectives), given the current level of uncertainty about system response, *and in anticipation that learning will improve decision making through time*. Under ARM, resource goals and objectives are *always* paramount and monitoring and research programs exist to provide managers with the tools they need to make better decisions. The essentials of ARM are clear, compelling, and critically needed in natural resource management. We believe that we can no longer afford the luxury, if we ever could, of management divorced from research and monitoring, and vice-versa. By keeping the focus on management decision-making and resource objective outcomes, ARM places an explicit value on research and monitoring that then can be used to justify monitoring and research programs.

<sup>1</sup>Georgia Cooperative Fish and Wildlife Research Unit, D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA

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## Policy and Conservation

### 1:20 PM The GCT Gray Partridge (*Perdix perdix*) Recovery Programme: a Species Action Plan in Action

Nicholas J. Aebischer<sup>1</sup>

In 1995, the UK government launched its Biodiversity Action Plan, and nominated The Game Conservancy Trust (GCT) as lead partner responsible for the gray partridge (*Perdix perdix*). The need for action was clear: figures from the British Trust for Ornithology indicated that since 1962, numbers had declined nationally by 91%. This paper reviews the practical steps that the GCT has taken to save the gray partridge and achieve the targets set out in the Species Action Plan: 1) Estimate the national distribution of gray partridge abundance, using broad landscape characteristics measured at the 1x1-km level by the Countryside Survey in 1990, and again in 2000; 2) Raise awareness of the problems facing the gray partridge among the public, especially the shooting and farming communities, using press articles and educational leaflets; 3) Encourage shoot managers, farmers, landowners and local BAP groups to conserve the gray partridge, by joining the GCT's Partridge Count Scheme; 4) Set up local Partridge Groups, to bring together like-minded people and act as a focus for information dissemination; 5) Motivate by example, by setting up a demonstration site to show how appropriate management leads to successful recovery of gray partridge numbers; 6) Initiate research into optimal methods of re-establishing gray partridges into areas where they have gone extinct. Twelve years on, I consider the current population status of the gray partridge in the UK, review the targets of the Species Action Plan in the light of that status, and discuss the chances of success.

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### 1:40 PM Game Bird Management: Linking Theory and Practice in South Texas

Leonard A. Brennan<sup>1</sup>, Fidel Hernández<sup>1</sup>, William P. Kuvlesky, Jr.<sup>1</sup>, Fred S. Guthery<sup>2</sup>

During the past 50 years, the South Texas landscape has provided a rich laboratory for developing a scientific basis for game bird management. For example, the recent Technology of Bobwhite Management book contains conceptual, quantitative, and theoretical models of all aspects of northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) life history: Energetics and Energy-Based Carrying Capacity, the Physiological Need for Water, Population Ecology, Viability and Production, Harvest Theory, Hunter-Covey Interface Theory, and Theory of Habitat Management. Linking such theoretical models with management practices remains a major challenge, but has potential to address and help us understand issues that have important implications for game bird management policy and regulation. Presently, there are at least four examples of such links in South Texas: 1) harvest Theory Management models were useful in clarifying implications of a proposal to double the daily quail harvest in Texas; 2) theoretical Hunter-Covey Interface models provide meaningful results that can help manage harvest pressure while optimizing hunting opportunities; 3) the role of heat in regulating bobwhite populations has been given a new prominence in quail management, both from a climactic perspective as well as from understanding how operational temperatures can make vast areas lethal to bobwhites during significant periods of the day; 4) ongoing research on predation dynamics and usable space for nesting indicate that while modest bobwhite population increases might be gained from nest predator control, annual



production can be devastated by only moderate decreases in nesting cover. Thus, concepts related to habitat theory and usable space remain the cornerstone of successful bobwhite management applications.

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## **2:00 PM The National Grey Partridge Conservation Project of Ireland: an Update 1999-2005.**

Kieran P. Buckley<sup>1</sup>, Conor O’Gorman<sup>2</sup>

Following a national survey in 1991, Irelands indigenous gray partridge (*Perdix perdix*) were deemed to be a species on the brink of extinction. By 1996, only two natural wild populations (Boora and Lullymore) remained on cut-away bogland in central Ireland. Since 1996, the conservation strategy has utilised a combination of predation control, habitat management and gray partridge translocations at Boora County Offaly. 2006 marks the 10th anniversary of the project at Boora. During this time the autumn population has increased from a low of 22 birds in 2000 to 148 birds in 2005. Spring pair counts ranged from a low of 5 pairs in 2000 to 18 pairs in 2005. The Lullymore population became extinct in the absence of management efforts. Government funding through the National Parks and Wildlife Service has been provided to expand the project at Boora over the next 5 years. This has resulted in land purchase, the employment of a second gamekeeper and an expansion of habitat creation. The project is now being managed through a partnership of the Irish Grey Partridge Conservation Trust and the National Association of Regional Game Councils in Ireland.

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## **2:20 PM Invasive Exotic Grasses and Quail on Southwestern Rangelands: What Have We Learned Since QUAIL V?**

William P. Kuvlesky, Jr.<sup>1</sup>, Joseph P. Sands<sup>1</sup>, Aaron Tjemeland<sup>1</sup>, Leonard A. Brennan<sup>1</sup>, Timothy E. Fulbright<sup>1</sup>, Stephen J. DeMaso<sup>2</sup>, Fidel Hernández<sup>1</sup>

Invasive exotic grasses were introduced to North America about 80 years ago to curb erosion and provide forage for livestock with little regard to the impacts these introductions might have on native ecosystem function. Invasions by particularly aggressive exotic plants often eventually result in monocultures of the exotic plant, which simplifies the ecosystem because native biodiversity is typically reduced. Numerous species of invasive exotic grasses currently occur on millions of hectares of southwestern rangelands in the United States and northern Mexico occupied by quail. It had generally been assumed by quail biologists that exotic grass infestations provide poor habitat conditions for quail populations. However, prior to QUAIL V, which was convened in 2002, little research had been conducted to determine the impacts that exotic grass invasions have on upland bird populations. Since 2002, a number of research projects were completed or initiated to quantify the impacts that invasive exotic grasses have on upland bird populations occupying southwestern rangelands. The results of these research projects indicate that exotic grasses can be useful to quail populations but their utility declines as exotic grass density and

cover increases in dominance. The specific properties of exotic grass infestations that are useful to quail will be discussed, as well as the major negative impacts that exotic grass invasions have on quail populations inhabiting the rangelands of the Southwest. In addition, recommendations for preventing or managing exotic grass invasions and even utilizing exotic grasses to benefit quail populations will be discussed.

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## 2:40 PM TeamQuail: Role of Extension Education in Quail Conservation in Texas

Dale Rollins<sup>1</sup>, Ken A. Cearley<sup>2</sup>, Benjamin D. Taylor<sup>3</sup>, Jenny R. Sanders<sup>4</sup>

Providing landowners and other stakeholders with timely, accurate information on quail management practices is prerequisite to sustaining quail on private lands. Over the past 15 years, extension education programs to foster quail management have been used effectively to increase landowner “appreciation” (e.g., awareness) of quail (northern bobwhite [*Colinus virginianus*] and scaled quail [*Callipepla squamata*]) and promote teamwork among stakeholders in Texas. These efforts have included traditional methods (e.g., field days, news releases) as well as more innovative efforts (e.g., websites, youth camps, leadership development) to engage stakeholders of all ages. A series of “Quail Appreciation Days” (QUADs) was initiated in 1998 to educate landowners; 44 such programs have been conducted to date reaching more than 1,800 landowners. Youth education was initiated in 1993 with the inception of the Bobwhite Brigade Wildlife Leadership Camp. This camp has subsequently been cloned in 5 states, and now includes a total of 6 camps (on various species) in Texas. Adult leadership development has been addressed via 2 programs: “W.I.L.D. about Quail” in 1998 and “QuailMasters” in 2005. A long-term, large-scale applied research effort called the Texas Quail Index was initiated in 2002 to engage landowners and county Extension agents in measuring quail happenings on their property. Partnerships with related agencies (e.g., Texas Parks & Wildlife and Natural Resources Conservation Service) and non-governmental organizations (e.g., Quail Unlimited and Texas Wildlife Association) have forged functional alliances with a common goal for quail conservation. These programs have equipped stakeholders to sustain northern bobwhite and scaled quail populations in the southern Great Plains.

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## Restocking

### 1:20 PM How to Re-introduce Gray Partridges (*Perdix perdix*): Conclusions from a Releasing Project in Switzerland

Francis D. Buner<sup>1</sup>

Once a widespread farmland bird in Switzerland, the gray partridge (*Perdix perdix*) has declined drastically since the 1960s as a result of agricultural intensification and changes in predator abundance. In the early 1990s the wild population had dropped to c. 8 pairs only. We initiated a reintroduction experiment of gray partridge to investigate its feasibility for conservation of the species in Switzerland. Between 1998 and 2001 we released 145 partridges in the Swiss Klettgau, an intensively cultivated area from which the species had become extinct in 1993, but had since been ecologically enhanced with wild-flower strips and hedges up to 5.8% of the available habitat in the release area (c. 530–ha). Although the duration of the study was too short to prove if further partridge re-introductions in Switzerland or abroad will be successful in terms of creating self-sustainable populations, it is possible to draw four basic conclusions for future partridge re-introduction projects: 1) prior to every partridge re-introduction or re-establishment the habitat must be enhanced with permanent habitat structures; 2) if translocated wild birds are not available for release, chicks should be fostered whenever possible to increase their survival, in the best case to wild birds still resident in the area; 3) reintroductions should only be envisaged in areas with low predator numbers and human activities; 4) in order to find possible weaknesses in re-introduction projects, post-release monitoring is essential to ensure the project targets are met.

<sup>1</sup>The Game Conservancy Trust, Fordingbridge, Hampshire, SP6 1EF, UK

### 1:40 PM Effects of Translocation on Northern Bobwhite (*Colinus virginianus*) Demographics within a Fragmented Landscape

Theron M. Terhune<sup>1</sup>, D. Clay Sisson<sup>2</sup>, William E. Palmer<sup>3</sup>, H. Lee Stribling<sup>4</sup>, Brant C. Faircloth<sup>1</sup>, John P. Carroll<sup>1</sup>

Northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) populations have been declining throughout most of their endemic range. These declines have been associated with changing land-use and habitat fragmentation. Thus, knowledge of the effects land-use and habitat fragmentation have on population persistence for bobwhites is warranted. Translocation of individuals between populations may mitigate negative effects of habitat fragmentation via providing a means to increase genetic diversity and augment remnant populations. To date, numerous translocations among disparate species have occurred. However, few have investigated the associated demographic and genetic ramifications. Translocation may function as artificial dispersal, subsequently introducing novel genes into isolated populations and increasing demographic parameters (e.g., fecundity) via “hybrid vigor”. However, prior to instituting this technique at large, the potential effects of translocations should be investigated. We conducted an investigation to determine the efficacy of translocation among bobwhites by integrating data from molecular lab techniques (microsatellite analysis) with field data. Translocated birds had similar survival and reproduction to their resident counterparts, and retained high site fidelity. We observed increased population levels following translocation. The translocated and resident bobwhites were genetically disparate; hence, introduction of “novel” alleles to resident populations may have increased heterozygosity.

ity. Translocation may operate as a conservation tool for restoring populations of declining and threatened species, which is of great significance for biodiversity conservation.

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## 2:00 PM Population Viability Analysis of Reintroduced Populations of Red-legged (*Alectoris rufa*) and Gray Partridges (*Perdix perdix*) in Central Italy

Francesca Pella<sup>1</sup>, Anna Vidus Rosin<sup>1</sup>, Alberto Meriggi<sup>1</sup>

Data collected from 10 years of monitoring two reintroduced populations of red-legged (*Alectoris rufa*) and gray (*Perdix perdix*) partridge in protected areas in the Siena province (Tuscany), were used to assess the viability of the populations. Reintroduction started in 1995 and the releases of hand-reared red-legged partridges have been carrying out for three years with 632, 1000 and 500 birds released in 1995, 1996 and 1997, respectively. Gray partridges were reintroduced in 1995, with 420 birds released, and in 1996 with 175. Released partridges were monitored by pre- and post-breeding censuses until 2005 and demographic parameters and their variability were assessed. Demographic parameters were used to run Population Viability Analysis using software for the stochastic simulation of the extinction process (Vortex). Simulations were conducted using: 1) average values of demographic parameters, 2) varying values in accord with trends observed during the study, and 3) hypothetical management options that improved demographic parameters by 5%. Variables modified in the different scenarios were: carrying capacity, chick survival rate, adult survival rate, brood production rate, and average brood size. The results of the different scenarios were compared by Log-linear Analysis procedures in order to identify significant differences in population viability. The dependent variable was the dichotomous survival/extinction of the population after 30 years for each of the 1000 simulations run for every scenario. We use our results to improve management guidelines for reintroductions of partridges.

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## 2:20 PM A Review of Historical Methods of Gray Partridge (*Perdix perdix*) Restocking and its Implications for the Species UK BAP

Stephen J. Browne<sup>1</sup>, Francis D. Buner<sup>1</sup>, Nicholas J. Aebischer<sup>1</sup>

The gray partridge (*Perdix perdix*) population in the UK has declined by over 75% during the last 20 years. Accordingly, it is a bird of conservation concern and a UK Biodiversity Action Plan (BAP) species. Two aims of the 1996 BAP is to increase numbers to over 150,000 pairs and to maintain or enhance its UK range by 2010. In many areas, densities are so low that the species is effectively extinct and cannot recolonise after habitat restoration. Re-establishment through releasing is therefore needed. Historically, many releasing systems have supplemented gray partridge numbers, but the intricacies of the techniques have been lost over time. Unlike modern releasing for driven shooting, where birds suffer from high predation and poor breeding success, traditional rearing systems use wild parents during part of the rearing process so that chicks may

learn survival skills from adults. However, data are lacking on site fidelity, over-winter survival, predation rates, and breeding success of these traditionally-released birds in subsequent years. We reviewed scientific literature, game management books, old gamekeeping books, and hunting magazines to identify existing and historical rearing and releasing techniques. We supplemented this information by interviewing gamekeepers and other interested parties. We describe how the results have been used to devise a field study designed to identify the optimal methods of release for re-establishment purposes. The current study should aid development of techniques, guidelines, and rules for gray partridge re-establishment throughout the UK.

<sup>1</sup>The Game Conservancy Trust, Fordingbridge, Hampshire, SP6 1EF, UK

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## Techniques

### 3:20 PM Pattern Recognition Analysis to Identify Nesting Behavior in Radio-marked Hen Pheasants (*Phasianus colchicus*)

Larkin A. Powell<sup>1</sup>, Ty W. Matthews<sup>1</sup>, J. Scott Taylor<sup>2</sup>

Early nest failures are often missed in galliform studies, as intrusive nest checks may result in nest abandonment. For example, during a 2005 Nebraskan study we were unable to document nests for 3 of 39 radio-marked, female ring-necked Pheasants (*Phasianus colchicus*). Radio-telemetry data allow biologists to infer behavior from movement patterns when an animal cannot be directly observed. We hypothesized that hen movement patterns should markedly change during nesting. We calculated 3 movement statistics from the daily movements of hen pheasants in our sample: distance from the previous location, a centroid for a 5-day moving window, and the mean distance between successive centroids. We used a classification analysis with a random sample of 3 hen pheasants with known nesting and non-nesting periods. We were able to correctly classify nesting periods with 65% accuracy using the average distance from the centroid. Most critically, only 11% of non-nesting periods were erroneously classified as nesting periods. Using these results, we were able to identify nesting periods for all hen pheasants that lacked field confirmation of a nest. Our technique provides biologists with a simple method to predict behaviors from real-time data in the field; similar behaviors in other species could be detected with this method.

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### 3:40 PM A Non-lethal Method for Determining Carcass Fat in Ruffed Grouse (*Bonasa umbellus*)

Aaron B. Proctor<sup>1</sup>, John W. Edwards<sup>1</sup>, Joseph S. Moritz<sup>2</sup>

Percent carcass fat is often considered a primary condition index in game bird species. Although regarded as the standard for determining fat reserves, traditional sampling methods require sacrificing the animal for chemical analysis. Lethal methods negate the ability to track condition of individuals through time. Many avian physiology studies require the ability to assess conditional changes through time and across various treatments, which necessitate the use of a non-lethal method for estimating fat levels. We were able to accurately estimate fat condition in captive ruffed grouse (*Bonasa umbellus*) utilizing total body electrical conductivity (TOBEC). We developed predictive models to estimate percent carcass fat directly from first-order regression of TOBEC and live mass values. Validation of our best model from an independent sample ( $n = 10$  individuals) produced an  $R^2 = 0.85$  for determining percent carcass fat in ruffed grouse. Future studies investigating galliform ecology or physiology could benefit from use of TOBEC for assessment of fat condition if non-lethal sampling is desired to track changes through time.

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**4:00 PM Age Determination of Pheasants (*Phasianus colchicus*) using Discriminant Analysis**

Maureen I. A. Woodburn<sup>1</sup>, John P. Carroll<sup>2</sup>, Peter A. Robertson<sup>3</sup>, Andrew N. Hoodless<sup>1</sup>

The majority of gallinaceous birds can be identified as juveniles or adults by plumage characteristics, since the outermost primaries (P9 and P10) are retained until after the first post-nuptial moult and are identifiable by colour and wear. In contrast, pheasants (*Phasianus colchicus*) moult all ten primary feathers during their post-juvenile moult. Several techniques are available to age pheasants with varying degrees of accuracy, but many of these are limited to use on dead birds only. To date, the method most widely used on live birds, is measurement of the shaft diameter of the proximal (innermost) primary feather since this is the first primary to be moulted in the post-juvenile moult, and therefore is replaced before the bird is fully-grown. Using a known age sample of 1051 pheasants in the wild, this study presents a discriminant function analysis using proximal primary feather measurements and a combination of other morphological characteristics to achieve a greater level of accuracy of ageing. Morphological measurements used in the final model were for males, primary shaft diameter and length, body weight to head length ratio, spur length and year, and for females, primary shaft diameter and length, body weight to head length ratio and year. Over 94% accuracy was achieved for ageing birds of both sexes when all parameters were used in the model. When our model was applied to an independent data set of unknown age birds we were able to classify 83%.

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**4:20 PM Stable Isotope Analysis Distinguishes Wild and Pen-Reared Northern Bobwhite (*Colinus virginianus*)**

Paul M. Castelli<sup>1</sup>, Lisa M. Reed<sup>2</sup>

We tested the hypothesis that stable isotope ratios of carbon, nitrogen, sulfur, and hydrogen in primary feathers of 16 wild and 22 pen-reared northern bobwhite (*Colinus virginianus*; hereafter bobwhite) differed sufficiently to discriminate between them. Foods eaten during feather tissue growth effects its isotope concentrations. Feathers are inert once grown, therefore they permanently reflect the food source at the time they were formed. Pen-reared bobwhite eat commercial foods not available to wild bobwhite. After grinding and weighing feathers, the ratios of stable isotopes of carbon, nitrogen, sulphur, and hydrogen were measured in a mass spectrometer. Delta values were calculated based on the general formula of isotopic differences in tissue divided by isotopic differences in environmental standards. Delta values of carbon, nitrogen, and sulphur were used in a discriminant analysis to classify the subjects back into a wild or pen-reared group using SPSS. Covariance matrices for the 2 groups differed (Box's M = 129.512, F = 19.544,  $P < 0.000$ ). The distributions of individual samples for the 2 groups were distinctive. Pen-reared bobwhite showed tight grouping while wild bobwhite exhibited a more scattered pattern, however there was no overlap. Stable isotope ratios of carbon, nitrogen and sulfur can be used to form a single function that discriminated between the groups 100% of the time (Wilks lambda = 0.015, Chi-square = 145.695, 3 df,  $P < 0.000$ ). Hydrogen was not useful in the discriminant function. Five additional wild samples and 30 pen-reared samples from 3 game farms were collected and prepared. Further results will be presented.

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## Habitat I

### 3:20 PM Usable Space Versus Food Quantity in Northern Bobwhite (*Colinus virginianus*) Habitat Management

Douglas S. Cram<sup>1</sup>, Ronald E. Masters<sup>2</sup>, Fred S. Guthery<sup>3</sup>, David M. Engle<sup>4</sup>, Warren G. Montague<sup>5</sup>

We studied the response of northern bobwhite (*Colinus virginianus*; hereafter bobwhite) foods (plants and invertebrates), usable space, and populations following thinning and burning on the 60,000-ha pine (*Pinus* spp.)-grassland restoration area in the Ouachita National Forest, Arkansas, to examine 2 features commonly used to manage bobwhite habitat: 1) usable space (suitable permanent cover) and 2) food quantity (an element of habitat quality). We estimated invertebrate food abundance using sweep nets and abundance of food-producing plants using herbaceous and woody stem counts. The disk of vulnerability was used to index usable space. We used whistling-male counts to index population response. Relative abundance, mass, and frequency of occurrence of invertebrate foods and richness, density, and frequency of occurrence of bobwhite food-producing plants increased following thinning and fire. Relative abundance of whistling males was greatest in thinned stands 3 growing seasons post-burn and in thinned but unburned stands. We found food supply was related to usable space following treatment. However, food abundance alone did not explain bobwhite population response, whereas, usable space was predictive for bobwhite response. By comparing treated stands with similar usable space but different food quantity, we observed no differences in bobwhite abundance. Neural models suggested bobwhite population response was less sensitive to changes in food supply relative to changes in usable space. Managers should seek first to provide usable space (suitable permanent cover in low basal area stands) recognizing that adequate food supply will likely be a side effect of management to this end.

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### 3:40 PM Effects of Timber Volume on Northern Bobwhite (*Colinus virginianus*) Autumn Abundance

Ian T. Little<sup>1</sup>, Shane D. Wellendorf<sup>2</sup>, William E. Palmer<sup>2</sup>, Tim M. Crowe<sup>1</sup>, John P. Carroll<sup>3</sup>

In the Red Hills of Florida and Georgia, northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) are often associated with pine forested ecosystems maintained with prescribed fire. Within this region, we have observed variability in quail abundance on properties managed specifically for bobwhite production and harvest. We hypothesized that the quality of understory herbaceous vegetation, which varies with timber canopy density, contributes to this variability. We used timber density measurements and covey call count indices over 3 years (2002–2004) to assess the influence of timber density on bobwhite abundance. In addition, we measured understory vegetation, canopy cover, and height to assess the impact of timber density on ground vegetation. We found that bobwhite abundance was negatively correlated with basal area of trees ( $P < 0.001$ ). This relationship was most pronounced as basal area increased from 9.08 m<sup>2</sup>/ha to 18 m<sup>2</sup>/ha. Ground vegetation height and density decreased with increasing basal area ( $P < 0.001$ ). Of the

sites we studied, longleaf pine stands contained larger populations of bobwhites at a given tree basal areas than other pine species. This contrast is likely a function of longleaf pine growth forms allowing more sunlight to the ground. Our research supports the hypothesis that increasing basal area of pines indirectly affects bobwhites by reducing ground level habitat quality. To minimize negative overstory timber effects on quail abundance, landowners should maintain a timber basal area below 10 m<sup>2</sup>/ha, if quail production is the primary objective.

<sup>1</sup>Gamebird Research Programme, Percy FitzPatrick Institute of African Ornithology, University of Cape Town, Private Bag, Rondebosch, 7701, South Africa; <sup>2</sup>Tall Timbers Research Station and Land Conservancy, 13093 Henry Beadel Drive, Tallahassee, FL 32312, USA; <sup>3</sup>D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA

#### 4:00 PM Native Grasses Versus Invasive Exotic Grasses as Northern Bobwhite (*Colinus virginianus*) Habitat in South Texas

Joseph P. Sands<sup>1</sup>, Leonard A. Brennan<sup>1</sup>, Fidel Hernández<sup>1</sup>, William P. Kuvlesky, Jr.<sup>1</sup>, James F. Gallagher<sup>2</sup>, Donald C. Ruthven, III<sup>3</sup>, James E. Pittman, III<sup>1</sup>

Northern bobwhite (*Colinus virginianus*) populations have undergone a range-wide decline in the last thirty years due to changes in land use and habitat at micro- and macrohabitat scales. Exotic grasses adversely affect diversity of native fauna and flora, and disrupt ecosystem functions however, little is known regarding the direct impacts of exotic grasses on quail. We conducted a study to investigate the impacts of invasive, exotic grasses on northern bobwhite microhabitat use during the breeding season (April-September) in southern Texas (Dimmit and LaSalle counties). We measured percent coverage of exotic grasses at organism-centered and random points using the line-intercept method. Northern bobwhite use of microhabitats declined as coverage of exotic buffelgrass (*Cenchrus ciliaris*) and Lehmann lovegrass (*Eragrostis lehmanniana*) approached 25–30% ( $R^2 = 0.94$ ). In addition, study plots with light (<5%) buffelgrass composition had 3.5 x more forbs, and 2.3 x more bare ground than plots heavily dominated (>30%) by buffelgrass. Northern bobwhite avoidance of microhabitats with exotic grass compositions may be an indicator of potential reductions of useable space available within mixed-brush shrublands and semi-desert grasslands in southern Texas.

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#### 4:20 PM Influence of Road-created Edge on Nesting Success of Northern Bobwhites (*Colinus virginianus*)

Jason L. Scott<sup>1</sup>, Joshua P. Rusk<sup>1</sup>, Fidel Hernández<sup>1</sup>, Fred C. Bryant<sup>1</sup>

Anecdotal observations suggest northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) exhibit a tendency to nest near edges. However, numerous studies have documented that avian species experience lower nest success near vegetation edges. It is unknown whether bobwhite nesting behavior contributes to the high depredation rates generally sustained by this species. The objectives of our study were to empirically determine if bobwhites were selecting nest sites

near roads and evaluate the influence of road–created edge on nest success. We documented preference–avoidance behavior of nesting bobwhites in Brooks County, Texas during April–October, 2000–2005. We delineated primary roads (e.g. paved) and secondary roads (e.g. pipelines, disked strips, etc.) from aerial photographs of 3 study sites ( $\approx 1,200$  ha each) using geographic information systems (GIS). We then calculated the perpendicular distance of nest sites ( $n = 318$ ) and random points ( $n = 500/\text{site}$ ) to the nearest road. We used continuous selection functions to assess preference–avoidance behavior of nesting bobwhites and compared nest success among 5 – 30–m intervals from roads. We documented that bobwhites selected nest sites that were within 120 m of roads in all 3 sites. However, nest success was not dependent on proximity to roads ( $P = 0.21$ ). Although bobwhites show a preference to nest near road–created edge, this behavior does not appear to be a maladaptive reproductive strategy.

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### 4:40 PM Species Visitation at Quail Feeders and Guzzlers in Southern New Mexico

Benjamin D. Taylor<sup>1</sup>, Troy D. Sparks<sup>1</sup>, Dale Rollins<sup>1</sup>, Tom E. Waddel<sup>2</sup>, George Richards<sup>2</sup>

Providing supplemental feed and water (i.e., guzzlers) are common management practices for scaled quail (*Callipepla squamata*) in the Chihuahuan Desert even though their biological and economical efficacy are debatable. Use by nontarget species is a given, but empirical data on species visitations are lacking. We used 2 types of surveillance technology (Trophyview® video systems and GameVu® digital cameras) to assess diel and seasonal visitations at 2 types of supplemental feed (barrel feeder with milo vs. commercial game bird block) and water (i.e., guzzlers) on the Armendaris Ranch in south–central New Mexico during 2003–04. Preliminary analyses suggest that scaled quail visited barrel feeders and blocks at similar rates, but quail spent about 300% more time feeding at a barrel feeder. Relative to similar studies of northern bobwhite use of feeders in west Texas, quail feeders at Armendaris Ranch tended to be more efficacious (i.e., a greater proportion of the feed being consumed by scaled quail). Mourning doves and nongame birds appear to be the primary nontarget consumers at this site. Analyses of guzzler data is pending, but video surveillance did document regular use of guzzlers by all age groups of scaled quail. We also discovered novel uses for the video surveillance relative to facilitating our reconnaissance of radio–tagged quail whose telemeters had malfunctioned. Future research should assess the potential for using video surveillance to estimate chick survival. Trophyview cameras cost \$1,100 USD while the GameVu cameras cost \$125 USD; advantages and problems encountered with each technology will be compared.

<sup>1</sup>Texas Agricultural Experiment Station, 7887 U.S. Hwy. 87 North, San Angelo, TX 76909, USA; <sup>2</sup>Armendaris Ranch, New Mexico Ranch Properties, Inc., Engle, NM 87935, USA

Thursday, 1 June 2006

## Survival and Predation

### 9:00 AM Over-winter Survival of Northern Bobwhite (*Colinus virginianus*) in Relation to Landscape Composition and Structure

Doug Holt<sup>1</sup>, L. Wes Burger, Jr.<sup>1</sup>, David Godwin<sup>2</sup>

It has been proposed that winter ranges of northern bobwhite (*Colinus virginianus*) differ in quality, based on habitat structure, composition, or interspersions. However, no studies have quantitatively linked landscape structure to winter survival. We modeled winter survival of radio-marked northern bobwhite (2000,  $n = 118$  in 16 coveys; 2001,  $n = 49$  in 7 coveys) as a function of landscape structure and composition at two spatial scales (daily and seasonal ranges). For each spatial scale we constructed nine a priori models. At the spatial scale of winter ranges, a model characterizing the quantity and configuration of linear herbaceous cover was the best approximating model, but models describing grassland composition/structure and landscape diversity were competing. However, parameter estimates for predictor variables often included zero. In the linear herbaceous cover model, mean patch size and edge density of linear herbaceous cover showed weak positive effects. At the spatial scale of daily activity, metrics describing landscape structure and composition were poor predictors of survival. During this study, the quantity, patch size, amount of edge, or interspersions of patch types within the winter range or surrounding daily activity locations did not measurably influence the hazard function, suggesting that seasonal ranges can have different composition and structure, yet show similar survival rates for the birds that inhabit each range. There was no strong evidence to suggest that seasonal ranges differed quantitatively in their survival benefits in relation to the composition or structure of the habitat within them.

<sup>1</sup>Department of Wildlife and Fisheries, Mississippi State University, Box 9690, Mississippi State, MS 39762, USA;

<sup>2</sup>Mississippi Department of Wildlife, Fisheries, and Parks, Box 9690, Mississippi State, MS 39762, USA

### 9:20 AM Breeding Season Survival of Female Scaled Quail (*Callipepla squamata*) at Three Sites in the Chihuahuan Desert

Dale Rollins<sup>1</sup>, Bobby J. Buntyn<sup>2</sup>, Scott A. Lerich<sup>3</sup>, Troy D. Sparks<sup>4</sup>, Benjamin D. Taylor<sup>1</sup>, Louis A. Harveson<sup>5</sup>, Cody B. Scott<sup>2</sup>

Scaled quail (*Callipepla squamata*) populations declined markedly across much of their range during 1988–2001. We monitored survival of radio-tagged female scaled quail during the breeding season on 3 sites in Brewster ( $n = 71$ ) and Pecos ( $n = 207$ ) counties, Texas, and Sierra county, New Mexico ( $n = 278$ ) during 1999–2003. We estimated survival using Kaplan-Meier methods for birds living  $\geq 7$  days post-capture. Interval survival rates during Mar–Aug ranged from 0.46 to 0.82 for populations in Pecos County, Texas, and from 0.5 to 0.64 in Brewster County, Texas; survival estimates are pending for New Mexico study site. Depredation by mammals was the leading cause of mortality on both Texas study sites, while depredation by raptors was the primary cause of mortality at the New Mexico site. Notably, we attributed 5 deaths to drowning: 3 in a water trough and 2 during a flash flood. Meso-carnivore abundance (as determined by scent station indices) was low at all sites. Survival rates of female scaled quail observed in these studies were

approximately twice those we have observed for northern bobwhite (*Colinus virginianus*) at several sites in west Texas. Survival was similar across sites featuring moist-soil management (Texas sites) and supplemental feed/water (New Mexico site) relative to control sites. These studies suggest that breeding-season survival is not a bottleneck for scaled quail, at least not on sites in moderate to high seral stages.

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### 9:40 AM Identifying Predators and Nest Fates of Northern Bobwhites (*Colinus virginianus*) in Southern Texas

Michael J. Rader<sup>1</sup>, Trent W. Teinert<sup>1</sup>, Leonard A. Brennan<sup>1</sup>, Fidel Hernández<sup>1</sup>, Nova J. Silvy<sup>2</sup>, X. Ben Wu<sup>3</sup>

Predation is the primary cause of nest failure for northern bobwhites (*Colinus virginianus*; hereafter bobwhite). Currently, there are few reliable data documenting the species diversity and relative importance of predators depredating bobwhite nests in southern Texas. We used infrared video-monitoring systems to document nest fates of 127 bobwhite nests over 4 nesting seasons, on 3 study sites of varying woody-vegetation composition (i.e., mean woody cover = 5%, 11%, and 32%, respectively) from 2002 to 2005 in southern Texas, USA. Mammals (83%), native fire ants (*Solenopsis xyloni*) (15%), and snake (3%) constituted the identified bobwhite nest predators. Mammalian predators, in order of importance, included coyote (*Canis latrans*), skunk (*Mephitis mephitis*), badger (*Taxidea taxus*), raccoon (*Procyon lotor*), rodents, and bobcat (*Lynx rufus*). We found that bobwhite nests monitored with video cameras ( $n = 127$ ) had a 15% lower failure rate than nests not monitored with cameras ( $n = 69$ ). Bobwhite nest survival varied by year and by study site. Estimated 23-day nest-survival ranged from a low of 0.26 in 2004 to a high of 0.44 in 2003. Nest survival ranged from a low of 0.25 on the Cuates study site (woody-species composition = 5%) to a high of 0.46 on the North Viboras study site (woody-species composition = 32%). The overall estimated 23-day nest survival for the study period was 0.36. We confirmed the existence of regional differences in bobwhite nest predator communities and documented high nest-predator diversity in southern Texas, including the significance of native fire ants.

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### 10:00 AM Northern Bobwhite (*Colinus virginianus*) Harvest Rates, Total Mortality Rates, and Over-winter Survival Rates on a Public Wildlife Management Area in South Florida

Ralph W. Dimmick<sup>1</sup>, Madan Oli<sup>2</sup>, Jeff Hostetler<sup>2</sup>, Tommy C. Hines<sup>3</sup>, Steve Brinkley<sup>4</sup>

We used 1108 radio-marked northern bobwhites (*Colinus virginianus*) captured by a variety of methods and fitted with 6-g transmitters to estimate harvest rates and crippling rates of birds shot by hunters on a 65,000-acre public hunting area in south Florida during 2002–2006. We estimated total mortality rates, cause specific mortality rates, and survival rates for winter, summer, and

annual periods during the period of study. We compared harvest rates and total mortality rates during the hunting season on 4 zones on the wildlife management area managed to achieve 2 different levels of hunting pressure. With one exception, the 2 zones with restricted hunter access had lower harvest rates and lower total mortality rates during the 6-week hunting season than did the zones with unrestricted access. Over 2 hunting seasons on the 4 zones, total mortality was positively and significantly correlated with mortality from hunting. At least at the level of harvest observed in this study, higher hunting mortality was not compensated for by lower mortality rates from other causes during the hunting season.

<sup>1</sup>Environmental Enterprise, 901 McFee Rd., Knoxville, TN 37934, USA; <sup>2</sup>Department of Wildlife Ecology and Conservation, University of Florida, Gainesville FL 32611, USA; <sup>3</sup>Florida Fish and Wildlife Conservation Commission, 1314 SW 186th Street, Newberry, FL 32669, USA; <sup>4</sup>Florida Fish and Wildlife Conservation Commission, 37501 Bermont Rd., Punta Gorda, FL 33950, USA

### 10:40 AM Meso-mammalian Predation Management and Nesting Ecology of Northern Bobwhite (*Colinus virginianus*)

John P. Carroll<sup>1</sup>, William E. Palmer<sup>2</sup>, D. Clay Sisson<sup>3</sup>, H. Lee Stribling<sup>4</sup>, Ryan P. Thornton<sup>1</sup>, Eric L. Staller<sup>2</sup>, Susan Ellis-Felege<sup>1</sup>

As northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) populations in the southeastern U.S.A. have declined, some of their predators have increased in abundance and range suggesting to some managers that there is a cause and effect. Our project determined experimentally whether predation management during spring and summer can enhance the nesting success and population densities of the bobwhite quail. Field work is being conducted for 7 years on 4 1,200–1,600 ha study sites in Georgia and Florida, U.S.A. Using a crossover design, pairs of sites were trapped or untrapped. Scent-station indices were used estimate predator abundance/activity. Bobwhite quail survival and productivity measures were assessed using radio-telemetry each site ( $n > 200$ /year/site). Estimates of autumn abundance of bobwhite quail is determined using covey-call quadrats. Predator indices declined on all study areas, but on trapped areas the index declined 37% and 67%, respectively. Untrapped controls declined only 15% and 22%, respectively. Pre-treatment autumn abundance estimates for bobwhites ranged from 0.71 quail/ha to 3.8 quail/ha. After treatment, the Albany trapped site increase 40% to 5.3 quail/ha, whereas the Albany untrapped site decreased by 6% to 1.9 quail/ha. On the Thomasville sites, abundance estimates on the trapped site increased by 210% to 2.2 quail/ha and the untrapped site increased by 26% to 3.2 quail/ha. Our targeted predator removal allowed predator species to remain in the ecosystem, retaining its necessary role, including maintaining and possibly preventing lower order predator species from taking its place, while reducing predatory pressures on prey species at critical times.

<sup>1</sup>D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA; <sup>2</sup>Tall Timbers Research Station and Land Conservancy, 13093 Henry Beadel Drive, Tallahassee, FL 32312, USA; <sup>3</sup>Albany Quail Project, Rt 1, Box 115, Newton, GA 39870, USA; <sup>4</sup>School of Forestry and Wildlife Sciences, 602 Duncan Drive, Auburn University, AL 36849, USA

### 11:00 AM Survival and Habitat Use of Wild Pheasant (*Phasianus colchicus*) Broods on Farmland in Lower Austria

Thomas H. Bliss<sup>1</sup>, Roger A. H. Draycott<sup>2</sup>, Brandon C. Anderson<sup>1</sup>, John P. Carroll<sup>1</sup>

Wild pheasants (*Phasianus colchicus*) have declined throughout much of their European range. The influence of habitat composition on survival and habitat use of wild pheasant broods is not well understood but is important for population management. We studied the brood rearing ecology of pheasants using radio-tagged hens on a 2400 ha farming estate in Lower Austria from 2001–2003. Brood survival rates to 3 weeks ( $n = 36$ ) were: 74.4% ( $\pm 15.6$  SE), 91.9% ( $\pm 7.8$  SE) and 65.7% ( $\pm 13.8$  SE) during 2001–2003, respectively, using the Kaplan-Meier method. Brood loss ( $n = 7$ ) occurred between 2–17 days after hatching with predation ( $n = 5$ ) accounting for 71.4% of losses. Survival of broods based on proportions of habitats within adaptive kernel home ranges was examined using an information-theoretic approach. Proportion of planted game crop within the home range had a positive affect upon survival, whereas age and condition of females did not influence survival of broods. To improve brood survival rates of pheasants in agricultural landscapes farmers and game managers should consider planting specialist brood rearing mixtures in areas close to nesting habitats.

<sup>1</sup>D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA; <sup>2</sup>The Game Conservancy Trust, Fordingbridge, Hampshire, SP6 1EF, UK

### 11:20 AM Survival and Cause of Mortality of Northern Bobwhites (*Colinus virginianus*) in the Southeastern USA

D. Clay Sisson<sup>1</sup>, Theron M. Terhune<sup>2</sup>, H. Lee Stribling<sup>3</sup>, Jerald Sholar<sup>4</sup>, Steven Mitchell<sup>5</sup>

Long-term studies are imperative to increase our knowledge of northern bobwhite (*Colinus virginianus*; hereafter bobwhite) demographics. During 1992–2005, we investigated survival and causes of mortality of bobwhites on 10 study sites in southern Georgia and eastern Alabama, USA. We monitored bobwhites ( $n = 7,105$ ) via radio-transmitters to examine spatial and temporal variation in survival both among and between bobwhite populations. Continual radio-telemetry monitoring yielded 49 annual (Oct–Sept) and 110 seasonal survival estimates. Annual survival for all sites and years combined averaged 0.196 (SE = 0.011; range: 0.08–0.40). We observed annual survival rates sufficient to maintain stable populations (production [juvenile/adult] required to stabilize the population  $\leq 7$ ) for 38 of 49 (78%) individually-derived annual survival estimates. Long-term averages for 9 of 10 (90%) annual survival estimates, delineated by site, were deemed sufficient to maintain stable populations. Over-winter seasonal survival estimates ( $n = 51$ ) averaged 0.541 (SE = 0.019) and ranged between 0.25 and 0.82, while breeding season survival estimates ( $n = 59$ ) averaged 0.352 (SE = 0.013) and ranged between 0.13 and 0.59. The cause of mortality was determined from 3,580 known fate individuals. Over-winter seasonal mortality ( $n = 1,465$ ) was attributed to avian predators ( $0.582 \pm 0.040$ ), mammalian predators ( $0.262 \pm 0.044$ ), harvest ( $0.126 \pm 0.028$ ) and snakes ( $0.004 \pm 0.004$ ). Breeding season mortality ( $n = 2115$ ) was ascribed to avian predators ( $0.605 \pm 0.026$ ), mammalian predators ( $0.370 \pm 0.049$ ) and snakes ( $0.025 \pm 0.006$ ). In this manuscript, we report long-term survival estimates and discuss the reliability of these telemetry-derived estimates to make inferential management and research decisions.

<sup>1</sup>Albany Quail Project, Rt 1, Box 115, Newton, GA 39870, USA; <sup>2</sup>D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA; <sup>3</sup>School of Forestry and Wildlife Sciences, 602 Duncan

Drive, Auburn University, AL 36849, USA; <sup>4</sup>Albany Quail Project, 752 Oglethorpe Trail, Sylvania, GA 30467, USA ;  
<sup>5</sup>Alabama Quail Project, 1442 Saint Mark Church Road, Hurtsboro, AL 36860, USA



## Conservation I

### 9:00 AM Status of Western Quails in Texas

Alfonso Ortega-Sanchez<sup>1</sup>, Louis A. Harveson<sup>1</sup>

Four quail species occur in Texas: northern bobwhite (*Colinus virginianus*), scaled quail (*Callipepla squamata*), Gambels quail (*C. gambelii*), and Montezuma quail (*Cyrtonyx montezumae*). Scaled quail are commonly found in the 5 western ecoregions; Gambels quail occur along primary drainages in the Trans-Pecos region; and Montezuma quail are limited to the desert mountains of the Trans-Pecos and Edwards Plateau regions of Texas. Of the 4 Texas quail species, only Montezuma quail are not hunted in Texas. Scaled quail populations show high annual variation and have decreased in 3 ecoregions (Rolling Plains, High Plains, and Edwards Plateau) and have remained stable in 2 ecoregions (South Texas and Trans-Pecos). Trends of Gambels quail and Montezuma quail are not monitored annually. As northern bobwhite populations and corresponding hunting opportunities continue to decline across the southeastern United States, management of western quails may become more critical. Although a considerable amount of scaled quail are harvested annually (60,000-600,000), western quail in Texas receive relatively little attention from the hunting public. Despite their prominence, little information exists on the ecology and management of western quails in Texas.

<sup>1</sup>Department of Natural Resource Management, Sul Ross State University, Alpine, TX 79832, USA

### 9:20 AM Parasite Ecology of Reared and Wild Northern Bobwhite Quail (*Colinus virginianus*) in the Southeastern U.S.A.

Jessica A. Rodriguez<sup>1</sup>, John P. Carroll<sup>1</sup>

Populations of northern bobwhite quail (*Colinus virginianus*; hereafter, bobwhite) have undergone a dramatic decline in the southeastern U.S.A. since the mid-1900s. This is due primarily to the loss of early successional habitat. Various management techniques are in place to help improve habitat for bobwhites and to increase their abundance. One management practice implemented to help increase the numbers of bobwhites for hunting opportunities is the rearing and releasing of quail into suitable habitat. Releasing pen-reared quail into habitats with wild populations potentially increases the risk of introducing disease and parasites to their wild counterparts and potentially to other game birds that share the same habitat, such as wild turkey (*Meleagris gallopavo*). This project studied the effects of management techniques on the parasite burden in bobwhites throughout the Southeast. We investigated the helminth fauna from hunter-killed bobwhites from 12 plantations throughout the Southeast. Bobwhites were sampled from plantations that manage for wild quail, pen-released quail, and sites with close to an even proportion of pen-released and wild quail. The helminth fauna of wild and pen-released bobwhites was determined to see if there was a cross contamination on sites inhabited by both wild and pen-released bobwhites. We determined intensity and prevalence of helminths using counts of each species after excising the intestinal tract. We found nine different species including, *Heterakis isolonche*, *Trichostrongylus tenuis*, *Cryneia colini*, *Subulura brumpti*, *Dispharynx nasuta*, *Capillaria contorta*, *Gongylonema ingluvicola*, *Railietina* sp., and *Rhabdometra* sp. Further analysis will determine if factors such as pen-releasing and population density has an effect on parasite intensity and prevalence.

<sup>1</sup>D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA

**9:40 AM Mountain Quail (*Oreortyx pictus*) Conservation: A Case for Metapopulation Theory**Kevin E. Church<sup>1</sup>, William Bosworth<sup>1</sup>, Tamara Fields<sup>1</sup>

Metapopulation theory is a popular framework for understanding threats faced by at-risk species in fragmented habitats, and ultimately for developing conservation strategies. Central to the theory is knowledge of suitable habitat at the landscape level. We used geophysical, climatic, and biological variables to calculate an ecological profile of occupied sites to develop an inductive model for mountain quail (*Oreortyx pictus*) distribution in the Intermountain West of North America. In contrast, we also used more traditional deductive techniques to assess the suitability of conditions in occupied habitat at a finer spatial scale. Our results suggested that metapopulation theory is a useful tool for identifying alternative hypotheses, such as mainland-island effects or source-sink dynamics, and for recognizing important data gaps. We caution that it may be unrealistic and unwise to promote general principles of metapopulation theory in the absence of empirical evidence. Nonetheless we recommend resource managers consider this approach before implementing conservation strategies derived solely from traditional site-level assessments.

<sup>1</sup>Idaho Department of Fish and Game, Idaho Conservation Data Center, PO Box 25, Boise, Idaho 83707, USA

**10:00 AM Habitat Use and Survival of the Spotted Tinamou (*Nothura maculosa*) in Agroecosystems in the Province of Buenos Aires, Argentina**Jeffrey J. Thompson<sup>1</sup>, John P. Carroll<sup>1</sup>

Changes in the composition and configuration of agricultural landscapes stemming from grassland conversion and agricultural intensification have contributed to the global declines of grassland and shrubland birds. In both North America and Europe there exists a large body of research on the effects of agriculture on populations of terrestrial gamebirds. However, little research exists for these species in Argentina or Latin America in general. In Argentina, the most important gamebird species is the spotted tinamou (*Nothura maculosa*), which has become increasingly scarce in a significant portion of its range due to agricultural intensification over the last 15 years. Using radio telemetry, I examined habitat preferences, movements, and survival of spotted tinamous in agricultural and mixed agricultural and grazing landscapes in the province of Buenos Aires, Argentina. Individuals most preferred fallow fields and lightly grazed areas, followed by wetlands. Although birds generally maintained small home ranges, in some cases changes in cattle density and the structure of row crops caused birds to move considerable distances. Survival from mid winter to early spring was more than double in the mixed landscape ( $\hat{s} = 0.77$ ) compared with the landscape dedicated to row crops ( $\hat{s} = 0.33$ ). Considering the results of research in other regions of the effects of agricultural intensification on terrestrial gamebirds, these results are not unexpected and suggest a precarious future for the conservation of grassland and agro-ecosystem species in Argentina in light of present agricultural trends.

<sup>1</sup>D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA

## Policy and Conservation II

### 10:40 AM Hunting Success on Albany, Georgia Plantations: The Albany Quail Project's Modern Quail Management Strategy

H. L. Stribling<sup>1</sup>, D. Clay Sisson<sup>2</sup>

The Albany Quail Project began in March 1992 as a cooperation between Auburn University's School of Forestry and Wildlife Sciences and the private quail plantation community surrounding Albany, Georgia. The goal of this collaboration was to increase population densities and hunting success of northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) on these properties. Issues important to the plantations were investigated via field research techniques (e.g. radio-telemetry) and then modifications in management regimes were put into practice. From 1992–2005 over 8,000 wild bobwhites were radio-tagged to study various demographic and population mechanisms of bobwhites. The result has been a change in management style based on science creating the concept of Modern Quail Management (MQM) techniques. Bobwhite population densities and hunting success during the last decade on these properties are now higher and more stable than witnessed during any previous period in their history. On our primary study site during 1980–1996 the average number of coveys seen per hour was 3.9 (SE = 0.265) with a range of 2.7–6.5 (CV = 0.28). Following the implementation of MQM techniques this average during 1997–2005 increased to 7.7 (SE = 0.317) with a range of 6.9–9.7 (CV = 0.12) and population density has been maintained at >2 birds per acre. This manuscript provides a brief history of the Albany Quail Project, describes how results from these studies have contributed to the evolution of new management philosophies over the last decade, outlines what these changes have been, and describes how they have been successfully applied on numerous properties in the Albany area to improve bobwhite populations.

<sup>1</sup>School of Forestry and Wildlife Sciences, 602 Duncan Drive, Auburn University, AL 36849, USA; <sup>2</sup>Albany Quail Project, Rt 1, Box 115, Newton, GA 39870, USA

### 11:00 AM Management of Montezuma Quail (*Cyrtonyx montezumae*) in Texas: Barriers to Establishing a Hunting Season

Louis A. Harveson<sup>1</sup>

Montezuma quail (*Cyrtonyx montezumae*) occur throughout the Desert Southwest, ranging from Vera Cruz, Mexico to southern Arizona, New Mexico, and western Texas. In Mexico, Montezuma quail are a protected species and in New Mexico and Arizona they are a harvested gamebird. The distribution of Montezuma quail has changed significantly during the past century. Currently Montezuma quail are limited to the Trans-Pecos with remnant populations in the Edwards Plateau. Although Montezuma quail are classified as a gamebird in Texas, seasons are currently closed. Recently, Texas Parks and Wildlife Department has expressed interest in opening the season on Montezuma quail. However, prior to implementing an open season, resource managers should evaluate possible barriers to changing their status. In this manuscript I review and chronicle the sociological and biological barriers associated with opening a hunting season for Montezuma quail in Texas. Sociological barriers include landowner competency and trust in state agencies, a growing voice among non-consumptive users in Texas, a localized ecotourism industry centered on Montezuma quail, and other cultural factors. Biological barriers include lack of

data on Montezuma quail population distribution, trends, and abundance; lack of scientific data relative to habitat management for Montezuma quail; or studies simulating the effects of harvest on Montezuma quail.

<sup>1</sup>Department of Natural Resource Management, Sul Ross State University, Alpine, TX 79832, USA

### **11:20 AM Managing Quail in Arizona: Meeting New Challenges with Old Techniques**

Mark L. Zornes<sup>1</sup>

I present an overview of past quail management in Arizona and the current direction of Arizona's Quail Program. Since the inception of Arizona's Quail Program, management activities progressed from an era of intensive population and habitat data collection and habitat improvements, to one of more passive management. I explore the reasons for the de-emphasis of field activities and active management, and will discuss the changing face of quail habitat and quail hunters in Arizona. I will also discuss quail management issues related to hunter recruitment and retention, and the current social climate that makes annual population data collection and more active management activities both desirable and necessary.

<sup>1</sup>Arizona Game and Fish Department, 2221 W. Greenway Rd., Phoenix, AZ 85023, USA

## Conservation II

### 3:20 PM Mountain Quail (*Cyrtonyx montezumae*) Ecology and Restoration on Steens Mountain

Jamie N. Nelson<sup>1</sup>, W. Douglas Robinson<sup>1</sup>, Michael D. Pope<sup>2</sup>

Mountain quail (*Oreortyx pictus*) populations have declined across eastern portions of their geographic range and have even been extirpated from some historically occupied sites such as Steens Mountain, Oregon. To re-establish populations in eastern Oregon, Oregon State University and Oregon Department of Fish and Wildlife initiated a mountain quail translocation program in 2001. As part of this ongoing effort, we released 90 wild mountain quail from southwestern Oregon on Steens Mountain in March, 2005. Thirteen male and 13 female birds were radio-marked and monitored for 5 months post-release. Most birds moved an average of 8 km in a north to northeast direction from the release site and occupied habitats characterized by western juniper and big sagebrush. Survival of radiomarked birds was 57% through the 5-month monitoring period. We located 26 nests, with 81% nest success, which is one of the highest documented nesting success rates for the species. Survival and nesting success were higher at Steens than at other release sites in eastern Oregon. Results from this first year indicate that mountain quail survive and reproduce well on Steens Mountain, suggesting that a continuing translocation program could potentially re-establish a viable population. Reintroduction efforts on Steens Mountain will continue with releases of approximately 100 birds each in spring of 2006 and 2007.

<sup>1</sup>Department of Fisheries and Wildlife, 104 Nash Hall, Oregon State University, Corvallis, OR 97330, USA; <sup>2</sup>Oregon Department of Fish and Wildlife, 3406 Cherry Ave. NE, Salem, OR 97303, USA

### 3:40 PM A Predictive Model to Determine Occurrence of Gambel's Quail (*Callipepla gambelii*) in the Trans-Pecos, Texas.

Alfonso Ortega-Sanchez<sup>1</sup>, Louis A. Harveson<sup>1</sup>, Michael R. Sullins<sup>2</sup>

Gambel's quail (*Callipepla gambelii*) are one of 3 western quail species that occur in the Trans-Pecos, Texas. There is practically no information about this species in Texas. Gambel's quail are an underused game-bird that could represent a strong source of income for landowners. We captured >300 Gambel's quail on 2 study sites in the Chihuahuan Desert of Texas. Based on >1,000 radiolocations Gambel's quail showed a strong association (>80% radiolocations) toward riparian habitats in the Chihuahuan Desert. To generate a predictive model that would help determine the occurrence of Gambel's quail throughout their distribution, we classified the desert habitat into 3 categories (i.e., native riparian habitat, exotic riparian habitat, and upland habitat) using a geographic information system (GIS). We created distribution-wide habitat model for Gambel's quail in Texas using digital ortho-quarter quadrangles and hydrology files. Our model will be used to determine areas with higher probability of occurrence of Gambel's quail for Texas.

<sup>1</sup>Department of Natural Resource Management, Sul Ross State University, Alpine, TX 79832, USA; <sup>2</sup>Texas Parks & Wildlife Department, Alpine, TX 79830, USA

#### 4:00 PM Use of Habitat and Landowner Suitability Models as Tools for Selecting Large-scale Quail Habitat Restoration Areas on Private Land in Missouri

Thomas V. Dailey<sup>1</sup>, Ronald A. Reitz<sup>1</sup>, Craig Scroggins<sup>1</sup>, Heather J. Scroggins<sup>1</sup>, Thomas B. Treiman<sup>1</sup>, Robert A. Pierce, II<sup>2</sup>

In response to dwindling populations of northern bobwhite (*Colinus virginianus*), the Northern Bobwhite Conservation Initiative and the Missouri Department of Conservation's Strategic Guidance for Northern Bobwhite Restoration are guiding habitat restoration efforts in Missouri. Success of these programs is dependent on restoration of habitat on large tracts of private land. Efficacious selection of restoration areas requires a foundation of ecological and sociological information. Although we know much about bobwhite ecology, our skill at engaging landowners in habitat restoration is meager. Our objective was to develop a systematic approach for using ecological and sociological data to identify potential private land restoration areas. We used a questionnaire to assess landowner willingness, motivations, and ability to carry out habitat restoration in a cooperative setting. We obtained land ownership information (1,738 names and addresses) in 5 28,000 ha study areas in northern Missouri and mailed a questionnaire to all landowners for whom we had a valid address. We received 735 completed questionnaires (44% response rate). More than 80% of respondents stated it was important to have quail on their property. Only 15% of respondents, however, expressed a strong interest in participating in habitat restoration in a cooperative setting. When deciding how to manage land, the most important factors to landowners related to their quality of life, e.g., enjoying land ownership with their family. Economic benefits, while not the most important aspects in management decisions, were still important to landowners. Results of this study will help guide efforts in implementing restoration programs.

<sup>1</sup>1110 S College Ave, Columbia, MO 65201, USA; <sup>2</sup>University of Missouri, Columbia, MO 65201, USA

#### 4:20 PM Carrying Capacity of the Montezuma Quail (*Cyrtonyx montezumae montezumae*) in Central Mexico

Salvador Ibarra-Zimbron<sup>1</sup>, Ixchel Marin Bello<sup>1</sup>, Marivel Hernandez Tellez<sup>1</sup>, German Mendoza Martinez<sup>2</sup>, Carolina Vazquez Guadarrama<sup>1</sup>, David Garcia-Solorzano<sup>3</sup>

The carrying capacity of Montezuma quail (*Cyrtonyx montezumae montezumae*) in the north-west portion of the state of Mexico is not well documented. In order to examine this we conducted a study during winter 2004 through spring 2005 in 5 northwestern counties. To examine food availability, we estimated the abundance of *Oxalis* spp. in terms of biomass at grasslands and pine-oak woodlands. Adult quail consumed 17.6 g/day. Dry matter (DM) availability was greater in spring (5.123–g DM/square meter) than in winter (3.55–g DM/square meter). Based on the DM available, the carrying capacity by county was as follows (spring–winter): Polotitlan (16.57–22.09 quails/ha); Temascalcingo (41.02–86.05 quail/ha); San Felipe del Progreso (27.61–36.82 quail/ha); Ixtlahuaca (20.51–20.51 quail/ha) and Atlacomulco (6.31–0 quail/ha). This was the first estimation of carrying capacity for Montezuma quail in central Mexico region.

<sup>1</sup>Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, Toluca, Estado de México, México; <sup>2</sup>Programa de Ganadería, Colegio de Postgraduados, Montecillo, Estado de México, México; <sup>3</sup>Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Kingsville, TX 78363, USA

## Gamebird Genetics

### 3:20 PM Development of a System of Genetic Markers to Differentiate Pure Strain Red-legged Partridges (*Alectoris rufa*) from Red-legged Partridges Hybridized with Chukar (*Alectoris chukar*) Ancestors

Michel Vallance<sup>1</sup>, Guillaume Queney<sup>2</sup>

Due to historical and current breeding practices, red-legged partridges (*Alectoris rufa*) released for harvest on estates in southern Europe are not commonly "pure-strain" individuals but hybrids of red-legged partridge and chukar (*Alectoris chukar*). This hybridization potentially threatens natural populations of red-legged partridges in these regions as a result of large, yearly releases on hunting estates. We have started a research program to develop a DNA test, based on SNP (single nucleotide polymorphism) genetic markers, to evaluate the level of hybridization occurring between red-legged partridges (wild or reared) and chukar. To Date we have: 1) developed 19, informative SNP markers from reference populations of the 2 species in collaboration with the CIBIO (Centro de Investigacao em Biodiversidade e Recursos Geneticos) and the INFS (L'Istituto Nazionale per la Fauna Selvatica); 2) selected a set of 10 reproducible SNP markers, with each possessing different common alleles in at least 90% of pure strain individuals tested; 3) conducted an assessment of red-legged partridge and chukar populations which have not been used to develop the genetic markers: each marker correctly assigned an average of 96% of individuals tested; 4) conducted an assessment of reared, red-legged partridge populations distributed throughout France by profiling 600 individuals sampled in collaboration with breeders syndicates. By the middle of 2006, our goal is to accomplish the following stages: 1) complete collection and conduct analysis of the data gained from our population assessment of both wild and reared partridge populations. Additionally, we will assess the results of experimental crossings; 2) define the precision, specificity, and conditions of use for each marker within the set of 10 SNP markers; 3) create a detailed protocol for the implementation of a routine DNA test that will potentially allow us to purify reared strains from hybrid genitors and monitor residual hybridization rates in the wild.

<sup>1</sup>ONCFS, B.P. 20, 78612 Le Perray-en-Yvelines Cedex, France; <sup>2</sup>Antagene, Immeuble le Meltem, 2 Allée des Séquoias, 69760 Limonest, France

### 3:40 PM Phylogeography and Genetic Population Structure of the Northern Bobwhite (*Colinus virginianus*)

Soo Hyung Eo<sup>1</sup>, C. Joseph Nairn<sup>1</sup>, John P. Carroll<sup>1</sup>

The northern bobwhite (*Colinus virginianus*) is currently undergoing population decline throughout most of its native geographic range. The species was recently listed as a species of concern by the IUCN. Despite a large number of publications on this species, we lack basic information on systematic relationships and genetic structure of subspecies and populations. For the purpose of population recovery many introductions and translocations of the northern bobwhite have been carried out without genetic consideration. Impacts on evolutionary processes in new ecosystems, on other organisms, on other populations of the species, and on the translocated population *per se* have not been considered in most cases. For these reasons, we are investigating genetic population structure, historical biogeography, and systematic subspecies relationships within the species using mitochondrial DNA and nuclear microsatellites as a critical component of the conservation

and management of the species and associated ecosystems. In order to achieve the intense geographical sampling required for the research, we are collaborating with researchers, hunters, and state agencies. Thus far, we have collected more than 400 samples from 25 sites, and have commitments for more than 1,000 additional samples from 30 sites throughout the native range of the species. The findings will be critical in developed conservation and management strategies for the species, especially when translocations are involved.

<sup>1</sup>D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA;

#### **4:00 PM Release of Pen-reared Northern Bobwhites (*Colinus virginianus*): Potential Consequences to the Genetic Integrity of Resident Wild Populations**

Kristine O. Evans<sup>1</sup>, Mark D. Smith<sup>1</sup>, L. Wes Burger, Jr.<sup>1</sup>, Rachel J. Chambers<sup>2</sup>, Allan E. Houston<sup>3</sup>, Rick Carlisle<sup>3</sup>

In response to low encounter rates with wild northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) during bird dog field trials at Ames Plantation in Tennessee, a large-scale release program of pen-reared bobwhites was implemented in the fall of 2002. To evaluate potential genetic effects of pen-reared releases on wild populations, we monitored survival of pen-reared and wild bobwhites from fall release of pen-reared bobwhites through the breeding season. We collected feather samples from wild and pen-reared bobwhites during Fall 2002 and from free-ranging juvenile bobwhites following the 2003 breeding season. We used genotypes from 6 polymorphic microsatellite loci to measure genetic diversity and conduct population assignment tests. Wild bobwhites experienced greater fall-spring (32.9–44.6%) and annual (4.5–8.4%) survival than pen-reared bobwhites; however, pen-reared bobwhites experienced greater fall-spring (12.2–29.8%) and annual (0.5–3.2%) survival than reported in most other studies. Genetic diversity, number of alleles, and allelic richness were greatest in the wild, intermediate in the F1 generation, and lowest in the pen-reared populations. Likelihood analysis and cluster analysis indicated 20.4% and 33.6%, respectively, of juveniles captured after the first breeding season following release were ambiguous in population assignment; suggesting successful reproduction between wild and pen-reared individuals. In some years, some pen-reared birds will survive to the breeding season and successfully reproduce with wild birds. Given that pen-reared and pen-reared x wild birds have reduced genetic variability relative to locally adapted wild birds, large-scale releases of pen-reared bobwhites may result in negative impacts on the genetic integrity of resident wild populations.

<sup>1</sup>Department of Wildlife and Fisheries, Mississippi State University, Box 9690, Mississippi State, MS 39762, USA;

<sup>2</sup>University of Tennessee Agricultural Experiment Station, Ames Plantation, P.O. Box 389, Grand Junction, TN, 38039, USA; <sup>3</sup>Department of Forestry, Wildlife, and Fisheries, University of Tennessee Agricultural Experiment Station, Ames Plantation, P.O. Box 389, Grand Junction, TN, 38039, USA



**4:20 PM A Landscape-scale Assessment of Genetic Diversity and Population Structure in Northern Bobwhite (*Colinus virginianus*)**

Erin M. Wehland<sup>1</sup>, Randy W. DeYoung<sup>1</sup>, Ana Sifuentes Rincon<sup>2</sup>, Michelle R. Garcia<sup>3</sup>, Leonard A. Brennan<sup>1</sup>

Over the last century, changes in land–use patterns have coincided with an overall decline in northern bobwhite (*Colinus virginianus*; hereafter bobwhite) numbers, possibly through fragmentation of habitat or decreases in habitat patch size. However, the specific manner in which land–use changes have affected bobwhite populations is unknown. We initiated a large–scale genetic survey of bobwhite with the goal of assessing genetic diversity and gene flow among populations. We sampled hunter–harvested quail from 17 areas in south Texas, a region containing large areas of contiguous habitat where bobwhite populations have been relatively stable. We extracted DNA and sequenced a 346 base–pair portion of the mitochondrial DNA control region, a haploid, maternally inherited genetic marker that is sensitive to changes in population genetic diversity. We found high levels of genetic variability (33 haplotypes in 116 samples; overall haplotype diversity = 0.73). Haplotypes were broadly distributed, with little genetic structuring among populations (95% of genetic variation contained within populations). This study, the first to examine regional genetic structure in bobwhites, revealed that south Texas bobwhites have high levels of genetic variability and are genetically similar across a broad region. Population genetic theory predicts that genetic diversity and genetic similarity among local populations are determined by the rate of dispersal (gene flow). Therefore, we conclude that dispersal must be more important in bobwhite population dynamics than previous studies have indicated. Disruption of dispersal by habitat fragmentation may explain the overall decline in bobwhite populations. We recommend quail management be conducted on a large–scale basis rather than focusing on isolated, site–specific treatments.

<sup>1</sup>Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Kingsville, TX 78363, USA; <sup>2</sup>Centro de Biotecnología Genómica, Instituto Politécnico Nacional, Cd. Reynosa, Tamaulipas, Mexico; <sup>3</sup>Department of Animal Sciences, Texas A&M University-Kingsville, Kingsville, TX 78363, USA

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**Friday, 2 June 2006****Farm Bill****9:20 AM A Decade of Upgrading CRP in Nebraska: The Importance of Partnerships and Science.**Peter S. Berthelsen<sup>1</sup>, James E. Inglis<sup>2</sup>

The Conservation Reserve Program (CRP) is the strongest wildlife program in the Farm Bill. CRPs debut in 1985 marked the beginning of landscape scale changes across the agriculture landscape. In the 1996 and 2002 Farm Bills, wildlife habitat, in addition to soil and water conservation, became a priority CRP ranking component in the Environmental Benefits Index (EBI). While CRP has benefited many upland wildlife species over the past 20 years, it often falls short of intended conservation goals. Wildlife benefits from CRP have decreased as a result of low vegetation diversity in original plantings and monotypic stand succession. Throughout the nation, aging, less productive CRP grass stands are the norm with 50% of these stands (16.6 million acres) being  $\geq 11$  years old. To address these issues, Pheasants Forever and the Nebraska Game & Parks Commission entered into a partnership to improve the wildlife habitat of current mature grass stands and make Mid Contract Management (MCM) an acceptable practice for landowners and resource agencies. Efforts to improve early successional wildlife habitat in CRP grass stands consist of combinations of prescribed burning, disking, chemical application and interseeding (e.g. interseeding legumes and native forbs). Incentives offered to landowners include increased rental payments, cost share, technical assistance, and offering turn-key contractors to perform stand upgrades. Efforts to make MCM an acceptable practice have included conducting tours for landowners and resource professionals, producing educational materials and documenting wildlife responses through research. The current partnership continues to develop further partnerships with Federal and State agencies, private industry and non-governmental organizations.

<sup>1</sup>1011 Alexander Ave Elba, NE 68835 USA; <sup>2</sup>11821 Twp Hwy 49 Upper Sandusky, OH 43351 USA**9:40 AM Midcontract Management of CRP in Nebraska: Pheasant (*Phasianus colchicus*) Habitat Selection, Insect Assemblages, and Grassland Bird Response**Lucas Negus<sup>1</sup>, Ty W. Matthews<sup>2</sup>, Craig A. Davis<sup>1</sup>, Larkin A. Powell<sup>2</sup>, J. Scott Taylor<sup>3</sup>, Jamie Bachmann<sup>1</sup>, Scott Wessel<sup>3</sup>

During the last 25 years grasslands such as those established through Conservation Reserve Program (CRP) have become an important habitat for grassland dependent wildlife. However, due to lack of management, many CRP grasslands that provided excellent habitat early in their enrollment are now dominated by monoculture stands of grass that have reduced wildlife benefits. In summer 2002, a program was initiated that promotes disking and interseeding legumes in CRP to improve nesting and brood-rearing habitat for ring-necked pheasants (*Phasianus colchicus*). The program identified several areas throughout the state in which disking and interseeding efforts were focused initially. Stanton County in northeast Nebraska was one of these areas. Evaluation was identified as a key component of the program, thus 3 research projects are currently or have been conducted in Stanton County. Grassland songbird and insect response were monitored in

2004 and 2005 and research on pheasant habitat selection is currently underway. Grassland songbird abundance, species richness, and diversity were all higher in disked/interseeded fields than unmanaged fields. Insect abundance and biomass were also higher in disked/interseeded fields than unmanaged fields. Radio-marked hen pheasants preferred nesting in interseeded CRP compared to untreated CRP or other grasslands. While tending their broods, hens selected switchgrass fields that had been interseeded the previous year, showing preference for areas with high forb content and taller vegetation. Results from all studies indicate management, specifically disk-ing/interseeding, is an important component of maintaining and improving wildlife habitat in CRP fields.

<sup>1</sup>430 LSW, Oklahoma State University, Stillwater, OK 74078, USA; <sup>2</sup>School of Natural Resources, 202 NRH, University of Nebraska-Lincoln, Lincoln, NE 68583-0819, USA; <sup>3</sup>Nebraska Game and Parks Commission, 2200 N. 33rd St., Lincoln, NE 68503, USA

#### 10:00 AM Summary of Georgia's Bobwhite Quail Initiative, 2000 - 2005

Reggie E. Thackston<sup>1</sup>, Chris D. Baumann<sup>2</sup>, Bobby T. Bond<sup>3</sup>, Mark D. Whitney<sup>4</sup>

Georgia's Bobwhite Quail Initiative (BQI) is a proactive effort to restore and improve habitat for northern bobwhite (*Colinus virginianus virginianus*) on private lands across a 15-county area of Georgia's Upper Coastal Plain. Secondary objectives include improving habitat for certain songbirds, and improving quail hunting and wildlife viewing. The BQI provides landowners/managers (Cooperators) with technical assistance and, through a competitive process, financial incentives for quail habitat management. The Georgia General Assembly and Department of Natural Resources (DNR) Board initiated BQI in 1998 in response to hunter/constituent concern over declining northern bobwhite populations; the Georgia DNR Wildlife Resources Division began implementation in 1999. Funding for BQI is provided through state appropriations, including since 2003 funds generated through the sale of BQI vehicle license plates. Habitat incentive payments and practice options have been gradually modified to increase Cooperator participation and better integrate quail management with commercial agriculture and forestry. Research and monitoring indicate positive impacts of habitat practices on northern bobwhite and certain songbirds. The BQI has generated many additional benefits including leveraged funding for management and research, youth quota quail hunts, and increased educational outreach regarding the northern bobwhite decline and effective restoration techniques. A Cooperator survey indicated high customer satisfaction and a strong perception that BQI practices have improved quail and songbird populations, as well as the environmental condition on Cooperators farms. BQI shows that: 1) northern bobwhite numbers can be increased on working farm and forestlands; 2) adequate levels of economic incentives and qualified technical staff are essential for success.

<sup>1</sup>116 Rum Creek Drive, Forsyth, GA 31029, USA; <sup>2</sup>1945 South Hwy 199 East Dublin, GA 31027, USA; <sup>3</sup>1014 Martin Luther King Jr. BLVD, Ft. Valley GA 31030, USA; <sup>4</sup>2070 US Hwy 278, SE Social Circle, GA 30025, USA

**10:40 AM Using CSP to Promote Northern Bobwhite Quail (*Colinus virginianus*) Habitat in Missouri**Bill White<sup>1</sup>

The Conservation Security Program (CSP) is a voluntary USDA conservation program that provides payments to agricultural producers for maintaining and enhancing natural resources. The Missouri Department of Conservation worked closely with state and local Natural Resources Conservation Service (NRCS) staff to integrate field borders and other buffers into CSP watershed enhancement lists. The habitat assessments for cropland and grassland make field borders and/or shrubby cover a necessary habitat component to move to Tier 2 or 3. Requirements for the field borders mirrored the Missouri requirements for the Conservation Reserve Program (CRP) CP33 practice. Enhancement rates were developed that would make it economically attractive to install native grass field borders. NRCS staff provided information on economic benefits to landowners of placing field borders and other wildlife practices into CSP. Landowners responded favorably to the enhancements and an estimated 8,000–10,000 acres (3,000–4,000 ha) of native grass field borders will be installed in CSP watersheds. Field borders were installed using Environmental Quality Incentives Program (EQIP), CRP or CSP funding. In some watersheds it is estimated that up to 90% of the producers will modify their contracts in order to reach Tier 2 and 3 by adding wildlife enhancements. CSP has produced many benefits for Missouri wildlife, but many hurdles remain. The 2007 Farm Bill should be used as a catalyst to increase USDA staffing options, require that USDA coordinate wildlife enhancements with state fish and wildlife agencies and allow enough options for CSP to address additional wildlife habitat needs.

<sup>1</sup>P.O. Box 180, Jefferson City, MO 65051, USA**11:00 AM Methods for Controlling Woody Invasion into CRP Fields in Tennessee**John P. Gruchy<sup>1</sup>, Craig A. Harper<sup>1</sup>, Matthew J. Gray<sup>1</sup>

Woody cover is an important component of northern bobwhite (*Colinus virginianus*) habitat; however, some species such as red maple (*Acer rubra*) and sweetgum (*Liquidambar styraciflua*) grow aggressively and may dominate unmanaged areas. Six treatments with controls were implemented in a completely randomized design on a CRP old-field with extensive invasion by sweetgum, red maple, and other woody saplings in 2004 to determine the most effective method for reducing coverage of woody plants. Treatments included dormant-season burning in March, applications in July of triclopyr (Garlon-4 at 5 qts/acre), imazapyr (Arsenal AC at 24 oz/acre), and glyphosate (Gly-4 at 4 qts/acre), bushhogging in August, and growing-season burning in September. Vegetation structure and composition were measured one growing season post-treatment. Percentage woody cover was reduced by all treatments (13 – 50%) except bushhogging (65.8%, SE = 7.4) compared to control (80.4%, SE = 7.0). Imazapyr (13.3%, SE = 3), growing-season burn (14.2%, SE = 4.3), and triclopyr (15.8%, SE = 2.5) most effectively reduced woody cover. Percentage cover of desirable forbaceous legumes (*Chamaecrista* spp., *Desmodium* spp., and *Lespedeza* spp.) was highest in growing-season burn (54.2%, SE = 5.5), imazapyr (28.3%, SE = 7.9), and dormant-season burn (24.5%, SE = 7.5) treatments. Imazapyr increased coverage of forbs and blackberries (*Rubus* spp.), while triclopyr increased coverage of warm- and cool-season grasses. We recommend growing-season fire in September for managing CRP fields invaded by undesirable woody species. If burning is not possible, imazapyr or tryclopyr applications may provide

suitable alternatives.

<sup>1</sup>University of Tennessee, Forestry, Wildlife, and Fisheries, 274 Ellington Plant Sci. Bldg., Knoxville, Tennessee 37996-4563, USA

### **11:20 AM Implementing the Northern Bobwhite Conservation Initiative on Rangelands in Florida Using Farm Bill Programs**

James A. Martin<sup>1</sup>, William E. Palmer<sup>2</sup>, Adam B. Butler<sup>1</sup>, Tommy C. Hines<sup>3</sup>, Greg Hendricks<sup>4</sup>, John P. Carroll<sup>1</sup>

Approximately 1.5 million hectares of native rangeland remain in peninsular region of Florida. Despite potential habitat within this region northern bobwhites (*Colinus virginianus*; hereafter bobwhite) have declined precipitously since 1980. Restoring native rangeland habitats is critical to meeting bobwhite population goals of the Northern Bobwhite Conservation Initiative (NBCI). Suitability of native rangelands for bobwhites and other species has declined due to reduced fire frequency over the past several decades and conversion to domestic forage crops. Therefore, we designed an Environmental Quality Incentive Program (EQIP) special project to provide cost-share funding for ranchers to implement prescribed burning, mechanical vegetation control (i.e. roller chopping), and grazing management to help restore native prairie and habitats on private lands. This project is designed to provide multi-year applications of management practices to approximately 22,000 ha of prairie/flatwood habitats located within a 5–county area over a 10–year period. Investigators will monitor songbird and bobwhite population responses to the vegetation changes resulting from application cost-share practices. Additionally, we will determine the influence of landscape metrics on response of wildlife populations. Outcomes of this project will provide ranchers, biologists and conservation planners with information that will improve the effectiveness of Farm Bill programs and conservation technical assistance for wildlife on Florida rangelands.

<sup>1</sup>D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA; <sup>2</sup>Tall Timbers Research Station and Land Conservancy, 13093 Henry Beadel Drive, Tallahassee, FL 32312, USA; <sup>3</sup>Florida Fish and Wildlife Conservation Commission, 1314 SW 186th Street, Newberry, FL 32669, USA; <sup>4</sup>USDA Natural Resources Conservation Service, 2614 NW 43rd Street Gainesville, FL 32606, USA

### **11:40 AM Assessing the Economic Feasibility of CRP to Improve Northern Bobwhite Quail (*Colinus virginianus*) Abundance in Illinois**

Beth A. Cole<sup>1</sup>, Donald W. Sparling<sup>1</sup>, Clayton K. Nielsen<sup>1</sup>, John L. Roseberry<sup>1</sup>

Northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) have experienced long–term population declines throughout most of their range. These declines have been attributed to multiple factors, but land use change leading to reduced or degraded habitat remains the most cited cause. The primary goal of this project was to establish a systematic approach for selecting target areas for habitat improvement to: 1) enlarge areas of suitable bobwhite habitat; 2) connect patches of existing habitat; and 3) predict bobwhite response to improved habitat. We used digitized maps depicting highly erodible soils, land cover, and land currently enrolled in CRP in Wayne County, Illinois to develop a habitat suitability index (HSI) model. Results from this model were used to

determine which habitat components were lacking from areas with a low HSI value and calculate costs for improving bobwhite habitat. Population modeling was conducted to predict land area(s) where proper habitat management would potentially increase bobwhite abundance. Target areas were selected and costs were estimated to examine the feasibility of a large-scale habitat improvement program. Management implications provided by this project include determining the practicality of restoring bobwhite habitat over a large area, the expected population response, and the projected costs. This information will allow managers to prioritize potential management areas according to expected population responses and cost-effectiveness.

<sup>1</sup>Cooperative Wildlife Research Laboratory, Southern Illinois University - Carbondale, 251 Life Science II, Carbondale, IL 62901-6504, USA

## Brood Ecology

### 9:00 AM Northern Bobwhite (*Colinus virginianus*) Productivity and Habitat Relationships in South Texas

Kyle A. Brazil<sup>1</sup>, Erin M. Wehland<sup>1</sup>, Leonard A. Brennan<sup>1</sup>, Fidel Hernández<sup>1</sup>

The goal of this study was to identify how northern bobwhite (*Colinus virginianus*; bobwhite) productivity varied in relation to a range of vegetation conditions in south Texas. We based estimates of productivity on juvenile:adult age ratios of bobwhites harvested on 9 study sites (1,167–7,284 ha each) participating in the South Texas Quail Associates Program. We constructed age ratios from wings of hunter-harvested birds using 2 age classes (juvenile [hatch-year] and adult [after hatch-year]). The 9 study sites were distributed across the Rio Grande Plains ecoregion. We collected habitat data on each study site using 3 1000–m transects with 10 plots/transect during the nesting season (May–Aug 2004). We measured woody vegetation, suitable nesting clump density, percent bare ground, angle of obstruction, and disc of vulnerability. Relationships between habitat variables and productivity were analyzed using regression. The relationship between suitable nesting clump density and productivity was fitted with a 3rd order polynomial ( $R^2 = 0.65$ ). Preliminary results indicate that bobwhite productivity in south Texas increased with increasing bunchgrass density, peaking at 1000 suitable nesting clumps/ha and declining as suitable nesting clumps/ha exceeded 1000/ha. This study was replicated on 13 study sites in 2005. These additional data will be incorporated into this analysis to further investigate the relationship between habitat and productivity.

<sup>1</sup>Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Kingsville, TX 78363, USA

### 9:20 AM Invertebrate Communities in Various Types of Food Plots in Eastern Texas

Charles W. Anderson<sup>1</sup>, R. Montague Whiting, Jr.<sup>2</sup>, Donald R. Dietz<sup>3</sup>

Northern bobwhite (*Colinus virginianus*) chicks (<2–weeks–old) are entirely dependent on invertebrates for food. Land managers often provide spring/summer food plots to meet these needs. We examined invertebrate production in native vegetation and food plots established using 6 different treatments in the Piney Woods Region of eastern Texas. Food plots were established by fallow disking only, fallow disking with fertilizer, fertilizing and planting a single species (sorghum, iron and clay peas, or browntop millet), and fertilizing and planting a mixture of species (browntop millet, catjang peas, iron and clay peas, Japanese millet, and pearl millet). Food plots were in a random block design with 5 replications. Invertebrates were collected weekly during late spring and summer along 3 randomly placed 15–m lines in each plot using a gasoline powered vacuum. Invertebrates were frozen initially, then thawed, air dried to a constant weight, separated from debris and weighed as a group. Every other week, a subsample of 100 invertebrates was randomly selected from each sample and sorted to order with weight and number of individuals recorded. Initial analyses showed overall differences among food plot types in biomass ( $P < 0.05$ ) and taxon richness ( $P < 0.05$ ). Fallow disking only was highest in biomass, while a mixture of species was highest in richness. Ongoing analyses are examining time and food plot type effects on taxon order and interactions of time and food plot type on biomass and richness.

<sup>1</sup>Cooperative Wildlife Research Laboratory, Southern Illinois University - Carbondale, 251 Life Science II, Carbondale, IL 62901-6504, USA; <sup>2</sup>Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University, Nacogdoches, TX 75962-6109, USA; <sup>3</sup>Temple-Inland Forest Products Corporation, Diboll, TX 75941, USA

#### 9:40 AM Transmitter Attachment Method for Ruffed Grouse (*Bonasa umbellus*) Chicks

Christopher A. Dobony<sup>1</sup>, Brian W. Smith<sup>2</sup>, John W. Edwards<sup>3</sup>, Thomas J. Allen<sup>4</sup>

Although methodologies to obtain cause-specific mortality and survival information for adult ruffed grouse (*Bonasa umbellus*) are well documented, procedures for determining similar parameters are lacking for grouse chicks. Mortality among grouse chicks has been speculated as highest during the first few weeks post hatch; however, at present, empirical data to support such conjectures is not extant. Therefore, during 1999–2002, we equipped grouse chicks ( $n = 97$ ), from 33 separate broods,  $\leq 4$ -day-old with radio-transmitters to assess the efficacy of transmitters and examine survival/mortality. We observed that grouse chicks retained transmitters until recapture or mortality. Handling time was limited because transmitter attachment took only a few minutes per brood. Additionally, we observed mortality fates for 91% of radio-collared chicks. Therefore, because of the non-intrusive nature, field application, and retention, of necklace-style transmitters observed during this study, these methods may provide a desirable alternative to assessing survival/mortality among ruffed grouse chicks.

<sup>1</sup>Fort Drum Fish and Wildlife Program, Environmental Division, Public Works, 85 First Street West, AFZS-PW-E, Fort Drum, NY 13602, USA; <sup>2</sup>Kentucky Department of Fish and Wildlife Resources, #1 Game Farm Road, Frankfort, KY 40601, USA; <sup>3</sup>Division of Forestry and Natural Resources, 322 Percival Hall, West Virginia University, Morgantown, WV 26506, USA; <sup>4</sup>West Virginia Department of Natural Resources, PO Box 67, Elkins, WV 26241, USA

#### 10:00 AM Brood Ecology of Northern Bobwhite (*Colinus virginianus*) in Remnant Longleaf Pine-Wiregrass Ecosystems

Adam D. Hammond<sup>1</sup>, William E. Palmer<sup>2</sup>, L. Wes Burger, Jr.<sup>3</sup>, Anthony V. Carver<sup>2</sup>

In the longleaf region of the Southeastern lower coastal plain, some landowners, managers, and biologists perceive intact native longleaf pine-wiregrass (LLP-WG) communities as poorer quality habitat for northern bobwhite (*Colinus virginianus*) than very disturbed, old field habitats (OF). We studied habitat use, growth, and survival of 103 1–12 day old broods of radio-tagged adult northern bobwhite in northern Florida and southern Georgia in 1998 and 1999. Broods were assigned a primary habitat association according to the dominant habitat used (OF, WG, or a combination thereof [MIX]). Indicators of fitness were used to assess habitat quality. In 1998, a severe drought year, OF broods exhibited higher growth rates ( $P < 0.05$ ). In 1999, no differences in growth were observed among habitats. Abundance and dry biomass of arthropods was least, and brood ranges were generally larger in WG ranges. Despite these apparent differences in resource availability among habitats, chick survival was similar among broods associated with WG, MIX, and OF habitats. Although wiregrass and old field communities may differ in habitat quality for northern bobwhite and this may lead to differences in population performance, our study does not support brood survival as the primary mechanism.

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## Telemetry Effects

### 9:00 AM Estimates of Survival from Radio-telemetry: A Response to Guthery and Lusk

Travis H. Folk<sup>1</sup>, James B. Grand<sup>1</sup>, William E. Palmer<sup>2</sup>, John P. Carroll<sup>3</sup>, D. Clay Sisson<sup>4</sup>, Theron M. Terhune<sup>3</sup>, Shane D. Wellendorf<sup>2</sup>, H. Lee Stribling<sup>5</sup>

Radiotelemetry has become an important and frequently used tool in wildlife research. Inferences drawn from radiotelemetry data depend on the assumption that the radio transmitters are not influencing parameter(s) of interest. Recently Guthery and Lusk (2004) in the *Wildlife Society Bulletin* questioned the validity of this assumption for estimating survival rates of northern bobwhites (*Colinus virginianus*) using radiotelemetry data. In this evaluation we address technical and philosophical flaws in Guthery and Lusk's (2004) critique. Guthery and Lusk (2004) calculated the level of productivity (given as a fall age ratio) required to balance a simple population model that contained published estimates of annual survival and assumed an annual finite population growth rate of 1.0. We show that the relationship between an annual survival rate and fall age ratio is nonlinear and this can lead to biased estimates of a fall age ratio, especially at lower values of annual survival. Further, we suggest that this assessment of a transmitter effect from a survival rate itself is not appropriate. This rate can be depressed (or elevated) for a variety of reasons not related to the influence of radio transmitters. In addition, Guthery and Lusk (2004) assumed that daily survival rates (as calculated from both annual and seasonal published estimates) were constant throughout the year; thus, they scaled daily survival rates from seasonal to annual estimates. Further, their meta-analysis was hindered by temporal pseudoreplication and a lack of independence among the observations used in the analysis. We conclude the weight of the evidence presented by Guthery and Lusk (2004) is not as strong as they claim because it fails to meet the test of sufficient causation.

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### 9:20 AM Factors Influencing Survival of Radio-tagged and Banded Northern Bobwhites (*Colinus virginianus*) in Georgia

Theron M. Terhune<sup>1</sup>, D. Clay Sisson<sup>2</sup>, James B. Grand<sup>3</sup>, H. Lee Stribling<sup>4</sup>

Numerous studies of behavior and ecology of northern bobwhites (*Colinus virginianus*) have depended on radio-tagging and telemetry for data collection. Excluding the presumably short-term effects of trapping, handling and attaching radio-transmitters; researchers often assume little bias is associated with estimating survival and behavioral parameters associated with this technique. A recent article has called into question this widely used technique, suggesting that researchers are "radio-handicapping" bobwhites. Therefore, we used Program MARK to analyze survival estimates of individually banded and/or radio-tagged bobwhites during 1997–2004 consisting of 6568 individuals (2527 radio-tagged) via combined analysis of mark-recapture, dead recovery (via harvest) and radio-telemetry data to test the effects of radio-transmitters on bobwhite survival. Based on Akaike's model selection criterion, the best model including the radio-

transmitter covariate ( $\Delta QAIC_c = 0.72$ ) did not explain more of the variation in survival than models without this effect. Thus, we found the effect of radio-transmitters was negligible. Average annual survival for the eight-year period was 22.76% (1.50 SE) for banded-only and 21.72% (1.49 SE) for radio-tagged birds. Survival rate varied annually, ranging from 12.42% (7.51 SE) to 37.16% (8.27 SE) and seasonally ranging from 23.82% (2.71 SE) to 65.06% (3.23 SE); however, between group (banded-only, radio-tagged) survival differences were still inconsequential. We surmise that utilizing an empirically supported modeling framework provides a superior, more direct approach for detecting potential radio bias. Additionally, we conclude that for our study, radio-telemetry provided reliable survival estimates on an intensively managed bobwhite population, where supplemental food was provided.

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### 9:40 AM Effect of Radiotransmitters on Northern Bobwhite (*Colinus virginianus*) Annual Survival

William E. Palmer<sup>1</sup>, Shane D. Wellendorf<sup>1</sup>

Radio telemetry is widely used in northern bobwhite (*Colinus virginianus*, hereafter, bobwhite) research to estimate survival rates and other demographic parameters. A fundamental assumption of survival estimation using marked bobwhites is that survival of tagged bobwhites is the same as unmarked birds. Therefore we compared survival rates of banded northern bobwhites ( $n = 3149$ ) with and without radiotransmitters using Burnhams model in Program MARK on Tall Timbers Research Station (TTRS), 1999–2004. We used model selection procedures to determine relative importance of year, gender, and radiotagged status on annual survival rates and recovery processes. Three plausible models ( $\Delta QAIC_c < 3$ ) included year-dependence in survival and an additive effect of gender, but no radiotransmitter effect. Male annual survival was consistently greater than female annual survival. Models including a radiotransmitter effect in survival were  $> 8 \Delta QAIC_c$  from the top models, had low Akaike model weights ( $w_{is} < 0.007$ ) and low importance weight ( $\sum w_i(\text{radio}) = 0.01$ ). We also compared band-recapture survival estimates from the QAICc minimizing model to staggered entry Kaplan-Meier (KM) survival estimates, 2000–2004. Annual KM survival estimates of male and female bobwhites were within the 95% CI of band-recapture estimates in 7 of 8 comparisons. We conclude that radiotagging bobwhites with necklace-style radiotransmitters did not negatively bias annual survival estimates on TTRS.

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### 10:00 AM Censor Periods in Survival Analyses

Brant C. Faircloth<sup>1</sup>, Theron M. Terhune<sup>1</sup>, Michael J. Conroy<sup>2</sup>, D. Clay Sisson<sup>3</sup>, William E. Palmer<sup>4</sup>, H. Lee Stribling<sup>5</sup>, John P. Carroll<sup>1</sup>

Radio-telemetry provides individual information on survival, reproduction, and other demographics at a scale inaccessible using other methods. Recent studies have addressed some issues pertaining to radiotransmitter effects on northern bobwhite (*Colinus virginianus*) and other

species. However, several issues remain under-studied, particularly the implementation of censor periods (left truncation of data) to account for observer-introduced biases related to the capture, handling, and radiotagging of individuals under investigation. We examined the validity of implementing a censor period for bobwhite survival analyses on 2 sites in the Southeast (Leon County, FL; Dougherty and Baker Counties, GA) during 2001–2003 and 2004–2005, respectively, using control and treatment groups. We applied radiotransmitters to birds in the control group ( $n_{Leon} = 164$ ;  $n_{Dougherty} = 144$ ) >30 days prior to the intervals under observation, and we applied transmitters to the treatment group ( $n_{Leon} = 607$ ;  $n_{Dougherty} = 455$ ) at the start of the intervals under observation. We found no difference in survival between control and treatment groups ( $\beta_{Treatment,Leon} = 0.111 \pm 0.404$  [CI];  $\beta_{Treatment,Dougherty} = 0.0905 \pm 0.425$  [CI]) during any portion of the intervals analyzed, indicating a lack of support for censoring the data to remove observer bias. The optimal means of assessing the validity of left truncation is to examine the data using control and treatment groups. However, most studies are limited in their ability to implement this design. Therefore, to help guide the use of a censor period in other studies, we additionally developed a technique, tested with simulated data, to help researchers assess the validity of censor-period implementation with known-fates data.

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#### 10:40 AM Additional Evidence Against Radio-handicapping Among Northern Bobwhites (*Colinus virginianus*)

D. Clay Sisson<sup>1</sup>, Theron M. Terhune<sup>2</sup>, H. Lee Stribling<sup>3</sup>

The validity of radio-telemetry to produce reliable information (e.g., survival estimates) has recently been challenged. Radio-telemetry is a widely used technique in studies of numerous species, therefore, concerns regarding potential bias warrants further investigation. As such, and as part of a larger study, we investigated 3 aspects of potential radio-bias: 1) variation in survival distributions among treatment (i.e., newly radio-tagged) and control (i.e., previously radio-tagged) groups; 2) proportion of trapped animals censored during the traditional 7-day censor-period; and 3) ramifications to cause specific mortality through estimation of harvest rate. Kaplan–Meier survival, based on 30-day post trapping, was similar between treatment ( $n = 901$ ) and control ( $n = 293$ ) northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) for all but 1 of 8 trapping sessions from 2000–2004. In this case, treatment bobwhites (0.971, SE = 0.015) had higher survival than control birds (0.878, SE = 0.042). We determined the effect of censoring relative to sample size was inconsequential for our data because the proportion of bobwhites (12 of 901; 0.013) meeting the criteria for censoring, i.e., dying during the first 7 days, was minimal. Censoring of these data influenced survival estimates by an average of 0.015 (SE = 0.004; range: 0.00–0.04). We evaluated harvest rate by comparing first year recovery rates of banded versus radio-tagged birds during thirteen hunting seasons occurring between 1992 and 2005. Annual recovery rate was not different ( $P < 0.05$ ) for banded birds and radio-tagged birds where harvest averaged 6.68% (range 3.3–11.7), 6.65% (range 3.4–11.1), respectively. This data supports previous research demonstrating that radio-telemetry can provide reliable demographic information.

However, we recommend that future researchers test for these potential effects before making biological inferences.

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## Abundance Estimation

### 10:40 AM Refining the Morning Covey-Call Survey to Estimate Northern Bobwhite (*Colinus virginianus*) Abundance

Joshua P. Rusk<sup>1</sup>, Jason L. Scott<sup>1</sup>, Fidel Hernández<sup>1</sup>, Fred C. Bryant<sup>1</sup>

Morning covey-call surveys have been mentioned extensively as a practical and efficient way to estimate abundance of northern bobwhite (*Colinus virginianus*; bobwhite) with minimal effort. However, many of the protocol specifics such as radius of audibility and probability of a covey calling lack empirical data. Other limitations also existed such as variation in observers detection capacity and calling behavior of coveys. These shortcomings limit the reliability of this survey technique. The objectives of our study were to 1) obtain an empirical estimate of radius of audibility; 2) document observer variability in estimating coveys heard; and 3) document calling behavior of bobwhite coveys. We found no difference in radius of audibility for areas with low-brush coverage (6%;  $956 \pm 72$ -m; mean  $\pm$  SE;  $n = 4$  observers) and high-brush coverage (30%;  $931 \pm 66$ -m). We determined an overall radius of audibility of 900-m (254-ha) pooled across sites. We documented considerable observer variability (CV 18–49%;  $n = 12$  observers) in detecting coveys. Regarding calling behavior, we observed that  $67\% \pm 9.0$  ( $n = 30$  coveys) of coveys emitted the covey-call during 2004 whereas  $88\% \pm 7.8$  ( $n = 17$  coveys) of coveys emitted the covey-call during 2005. Of the coveys that called,  $70\% \pm 10.2$  in 2004 and  $93\% \pm 6.4$  in 2005 involved  $>1$  bird calling/covey. Our findings allow for a refinement of the morning covey-call survey. We found a 900 m radius of audibility to be appropriate but recommend that the influence of other factors on this radius be tested. We also recommend using a core number of observers that remain consistent from year to year.

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### 11:00 AM Surveying Montezuma Quail (*Cyrtonyx montezumae*) in Arizona with Pointing Dog Flush-counts

Richard A. Ockenfels<sup>1</sup>, Kirby D. Bristow<sup>1</sup>, Neil L. Lawson<sup>1</sup>

A reliable survey method is needed to manage Montezuma quail (*Cyrtonyx montezumae*) in the Southwest. We tested pointing dog flush-counts to determine number of transects for data stability and robustness within a sampling period (April-May 1997 pairing season, October-November 1997 pre-hunt autumn season), then estimated minimum detectable differences based on number of transects completed. We recorded number of flushes, covey size and composition (gender of birds seen), and time to first flush as response variables, then related to season, time of day, number of dogs and observers, and weather conditions. Coveys/route and mean covey size stabilized with 7–9 1.5-hr routes per site, but 95% CI were wide. Mean time to first flush could not be correctly calculated because of numerous zero coveys seen on routes, but distribution of flush times was a measure of relative density and dog efficiency. Season and number of observers affected ( $P < 0.10$ ) mean coveys/route. Pointing dog surveys could not detect small ( $<0.25$  coveys/route) annual changes in the pairing season (Apr–May) or autumn (Oct–Nov) densities, but the method can detect large ( $>0.50$  coveys/route) changes (for either season of year, between years, or between sites) with reasonable numbers of routes. Increasing Type I and Type II errors reduced necessary sample sizes and minimum detectable differences. Based on the species life history and

behavior, pointing dog flush-counts is the only realistic survey tool for Montezuma quail.

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### **11:20 AM The GCT Partridge Count Scheme: A Volunteer-based Monitoring and Conservation Promotion Scheme.**

Julie A. Ewald<sup>1</sup>, Neville G. Kingdon<sup>1</sup>, Hugues Santin-Janin<sup>2</sup>

The Game Conservancy Trusts (GCT) Partridge Count Scheme (PCS) is a volunteer-based monitoring system serving as a means for delivering conservation and best practice advice to farmers, land managers and gamekeepers. It was originally designed to monitor numbers of gray (*Perdix perdix*) and red-legged (*Alectoris rufa*) partridges on UK shooting estates. Recently, in response to the UK governments Gray Partridge Species Action Plan, it has been expanded to include participants primarily interested in conservation. In terms of monitoring, the PCS is an invaluable tool for examining trends in partridge densities and population parameters. We examined trends in annual gray partridge production (autumn counts available from 1933) and breeding density (spring counts available from 1952). We compared trends of production and breeding density from old participants (mainly shooting estates) to recent trends (conservation-interested farms), and interpreted the results relative to the Gray Partridge Species Action Plan. We report the information provided to members, both as individuals and in County Groups, to aid the conservation work that they are undertaking. We also discuss future plans for conservation advice and collaboration with other organizations, in particular the UK governments Department for the Environment, Farming and Rural Affairs.

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### **11:40 AM Estimating Sample Sizes for Distance Sampling of Autumn Northern Bobwhite (*Colinus virginianus*) Populations**

Mark D. Smith<sup>1</sup>, Richard G. Hamrick<sup>1</sup>, L. Wes Burger, Jr.<sup>1</sup>, John P. Carroll<sup>2</sup>

Distance sampling methods have been advocated for estimating fall density of northern bobwhite (*Colinus virginianus*). Natural resource managers need information on expected levels of precision for a given sampling effort. We conducted power analysis, over a range of expected densities, to determine sampling effort required to obtain estimates with desired levels of precision. We used distance/detection information from 701 point count mornings on 39 farms in the Upper Coastal Plain of Georgia to construct detection distributions and estimate a global detection function (Uniform with cosine adjustment). We used simulation models to determine the expected Coefficient of Variation (CV) on density in relation to number of points sampled. We generated 1000 sets of random samples in increments of 10 at sample sizes of 10 to 1000. At each sample size we generated the respective number of observations from a Poisson distribution with  $\lambda = 0.5$  to 3 and computed the density and associated statistics using the global detection function. We report the mean CV on covey density at each sample size. As expected, the CV on density decreased with increasing sample size and expected number of detections per point. A CV of <15% could be achieved with 50 points with an expected mean detection of 1 covey/point or 15 points

with 2 coveys/point. A mean CV of 10% required 100 points at an expected 1 covey/point or 30 points at 2 coveys/point. These simulations demonstrate that distance-based fall covey surveys can provide density estimates with reasonable precision given sufficient allocation of effort.

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## Habitat II

### 3:20 PM Consumption of Invertebrate Agricultural Pest Species by Human-imprinted Northern Bobwhite Quail (*Colinus virginianus*) Chicks

Elizabeth D. Doxon<sup>1</sup>, John P. Carroll<sup>2</sup>

Northern bobwhite (*Colinus virginianus*) chicks are heavily dependent on invertebrates during their first weeks of life. Numerous taxa of invertebrates have been identified in the diet, including many of agricultural significance. We human-imprinted, then allowed to forage, 100 groups (6–10 chicks/group) of northern bobwhite chicks in wheat and Conservation Reserve Program (CRP) fields in Kansas during June and July 2004 and 2005. Invertebrates eaten by the chicks were identified and quantified using crop and fecal analysis. Of the 22 families/orders eaten by northern bobwhite, 9 (41%) of them contained species considered pests in Kansas. The number of invertebrate pest insects consumed per chick ranged from 0.20 to 6.25/30 min, with the most common species being Lepidopteran larvae, Aphididae, and Curculionidae. Lepidopteran larvae were taken at 3.1 times the rate of the next most common taxon (Aphididae). When Lepidopteran larvae were consumed, two major Lepidopteran pests, Green Cloverworms (*Plathypena scabra*) and Wheathead Armyworms (*Faronta diffusa*), were consumed in large numbers, ranging from 1.20–5.27 larvae/chick. Our data suggest that gamebird chicks may consume large numbers of invertebrates considered to be agricultural pests, and we suggest further research on their potential to affect pest outbreaks.

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### 3:40 PM Influence of Precipitation on Demographics of Northern Bobwhites (*Colinus virginianus*) in Southern Texas

Fidel Hernández<sup>1</sup>, Froylan Hernández<sup>1</sup>, Juan A. Arredondo<sup>1</sup>, Fred C. Bryant<sup>1</sup>, Leonard A. Brennan<sup>1</sup>, Ralph L. Bingham<sup>1</sup>, William C. Stasey<sup>1</sup>

Northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) populations in southwestern rangelands are influenced by precipitation; populations increase during relatively wet periods and decrease during drought. Understanding demographic precipitation responses may help to identify mechanisms explaining this phenomenon. We compared 10 demographic variables between dry (Sep 2000 – Aug 2001; 51–cm precipitation) and wet periods (Sep 2002 – Aug 2003; 93–cm precipitation) in Brooks County, Texas. We monitored radiomarked bobwhites on 3 sites during the dry ( $n = 263$  bobwhites) and wet period ( $n = 191$  bobwhites) to obtain estimates of survival and reproductive effort. Survival curves ( $\hat{s} \pm SE$ ) differed between the dry period ( $0.30 \pm 0.04$ ;  $n = 102$ ) and wet period ( $0.60 \pm 0.06$ ;  $n = 71$ ;  $P < 0.001$ ) during fall–winter (Sep–Feb). Fewer hens nested during the dry period (95% CI:  $52.6 \pm 22.5\%$ ;  $n = 19$ ) than the wet period (100%;  $n = 15$ ). Of hens nesting, the dry period exhibited lower per capita nesting rate (95% CI:  $1.2 \pm 0.3\%$  nests/hen) than the wet period (95% CI:  $2.3 \pm 0.5\%$  nests/hen). Nesting season was shorter during the dry period (69 days) than the wet period (159 days). Lastly, percent juveniles (Nov–Feb) were lower during the dry period (95% CI:  $69.3 \pm 0.3\%$ ;  $n = 740$  harvested bobwhites) than the wet period (95% CI:  $78.3 \pm 2.1\%$ ;  $n = 1,415$  harvested bobwhites). Our field study highlights 4 demographic

variables (i.e., survival, percentage of hens nesting, nesting rate, and nesting-season length) that warrant further research to identify causal factors responsible for the boom-and-bust phenomenon in bobwhites.

<sup>1</sup>Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Kingsville, TX 78363, USA

#### 4:00 PM Effects of Sex, Age, and Habitat on Northern Bobwhite (*Colinus virginianus*) Spring Dispersal Patterns in a South Georgia Agricultural Landscape

Patrick Cook<sup>1</sup>, John P. Carroll<sup>2</sup>, Richard G. Hamrick<sup>3</sup>

Information on northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) dispersal patterns is crucial for implementing effective management strategies. Researchers have examined bobwhite dispersal, but information on how habitat affects dispersal patterns is lacking. We examined the effects of habitat, sex, and age on bobwhite spring dispersal patterns in a southern Georgia agricultural landscape during 2002–2003. Of 101 birds used in our analyses, 29.7% (SE = 4.6) dispersed an average of 1,835–m (SE = 194). We fit 8 logistic regression models to predict bobwhite dispersal probability. The best approximating model (Akaike weight = 0.69) included age, proportions of closed-canopy pine within winter home ranges (CCPN), and an age\*CCPN interaction term. Adults with higher proportions of closed-canopy pine within their winter home range were more likely to disperse ( $\beta = 0.18 \pm 0.06$  SE). Adults may perceive habitat quality differently from juveniles, which could influence adult tendency to disperse. Although dispersal may allow bobwhite populations to persist in fragmented landscapes, management at the local scale is hindered if emigration exceeds immigration. Adults can be important contributors to production, therefore, characteristics of landscape context that influence retention of adults may influence the magnitude and direction of population response on managed sites. However, a portion of birds will likely disperse every spring, regardless of habitat quality. Therefore, it is important to consider landscape quality and management unit size when determining which areas are most likely to respond to management.

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#### 4:20 PM Population Response of Northern Bobwhite (*Colinus virginianus*) to Field Border Management Practices in Mississippi

Mark D. Smith<sup>1</sup>, L. Wes Burger, Jr.<sup>1</sup>

Empirical relationships of the intensity and spatial extent of field border management required to elicit measurable population responses of northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) are needed. We established 90.5 km of herbaceous field borders (6.1 m wide) along row crop field edges on one half of each of 3–800-ha agricultural landscapes in northeast Mississippi. Experimental field borders comprised between 0.8–1.3% of the land base of study sites. During 2000–2002, we measured breeding season abundance and fall density on all 3 sites and survival of radiomarked bobwhites on 2 of 3 sites. We used space–use models of bobwhite habitat composition and configuration to estimate changes in habitat suitability resulting from field border im-

plementation. Survival did not differ between bordered ( $S = 37.2$ ,  $SE = 0.06$ ) and non-bordered ( $S = 42.7$ ,  $SE = 0.09$ ;  $\chi^2_1 = 1.70$ ,  $P = 0.191$ ) sites. Moreover, bordered and non-bordered sites did not differ significantly with respect to breeding season call counts (bordered = 1.0,  $SE = 0.18$ ; non-bordered = 0.8,  $SE = 0.27$ ;  $F_{1,10} = 0.44$ ,  $P = 0.219$ ) and fall density (bordered = 0.2,  $SE = 0.07$ ; non-bordered = 0.1,  $SE = 0.05$ ;  $F_{1,10} = 2.18$ ,  $P = 0.171$ ). However, field borders increased the amount of usable space by up to 15% on bordered landscapes. The relatively low percentage of field borders established on our sites was not sufficient to elicit measurable population responses of bobwhite. Within the context of other field border studies, we recommend at least 5–10% of a study area be placed in field border habitats to enhance local bobwhite populations.

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#### 4:40 PM Northern Bobwhite (*Colinus virginianus*) Demographic and Population Response to an Intensive Habitat Modification on an Agricultural Landscape

Theron M. Terhune<sup>1</sup>, D. Clay Sisson<sup>2</sup>, Steven Mitchell<sup>3</sup>, H. Lee Stribling<sup>4</sup>

Northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) populations have been declining throughout most of their endemic range. Whereas declining populations have been associated with numerous factors (e.g., increased urbanization, predators), changing land-use practices have proved most detrimental to bobwhites. In the southeastern USA, small-scale farming has reduced in favor of large-scale center-pivot irrigation systems and this has exacerbated habitat loss. Despite these trends, bobwhite populations in the Southeast have not declined on many areas employing intensive habitat management regimes, highlighting the importance of appropriate management for bobwhite. Therefore, we intensively modified a center-pivot, agriculture dominated landscape to benefit bobwhites by creating new habitat and improving existing habitat. Techniques utilized to modify this landscape were: establishment of linear habitats, field borders and buffer strips; planting longleaf pines; and management of existing habitats via prescribed burning and timber management. During 1998–2001, we monitored bobwhite ( $n = 440$ ) demographics and population response following annual habitat restoration and management using radio-telemetry and fall abundance estimation (i.e., covey call-counts). Survival during over-winter (0.58,  $SE = 0.04$ ), breeding (0.36,  $SE = 0.03$ ) and annual (0.21,  $SE = 0.025$ ) time-periods was higher than those reported for other agriculture studies and similar to those intensively managed plantation habitats. Bobwhite coveys and broods used newly developed longleaf pine, field borders/hedgerows, linear habitats, and managed woodlands. Further, nest site selection was commonly associated with these novel habitat types. Consequently, we surmise that modification of agricultural landscapes may improve habitat quality and quantity for bobwhites and subsequently increase demographic rates and bobwhite abundance.

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## Habitat Management

### 3:20 PM Half-cutting as a Management Tool to Increase Abundance of Northern Bobwhite (*Colinus virginianus*) in South Texas

Nova J. Silvy<sup>1</sup>, Dale A. Hall<sup>2</sup>

We evaluated the effectiveness of half-cutting honey mesquite (*Prosopis glandulosa*) trees to increase northern bobwhite (*Colinus virginianus*; hereafter bobwhite) habitat and abundance in South Texas. We compared the effects of half-cutting on the survival of mesquite and its effects on understory vegetation on both treated and control areas monthly. Data were taken under the trees canopy to determine understory plant species diversity, height, and density. We used bobwhite whistle counts, mark-recapture, and searched with trained dogs to determine the effects of half-cutting on bobwhite abundance. Half-cut young trees had 23.1% greater survival than did older half-cut trees. The area protected from grazing under half-cut trees was 10.2 times larger than that protected by control trees. Height of understory vegetation under half-cut trees was significantly ( $P = 0.005$ ) taller than that under control trees. Treated areas supported more plant species than control areas but the difference was not significant ( $P = 0.072$ ). Three bobwhite food plants had a positive response to half-cutting, whereas 3 were negatively affected. Half-cutting had no significant influence on numbers of cocks whistling (maximum 9 and 8 males calling/5-min period, respectively for treatment and control). The number of bobwhite trapped on the half-cut area was 91 while only 75 were trapped on the control area. Trained bird dogs located 101 bobwhites on the half-cut areas and 78 on the control areas. The half-cut areas had the same number of coveys (10) as the control areas, however, covey sizes were larger (2.3 birds/covey) on the half-cut areas. We believe that half-cutting can add habitat and increase bobwhite abundance on many heavily grazed rangelands.

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### 3:40 PM Establishment of Mixed Mast Species Plantings for Wildlife from Local Seed Sources Using Quality-Improved Seedlings in Tennessee

Jason S. Maxedon<sup>1</sup>, Joseph L. Elkins<sup>2</sup>, Scott E. Schlarbaum<sup>3</sup>

Reforestation of both upland and bottomland hardwood sites in Tennessee has markedly increased in recent years, primarily due to financial incentives offered through various Natural Resources Conservation Services programs. In addition, reversion of agricultural sites to forests using artificial regeneration is becoming increasingly common due to decreased profitability of agricultural production on marginal farmland. The Tennessee Wildlife Resources Agency (TWRA) has been acquiring former agricultural sites for conversion to wildlife habitat. The feasibility of establishing locally adapted wildlife plantings using quality-improved seedlings in east Tennessee uplands and west Tennessee bottomlands were studied on various TWRA properties. Seeds of various mast producing species were collected from local seed sources beginning in the fall of 1998 and continuing through the fall of 2005. In this study more than 550,000 total seedlings of seven upland oak species, ten soft mast species and nine bottomland oak species were grown at the Georgia Forestry Commissions Flint River Nursery. Seedlings were established at 22 sites, ranging from 1 to 530 acres and comprising 1,500 total acres. Results of survival and the logistics

of establishing a management project on this scale will be presented.

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#### 4:00 PM Northern Bobwhite (*Colinus virginianus*) Breeding Season Survival on a Rotationally Grazed South Florida Ranch

James A. Martin<sup>1</sup>, William E. Palmer<sup>2</sup>, Tommy C. Hines<sup>3</sup>, John P. Carroll<sup>1</sup>

Northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) have decreased at an annual rate of 4.3% in the peninsular region of Florida over the last several decades due to habitat loss and degradation. Specifically for this region, native prairie habitats have been converted to exotic grass pastures that are much less suitable for bobwhites. However, bobwhites do exist at low densities on these habitats and have potential to proliferate if management changes are made. Our study area was a 2300-ha ranch typical of the region where the primary habitat type is improved pasture, predominately Bahia grass (*Paspalum notatum*). The grazing system used on the ranch can be categorized as a deferment type of rotational grazing. We evaluated breeding season (March–September) survival of radio-marked bobwhites ( $n = 81$ ) for two years, 2004 and 2005, using the known-fate model in program MARK. Candidate models were ranked using Akaike's Information Criterion (AIC). Model parameters included season, sex, age, and habitat variables. Breeding season survival for 2004 and 2005 was 0.25 (SE = 0.07) and 0.37 (SE = 0.08), respectively.

<sup>1</sup>D. B. Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602, USA; <sup>2</sup>Tall Timbers Research Station and Land Conservancy, 13093 Henry Beadel Drive, Tallahassee, FL 32312, USA; <sup>3</sup>Florida Fish and Wildlife Conservation Commission, 1314 SW 186th Street, Newberry, FL 32699, USA

#### 4:20 PM Effects of Two Burning Scales on Northern Bobwhite (*Colinus virginianus*) Demographics and Habitat Use

Shane D. Wellendorf<sup>1</sup>, William E. Palmer<sup>1</sup>

Properties managed for northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) hunting in the Red Hills region of Florida and Georgia use prescribed fire to burn 40–60% of their upland areas annually. Burning large areas could negatively affect bobwhite survival by increasing predation risk. Burning small areas could influence daily habitat use patterns and may influence breeding success. Research on how the scale of management influences habitat use and demographics of bobwhites is lacking. Therefore, at Tall Timbers Research Station (TTRS) we established 4 140-ha treatment areas and randomly assigned 2 areas to be burned at a small scale (2.25-ha burn patch size) and 2 areas burned at a large scale (8.4-ha burn patch size). Upland habitat areas were divided into similar size patches, depending on treatment, with half being burned annually in an alternating pattern. We radio-tagged bobwhites annually (2003–2005) and monitored survival, productivity, and habitat use between March and September. The risk of mortality was higher on large scale versus small scale treatments during March–May. However, small scale treatments had a higher risk of mortality during June–August. Per capita nest production was higher on small scale areas, 0.58 nests/bird (SE = 0.12), than large scale areas, 0.40 nests/bird

(SE = 0.07). Autumn density was higher on small scale treatment areas (3.5 bobwhite/ha, SE = 0.62) compared to large scale treatment areas (2.7 bobwhite/ha SE = 0.67)( $F_{1,2} = 12.9, P = 0.07$ ). On TTRS, burning smaller areas to create a patchwork of burned and unburned habitats increased early breeding productivity, which can be important in improving overall productivity.

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## Poster

### Summer Male Call Index Relative to Nesting Activity and Autumn Density of the Northern Bobwhite (*Colinus virginianus*)

Theron M. Terhune<sup>1</sup>, Richard G. Hamrick<sup>2</sup>, D. Clay Sisson<sup>3</sup>, H. Lee Stribling<sup>4</sup>

We studied breeding season male call counts and breeding behavior of the northern bobwhite (*Colinus virginianus*) to determine the relationship between male calling activity and nesting chronology. Additionally, we examined the relationship between breeding season call counts and fall population size. Standardized call count routes were conducted on six different sites located in southwest Georgia and north Florida during the breeding seasons (1 Apr – 31 Sep) of 2001 and 2002. An information theoretic approach was used to evaluate a set of seven candidate linear mixed models describing breeding season calling of northern bobwhite males. Of the candidate models, a model in which call counts depended on year and a quadratic effect of the number of incubating hens was the best approximating model, suggesting that the percentage of incubating hens had the greatest influence on activity of calling males. We also used multiple linear regression models to predict autumn northern bobwhite abundance from mean numbers of calling males detected during the breeding season. Peaks in male calling activity during June and July demonstrated a strong relationship ( $R^2 = 0.987$ ) with autumn population size, suggesting that breeding season call counts were useful indices of autumn northern bobwhite abundance.

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### A Method for Determining Asymptotes of Home-range Area Curves

Aaron M. Haines<sup>1</sup>, Fidel Hernández<sup>1</sup>, Scott E. Henke<sup>1</sup>, Ralph L. Bingham<sup>1</sup>

Home-range area curves are used to estimate the number of locations needed to estimate home-range size based on the asymptote of the curve. However, the methodology used to identify asymptotes for home-range area curves has been mostly subjective and has varied between studies. Our objective was to evaluate the use of reciprocal function models as a means for identifying asymptotes for home-range area curves. We radio-monitored northern bobwhite (*Colinus virginianus*) coveys from mid-September through November 2001–2002 in Jim Hogg County, Texas. We calculated home-range size of radiomarked coveys using the 95% fixed kernel with least-squares cross-validation and minimum convex polygon home-range estimators. We fitted area observations and coefficient of variation to the number of locations using a reciprocal function model to estimate the minimum number of locations necessary to obtain a representative home-range size for each home-range estimator. A reciprocal function model provided a relatively good fit ( $0.58 \leq R^2 \leq 0.97$ ;  $P < 0.05$ ) for area curves and coefficient of variation curves for both home-range estimators. The use of reciprocal function models appears to provide a structured and useful approach for calculating area-curve asymptotes. We propose that researchers consider the use of such models when determining asymptotes for home-range area curves.

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## A Review of Crippling Losses for Northern Bobwhites (*Colinus virginianus*): Estimates and Implications

Aaron M. Haines<sup>1</sup>, Fidel Hernández<sup>1</sup>, Scott E. Henke<sup>1</sup>

The purpose of this paper is to: 1) report an estimate of crippling loss for harvested northern bobwhites (*Colinus virginianus*) in south Texas (Jim Hogg County); 2) provide a review of crippling loss for northern bobwhites across their range; and 3) discuss crippling loss within a population context. We fitted 150 northern bobwhites with 6–7g neck-loop radio-transmitters from September to February 2001–2003. We documented 52 deaths of radiomarked birds, of which 34 (65%) were depredated, 17 (33%) were harvested, and 1 (2%) died of unknown causes. Five of the 17 (29%) harvested northern bobwhites represented crippling losses. Estimates of crippling loss for northern bobwhites ranged from 10% to 30% across their distribution. Regarding population impacts, crippling loss had minimal effect when harvest was low (25%). However, the addition of high crippling loss (e.g., 30%) to high harvest rates (e.g., 75%) caused total mortality to reach 100%. We propose that when mortality rates are reported and hunting is listed as one of the causes, researchers and land managers should report crippling loss. Future research should be conducted to identify which hunting techniques are most effective at minimizing crippling loss.

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## Does Prickly Pear Cactus Deter Raccoons from Depredating Northern Bobwhite (*Colinus virginianus*) Nests?

Fidel Hernández<sup>1</sup>, Scott E. Henke<sup>1</sup>, Nova J. Silvy<sup>2</sup>, Dale Rollins<sup>3</sup>

Recent research indicates that northern bobwhite (*Colinus virginianus*) in Texas commonly nest in prickly pear cactus (*Opuntia* spp.) instead of conventional bunchgrass habitat. Because degree of nest protection can affect nest-site selection, we experimentally tested the hypothesis that simulated nests located in prickly pear exhibited greater survival than nests located in bunchgrass. Our objective was to document the effectiveness of prickly pear as a predator deterrent. We tested the nest-protection hypothesis by providing 50 wild-caught captive raccoons (*Procyon lotor*) with combinations of simulated northern bobwhite nests. Nest combinations included either, 1 nest in bunchgrass (*Schizachryium scoparium*) and 1 nest in prickly pear cactus (partial [75%] and full [100%] protection), or 2 separate nests in prickly pear (partial and full protection). Raccoons depredated 97%, 33%, and 14% of nests constructed of bunchgrass ( $n = 35$  nests), partial protection prickly pear ( $n = 30$  nests), and full protection prickly pear ( $n = 35$  nests), respectively. Prickly pear nests that provided full protection exhibited better survival against raccoon depredation than the other nest types. Our study provides support for the nest-protection hypothesis concerning northern bobwhite use of prickly pear cactus as a nesting substrate.

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### How Many Eggs Can Northern Bobwhite (*Colinus virginianus*) Hens Produce?

John T. Baccus<sup>1</sup>, Kevin W. Dees<sup>1</sup>, Michael F. Small<sup>1</sup>

Boom and bust cycles of northern bobwhites (*Colinus virginianus*) has long fascinated and perplexed wildlife biologists. Yearly population amplitude depends on the reproductive performance of females induced by environmental pressures. The objective of our study was to determine the reproductive potential of northern bobwhite hens from southern Texas. We describe egg production by 90 pairs of randomly-selected, mature, wild-caught northern bobwhites with continuous cohabitation housed under optimal conditions of food, water, climate and a 17-h photoperiod. We collected eggs daily using an 18-day period to differentiate clutches. Females continuously laid eggs until ceasing production. We evaluated number of eggs laid by each hen individually and collectively including total number, number/clutch, number laid/day, and egg weight. Number of eggs produced by individual hens ranged from 0 to 171 over about 200 days. Eggs laid/day varied from 0 to 0.86. Clutch size by individuals ranged from 4 ( $n = 76$ ) to 12 ( $n = 1$ ) with a strong correlation between size of clutch and number of clutches ( $R^2 = 0.9777$ ). Mean number of eggs per clutch was 8.57. Overall, 88 hens produced 5,888 eggs. Egg weight did not vary by clutch number or hatching success. Some females continuously produced several large clutches of eggs. Our research questions the paradigm of maximum clutch size of 15 eggs for this species.

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### Status and Harvest of Gray Partridge (*Perdix perdix*) in the Saratov Region of the Russian Federation

Evgeni V. Zaviyalov<sup>1</sup>, Vasily G. Tabachishin<sup>2</sup>

Surveys conducted during 1998–2005 have revealed gray partridge (*Perdix perdix*) to be an ordinary nesting bird species in the Saratov region of Russia. In a majority of regions, it lives a non-migratory life. However, nomadic movements are observed in some years, comparable to true overflies given their cyclic character and distances. The routes of these periodic, seasonal migrations bind the Saratov region with the Astrakhan and Pre-Caucasian steppes and the lower reaches of the Don River. Additionally, trophic roaming is characteristic of gray partridge in the winter season, with distances not normally exceeding 100-km. This behavior results in bird redistribution within the region and concentration of a large part of the winter population in valleys of small rivers. Geographically, the population density of gray partridge is subject to considerable variations. During the nesting period, density varies from 0.7 to 12.2 ind/km<sup>2</sup> in areas suitable for nesting across various landscapes of the Saratov region, with an average density of 1.1 ind/km<sup>2</sup>. Unfortunately, the total number of gray partridges in the Saratov region is estimated by several organizations, often using different techniques. This circumstance potentially results in considerable errors (underestimation) in the estimation of this species' abundance in the region. According our route surveys, the number of gray partridges in the post-nesting season is 141,000 ± 12,450 birds. On the basis of these estimations, we suggest opening a hunting season for gray partridges during the autumn with some necessary limitations.

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## Vegetation Composition of Georgia Department of Natural Resources Bobwhite Quail Initiative Field Borders

Jason K. Burkhardt<sup>1</sup>, John P. Carroll<sup>1</sup>

In the southeastern U.S.A., soil disturbance through light disking is often employed as a management tool to enhance the quality of field–borders for northern bobwhite (*Colinus virginianus*) brood habitat. Desirable annual and perennial species of vegetation often respond favorably to soil disturbance when conducted during late–autumn and/or early–winter. However, several undesirable species, such as bermudagrass (*Cynodon dactylon*), can impede habitat quality. Because disking as a management tool is an important component of the Georgia Department of Natural Resources Bobwhite Quail Initiative (BQI), we assessed the vegetative response following soil disturbance. We compared vegetation composition and structure, for 2 years following dormant–season management, by disking 10-m wide BQI managed field borders and 10-m wide, non–BQI field borders, quantified abundance of beneficial plant species in BQI fields, and surveyed for invasive plant species in BQI managed field borders. BQI field borders generally contained more beneficial vegetation (e.g., ragweed [*Ambrosia artemisiifolia*]) than non–BQI field borders. However, BQI borders also contained more undesirable sod grasses including bermudagrass. Whereas both BQI field–borders and non–BQI field–borders contained few beneficial plant species (e.g. beggarweed [*Desmodium* spp.], broomsedge [*Andropogon* spp.], or partridgepea [*Chamaecrista* spp.]), during the first year following treatment, small amounts of broomsedge and partridge pea were observed during year 2. Our results suggest that dormant season disking can be beneficial; however, due to seed banks that are poor in desirable native plant species and the presence of exotic sod–forming grasses, the value of soil disturbance as a practical management tool is hindered.

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## Observations on the Pheasant (*Phasianus colchicus*) in the Alazani River Valley, Republic of Georgia

John P. Carroll<sup>1</sup>, Brant C. Faircloth<sup>1</sup>, Revaz Machaidze<sup>2</sup>

The common (ring-necked) pheasant (*Phasianus colchicus*) is one of the most widespread and important of the Galliformes. It is found throughout temperate Asia and into Europe. Populations have been introduced around the world and large populations are found in North America. However, this complex species, comprised of a reported 31 subspecies, is poorly studied in many parts of its native range. Some of the morphologically distinct subspecies are now known to be declining. The nominate race of the common pheasant (*P. c. colchicus*) was originally described from what is now known as the Republic of Georgia. Following the dissolution of the Soviet Union, changes in land use and management are thought to have resulted in rapid decline of this species. We conducted widespread, intensive surveys throughout southeastern Georgia during 2005 to assess distribution and abundance of pheasants in the Alazani River valley. Surveys revealed few areas of pheasant presence. These areas were generally limited to remnant woodlands adjacent to the Alazani River, and several birds were also located within wooded draws on steep slopes above the river valley. Intensive monitoring on 1–km<sup>2</sup> quadrats revealed reasonable pheasant numbers in a few remnant populations. However, impacts of livestock grazing on ground vegetation combined with high raptor abundance limit the application of traditional survey techniques.

Our surveys confirm anecdotal evidence of low pheasant abundance in these areas and suggest that fragmentation of populations within these regions is of concern.

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### **Assessment of Gene Flow Between and Introgression of Pen-raised Stock into Northern Bobwhite (*Colinus virginianus*) Populations in the Southeast Using Microsatellite Markers**

Teresa L. Valentine<sup>1</sup>, Brant C. Faircloth<sup>1</sup>, C. Joseph Nairn<sup>1</sup>, William E. Palmer<sup>2</sup>, John P. Carroll<sup>1</sup>

Concurrent with the decline in early successional habitat throughout the Southeast, the northern bobwhite (*Colinus virginianus*; bobwhite) has suffered dramatic population losses over the past half century. Given its seemingly limited dispersal capability and the increasing degree of fragmentation of suitable habitat, the potential for genetic isolation of populations has been of growing concern. Additionally, releases of both pen-raised and imported stock into the wild have the potential to negatively impact locally adapted gene complexes, diluting the native gene pool, and possibly reducing the fitness and evolutionary potential of native populations. We sampled 258 bobwhites from 8 locations in Georgia, Florida and South Carolina, and from 4 commercial breeders to assess current bobwhite population structure and levels of genetic diversity using a panel of species-specific microsatellite markers. Our data demonstrate little genetic substructuring among both geographically proximate and distant populations. These results suggest that there is currently little to no genetic isolation among bobwhite populations due to habitat fragmentation, although these effects may as yet be undetectable if such isolation has been recent. We additionally found few differences, overall, between pen-reared and native bobwhite populations; therefore allelic introgression into wild populations from pen-raised stock appears limited.

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### **Landscape-scale Assessment of Northern Bobwhite (*Colinus virginianus*) Productivity in South Texas**

Kyle A. Brazil<sup>1</sup>, Erin M. Wehland<sup>1</sup>, Jason B. Hardin<sup>1</sup>, Tina R. Martin-Nims<sup>1</sup>, Leonard A. Brennan<sup>1</sup>, Fidel Hernández<sup>1</sup>

There is no comprehensive information regarding how northern bobwhite (*Colinus virginianus*; bobwhite) populations and productivity vary temporally and spatially. The South Texas Quail Associates Program was formed in 2001 to address this knowledge gap. Quail Associate participants collected hunter-harvest data on bobwhite age, sex, and body weights during 2001–2005. Participants were provided with a kit and instruction manual that showed how to determine quail age, sex, and body weight. One wing was clipped from each harvested bird and sent to us for verification of age. Productivity was measured by age ratio of harvested bobwhites (juvenile:adult or hatch-year:after hatch-year). Overall age ratio for the 2004–2005 hunting season was 3.3:1 ( $n = 17,348$ ), as compared to 4.1:1.0 ( $n = 18,533$ ) for 2003–2004, 3.1:1.0 ( $n = 7,397$ ) for 2002–2003, and 1.4:1.0 ( $n = 4,355$ ) for 2001–2002. Increases in precipitation beginning during the summer

of 2002 and continuing through 2004 was correlated with dramatic increases in bobwhite age ratios from the 2001–2002 hunting season through the 2003–2004 hunting season. Precipitation was near average in 2005. Productivity data for the 2005–2006 hunting season will add to the long-term dataset. The South Texas Quail Associates Program represents the first time that quail managers, hunters, and researchers have collaborated to obtain a landscape-level assessment of quail population productivity.

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### **Northern Bobwhite (*Colinus virginianus*) Brood Habitat Selection in South Florida**

Nevena Crawford<sup>1</sup>, James A. Martin<sup>1</sup>, John P. Carroll<sup>1</sup>

During the past three decades, northern bobwhite (*Colinus virginianus*; hereafter, bobwhites) populations have decreased throughout most of their distribution. A variety of factors have been suggested as the cause of this decline including changes in land use, agricultural intensification, increase in predation, and high chick mortality. We assessed fourth-order habitat selection of broods in south Florida to develop predictions of management strategies that favor bobwhite brood success. We analyzed canopy coverage at actual brood locations versus both random-within MCP home range locations and random-outside MCP home range locations. Average home range size was  $5.53 \pm 2.43$  ha. Our data suggest that no single vegetation type can be used to predict use by bobwhite broods. The models we evaluated using Akaike's Information Criterion (AIC) support this belief. We also found sod-forming grasses to be most prevalent at brood and random-within MCP home range locations whereas forbs were most prevalent at random-outside MCP home range locations. Broad-leaf woody vegetation and legumes were more prevalent at brood locations than either type of random locations. Brood-rearing habitat is dependent on invertebrate abundance and broad-leaf woody vegetation and legumes provide excellent habitat for invertebrates. We believe that, at the ranch level, a combination of vegetation management within pastures, as well as larger-scale management that increases greater interspersion of desirable vegetation communities, will allow bobwhites access to quality habitat at all periods of their life cycle.

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### **Artificial Incubation and Ex-Situ Rearing of the Montezuma Quail (*Cyrtonyx montezumae montezumae*) in Central Mexico**

David Garcia-Solorzano<sup>1</sup>, Carlos Gonzalez-Rebeles Islas<sup>2</sup>, Ernesto Avila Gonzalez<sup>2</sup>, German Mendoza Martinez<sup>3</sup>, Salvador Ibarra Zimbron<sup>4</sup>

Habitat fragmentation is one of the main causes of the Montezuma quail (*Cyrtonyx montezumae montezumae*) population decline in central Mexico. *Ex-situ* rearing as well as critical habitat protection are management strategies needed to protect this species. We established an *ex-situ* rearing protocol for Montezuma quail. Both eggs and hatchlings were collected from wild nests for captive rearing of chicks. We artificially incubated 10 eggs collected from 2 wild nests located at the northwestern region of the State of Mexico. During the first 21 days of incubation, the eggs were incubated at 37.6°C and 54% relative humidity (RH) with automatic rotation. During the last

2 days of incubation, the temperature was maintained at 37.2°C and 79% RH. The hatch rate of fertile eggs was 60%. The captive rearing was divided into 2 phases: initiation (1 day – 6 weeks of age) and development (6 – 16 weeks). We placed artificial cover (branches and leaves) onto their cages during the initiation phase in order to simulate natural conditions and to decrease possible stress. The survival rate of *ex-situ*-reared chicks was 95%. It was possible to distinguish sexual dimorphism by plumage coloration after chicks were 5 weeks of age; the observed sex ratio was 1.4 females:1 male ( $n = 21$ ). This was the first successful documented attempt of artificial incubation and *ex-situ* rearing for this species in Mexico.

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### **Responses of Northern Bobwhite (*Colinus virginianus*), Vegetation and Invertebrate Communities to Applied Mid-contract Management in Old-Field CRP Grasslands in Southcentral Illinois**

Douglas C. Osborne<sup>1</sup>, Donald W. Sparling<sup>1</sup>, John Cole<sup>2</sup>, Dave Howell<sup>3</sup>

We examine methods of renovating herbaceous cover on CRP fields in Illinois. Currently, there are 194,000 ha of CRP grasslands in the primary range of the northern bobwhite (*Colinus virginianus*) in Illinois. However, most fields are monotypic stands of cool season grasses in excess of 4 years old and in need of renovation to thin grass stands and restore annuals and legumes favored by northern bobwhite and other early successional species. There is not much information evaluating efficacious and economical methods for renovating such habitat. In this study we examine the effects and costs of three methods: 1) disking; 2) herbicide spraying; and 3) herbicide spraying followed by planting with legumes. We hypothesize that treatment fields with applied farm management practices will support a greater diversity of vegetation, arthropod, and grassland birds than that of the untreated control fields. Our data will be used to determine the most ecologically beneficial and cost-efficient methods of renovating monotypic grasslands and will allow us to make suggestions to landowners and managers for improving wildlife habitat.

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### **Proposals for an Improved Management of Red-Legged Partridge (*Alectoris rufa*) Populations With or Without Release of Reared Birds**

Françoise Ponce-Boutin<sup>1</sup>, Jean-Christophe Brun<sup>2</sup>, Jean-François Mathon<sup>3</sup>, Jean-Claude Ricci<sup>4</sup>

The decline of red-legged partridge (*Alectoris rufa*) populations prompted the Office National de la Chasse et de la Faune Sauvage to study the status of this species and its hunting. The results obtained for eight administrative divisions of the French Mediterranean region will be presented. Simultaneously, a long-term study on the dynamics of the populations and their hunting was conducted at one site, Pailhès to determine the impact of releases on wild red-legged partridge populations. The inquiry form, designed for hunting area managers ( $n = 1250$ ), consists

of questions regarding the hunting structure, the abundance of the partridge populations, their management progress, their hunting bag, the measures of shooting management as well as habitat management. Three barycentric discriminant analyses were performed. Dependent variables were, alternatively, the abundance of the species, with and without release, and the presence or not of this practice. The results show that the abundance is strongly related to the shooting restriction measures, the density of game crops, the control of predators as well as the absence of releasing operation just before or during the hunting season. On the contrary, releasing practices are accompanied with habitat management efforts and an intensification of hunting pressure. The example of Pailhès allows a better understanding of the mechanisms by which releases can have a negative impact on the wild populations and illustrates the effects of applying the results of our study. The publication ends with recommendations for red-legged partridge population management.

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### Winter Food Habits and Preferences of Northern Bobwhites (*Colinus virginianus*) in Eastern Texas

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We investigated food habitats and preferences of northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) collected on forested lands subjected to 3 management regimes, namely intensively managed for bobwhites (INT) (i.e., tree basal area reduced, annually burned, numerous multi-stage food plots, etc.), extensively managed for timber and wildlife (EXT) (i.e., burned every 3-5 years, scattered 2-stage food plots with corn feeders), and unmanaged for wildlife (UNM) (i.e., burned every 5-7 years), in eastern Texas during late winter, 1994 and 1995. With years pooled, partridge pea (*Cassia fasciculata*), Hercules-club (*Zanthoxylum clava-herculis*), and pine (*Pinus* spp.) seeds and clover leaflets (*Trifolium* spp.) comprised 93% by weight of bobwhite ( $n = 108$ ) foods on INT. On EXT, 81% of the diet ( $n = 40$ ) was butterfly pea (*Centrosema virginianum*), browntop millet (*Panicum fasciculatum*), pine, wild bean (*Strophostyles* spp.), and corn (*Zea mays*) seeds and clover leaflets; millet and corn were from food plots and feeders, respectively. For UNM ( $n = 11$ ), 79% of the diet was butterfly pea, rush (*Juncus* spp.), pine, partridge pea, and American beautyberry (*Callicarpa americana*) seeds and clover leaflets. Sorensons similarity index showed diets of bobwhites on INT and EXT were most similar (0.72). The PREFER program indicated that top-ranked food items on INT were pine and hairy vetch (*Vicia villosa*) seeds in 1994 and butterfly pea, partridge pea, and waxmyrtle (*Myrica cerifera*) seeds in 1995. On EXT, hawthorn (*Crataegus* spp.) and beautyberry seeds comprised the top-ranked group in 1994 as did lespedeza, wild bean, and butterfly pea seeds in 1995. On UNM, butterfly pea and partridge pea seeds and clover leaflets were highest ranked in 1995. On forested lands, activities (i.e., disking, burning, establishing food plots) which provide seed-bearing plants, especially legumes, and clover greenery benefit bobwhites.

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### Long-term Climate Trends and Northern Bobwhite (*Colinus virginianus*) Populations in South Texas

Jeffrey J. Lusk<sup>1</sup>, Fred S. Guthery<sup>2</sup>, Markus J. Peterson<sup>3</sup>, Stephen J. DeMaso<sup>4</sup>

Because climate change and its associated weather changes may influence population trends of birds, we analyzed northern bobwhite (*Colinus virginianus*; bobwhite hereafter) age ratios and abundance in relation to climate trends during 1908–1997 in south Texas. Weather variables included regional mean temperature maxima for June, July, and August, and precipitation totals for autumn (Sep–Nov), winter (Dec–Feb), spring (Mar–May), and summer (Jun–Aug). Long-term temporal trends for these weather variables were estimated with a linear regression. Yearly weather data were used to predict bobwhite age–ratios and abundance between 1908 and 1997 using neural network models. We compared these predictions with data available from various bobwhite surveys in south Texas over the period 1940–1999. Means for daily maximum temperature during summer declined at rates between 1.6 and 2.3°C/century. No temporal trends were detected for seasonal precipitation (1908–1997), age ratios (1940–1999), or abundance (1977–1998). Neural models developed independently to predict bobwhite age ratios and bobwhite abundance from weather data produced predictions that were consistent with each other. Years with high age ratios tended to coincide with or precede years of high abundance.

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### Impact of Game Crops Intensification in a Mediterranean Zone in Rural Decline on Wildlife, Especially Game.

Françoise Ponce-Boutin<sup>1</sup>, Jean-François Mathon<sup>2</sup>, Tanguy Le Brun<sup>3</sup>

The French Mediterranean region was no exception to the rural abandonment, responsible for the loss of favorable habitats for red-legged partridge (*Alectoris rufa*). In order to counteract this phenomenon, a local agri-environment operation was implemented in 13 areas. The aim was to restore cultivation of abandoned vineyards for 5 years, after potential clearing. These vineyards were abandoned in the mid–1970s and had become covered by shrubby “mattoral” formations and/or succeeded to woodlands. The impact of this new management scheme was monitored in a 6–km<sup>2</sup> wine-producing area of which 1–km<sup>2</sup> were abandoned. The new management procedures were put in force on an area of ca. 0.2–km<sup>2</sup>. The opening of these lands and their sowing or maintenance was concentrated, for experimental reasons, on one half of the area. The records concerned the red-legged partridge populations (density and breeding success) and the avifauna of high patrimonial value before, during and after the operation, as well as on managed versus non-managed areas. The results show a clear increase of partridge brood size and of patrimonial avifauna richness. Hypotheses concerning causes of these changes are formulated. One can only recommend the restoring of cultivated lands in abandoned areas for these bird species.

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## Territorial Behavior of Spotted-bellied Bobwhite (*Colinus leucopogon*) Males During the Reproductive Season

Luis Sandoval<sup>1</sup>

During the reproductive season (March–October), the spotted–bellied bobwhite (*Colinus leucopogon*) are territorial and call from a perch, possibly to attract females and/or to reject other males. I studied the male territorial answer to both male and female calls during the reproductive season inside their territories. Once a week during 2005, I sampled a 25–ha plot of grassland and coffee plantation. The male's song answer rates to male song playbacks were not different when compared to control songs ( $t = -0.62$ ,  $df = 13$ ,  $P = 0.54$ ), but the song rates per minute increased in answer to female calls versus control songs ( $t = -3.54$ ,  $df = 13$ ,  $P = 0.004$ ). When I reproduced the male song, most males stayed in the same place or perched close ( $n = 10$ ), but when there was a female call, most males moved toward the recording either by flying or walking ( $n = 8$ ). These results suggest that song in territorial males is mainly to attract females and is due to the increase in song rates. The song also could be to transmit information about male morphology, thus avoiding competition among males. The observed displacement as an answer to female calls possibly stimulates the male to display for the female, and thus to be selected by her. Studies of song characteristics could permit a better understanding of the songs function and could demonstrate variance among birds.

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## Fate and Survival of Radio-marked Montezuma Quail (*Cyrtonyx montezumae*)

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Montezuma quail (*Cyrtonyx montezumae*) represent one of the least studied North American quail species, particularly in Texas. This lack of information may be partly due to their secretive nature and difficulty of capturing. We provide the first published report of fate for radiomarked Montezuma quail. We captured, radiomarked, and released 14 Montezuma quail on Elephant Mountain (marginal habitat;  $n = 9$ ) and Davis Mountain Preserve (excellent habitat;  $n = 5$ ) during 2002–2005. We used 2 methods of attachment for pendant style, neck-loop radiotransmitters. Body-loop transmitters were affixed to quail captured at the Davis Mountain Preserve whereas both body-loop and chest-loop were used at Elephant Mountain. All radio-marked Montezuma quail died within a relatively short period (1–27 days). Causes of mortality for most Montezuma quail were attributed to raptors ( $n = 9$ ), mammals ( $n = 1$ ), and miscellaneous ( $n = 4$ ). Because this low survival rate would not sustain a natural population, we suspect trapping, handling, and/or radio–marking negatively affected survival. Lying motionless is the primary behavioral defense strategy of Montezuma quail; thus, it is possible that transmitters potentially restricted escape movements or interfered with other behavior thereby making Montezuma quail more vulnerable to predation. Traditional techniques used to affix radiotransmitters or transmitter design itself need to be refined if Montezuma quail are to be studied using radiotelemetry.

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**Usable Space Versus Habitat Quality in Forest Management for Northern Bobwhites (*Colinus virginianus*)**

Ronald E. Masters<sup>1</sup>, Fred S. Guthery<sup>1</sup>, W. Russ Walsh<sup>1</sup>, Warren G. Montague<sup>2</sup>

We determined whether habitat quality (patch richness and diversity, edge density) or the quantity of usable space (suitable permanent cover) best explained the presence or absence of calling male northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) on 50-ha, circular plots ( $n = 80$ ) in the Ouachita National Forest, Arkansas, during 2000 and 2001. Information theoretic analysis of logistic regression models revealed that usable space was predictive of bobwhite occurrence, whereas habitat quality variables were not. A logistic regression model with data pooled over 2 years predicted the presence of calling males if usable space was  $>26$  ha on the 50-ha plots. Composition of patches within plots (usable space) rather than configuration of patches (e.g., amount of edge) best explained bobwhite presence. Creation of usable space on the study area involved removal of mid story and co-dominant shortleaf pine (*Pinus echinata*) and hardwoods (wildlife stand improvement) followed by February or March (late dormant-season) prescribed burns at 3-year intervals. Our results are consistent with the hypothesis that predicts bobwhite presence as a function of usable space in time versus the classical principle of edge.

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**The Influence of Habitat, Fire, and Weather on Quail Abundance at Avon Park Air Force Range, Florida**

Brett D. W. Miley<sup>1</sup>, Marian Litchler<sup>1</sup>

As northern bobwhite (*Colinus virginianus*) populations decrease across most of their range, managers must identify techniques to understand and increase local populations. Throughout their range, quail abundance has been shown to be influenced by habitat, fire, and weather. We conducted thirteen years of male breeding abundance surveys (1993–2005) at Avon Park Air Force Range, in south–central Florida. Historically, this area was an open, frequently burned landscape with a rainy summer season and a dry spring. We used point call count data ( $n = 67$  points/year) with 400-m buffer areas around each point to investigate the effects of habitat preference, fire impacts, and weather variations (rain amount, number of raindays, and Palmer modified drought index) on male breeding. Using logistic regression, we determined quail in south–central Florida prefer open canopy, dry–mesic habitats in prairie and flatwoods over pine plantations and wet areas. These analyses also revealed significant positive correlations between quail abundance and a dry spring, a wet October, and normal to above normal number of raindays in July. Within one year of a burn within a buffer area, male breeding abundance, investigated by analysis of variance increased from pre–burn levels. A significant decrease in abundance occurred from year one post–burn to year two post–burn. Burning in less optimal habitats (i.e., those dominated by dense canopy or wet habitats) did not affect quail populations. Interactions of management techniques such as the use of fire and hunting with weather should be investigated further to see if management may ameliorate weather impacts on quail abundance.

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## Habitat Use of Northern Bobwhites (*Colinus virginianus*) on a Rotationally Grazed Cattle Ranch in South Florida

James A. Martin<sup>1</sup>, William E. Palmer<sup>2</sup>, Tommy C. Hines<sup>3</sup>, John P. Carroll<sup>1</sup>

Northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) have decreased at an annual rate of 4.3% in the peninsular region of Florida over the last several decades. In this region, native prairie habitats have been converted to exotic grass pastures that are much less suitable for bobwhites and remaining native grasslands are dominated by saw palmetto (*Serenoa repens*). However, bobwhites do exist at low densities on these habitats and have potential to proliferate if management changes are made. The Carlton 2x4 Ranch is a 2300-ha ranch that produces citrus, sod, and a cow/calf operation. The primary habitat type of the ranch is improved pasture, predominately Bahia grass (*Paspalum notatum*). The grazing system used on the ranch is a type of deferment rotational grazing. Using compositional analysis, we evaluated bobwhite habitat selection at two spatial scales using radio-marked bobwhites ( $n = 64$ ) during 2004 and 2005. We used 2004 DOQQs, a geographic information system, and global positioning systems to create a land cover map of the property. Bobwhites did not establish their home range at random (2nd order: Wilkes  $\lambda = 0.198$ ;  $df = 7, 54$ ;  $P < 0.0001$ ). Bobwhites preferred fallow and unimproved pasture habitat types and avoided hardwood and improved pasture areas. Within home ranges bobwhites did not use habitats at random (3rd order: Wilkes  $\lambda = 0.44$ ,  $df = 5, 50$ ;  $P < 0.0001$ ). Managers interested in managing for bobwhites should not convert native range to pasture. Also, allowing ditch banks and fence lines to become fallow will provide more usable habitat space for bobwhites.

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## Population Response and Economic Ramifications of Habitat Management on a Working Cattle Ranch in South Florida

James A. Martin<sup>1</sup>, William E. Palmer<sup>2</sup>, Tommy C. Hines<sup>3</sup>, John P. Carroll<sup>1</sup>

Northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) have decreased at an annual rate of 4.3% in the peninsular region of Florida over the last several decades. The decline can be attributed to habitat loss and degradation. Specifically of this region, native prairie habitats have been converted to exotic grass pastures that are much less suitable for bobwhites. However, bobwhites do exist at low densities on these habitats and have potential to proliferate if management changes are made. The Carlton 2x4 Ranch is a 2300-ha ranch that produces citrus, Bahia grass sod, and a cow/calf operation. Bobwhite restoration on working ranches will depend on the economic costs and benefits resulting from a change in management. We tested if managing a small percentage (7%) of the ranch for bobwhites would result in a positive bobwhite population response. We also evaluated the economic trade-offs of bobwhite management on beef production. We identified areas of the ranch where bobwhites currently existed and used these areas as primary targets for increasing habitat area. In those areas we increased the amount of prescribed burning and roller chopping. Pasture areas were also treated with herbicide to reduce exotic forage grasses. We also manipulated mowing and grazing procedures on the ranch to benefit bobwhites. The fall covey call technique was used to measure bobwhite density in 2004 and 2005. Populations in-

creased approximately 50% from 2004 to 2005. Costs of habitat management were negligible, and no reductions in beef production were noted. The increase in bobwhite numbers cannot be completely attributed to the prescribed management, but we believe it explains much of the change. Our study was cut short because of a change of ranch ownership.

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### Habitat Use and Survival of Gray Partridge (*Perdix perdix*) Pairs in Bavaria, Germany

Wolfgang Kaiser<sup>1</sup>, Ilse Storch<sup>2</sup>, John P. Carroll<sup>3</sup>

Gray partridge (*Perdix perdix*) habitat studies have been undertaken in a number of countries but have generally focused on winter survival or brood rearing. We monitored survival of gray partridge pairs relative to habitat during the breeding season. Our study area was located near Feuchtwangen in north-west Bavaria, Germany. During 1991 to 1994, we used data from 38 radio-tagged partridge pairs with compositional analysis to assess the relationship between habitat, survival (died or survived breeding season), and time (year). Comparing habitat within the study area to habitats within pair home ranges, we found overall habitat use was non-random and no effect of time. However, we identified a significant effect of habitat on survival status. Plowed fields, winter cereals, and edge habitats ranked high for both survival categories, whereas those pairs where the radio-tagged bird died were associated with meadow habitat. Comparing home ranges to individual radio locations, only surviving partridges used habitat differently from that available. Meadows ranked high for both groups, but surviving pairs utilized more edge and set aside habitat with non-surviving pairs utilizing more stubble and winter cereals. Our results suggest differences between habitats of partridges which died versus those that survived during breeding season. At the landscape level, the association of non-surviving pairs with meadow habitat suggests that it may provide cover but may also support predators. Within home ranges, we identified edge and set aside habitats as possibly providing more cover diversity, suggesting these habitats allowed greater predation avoidance for surviving pairs. Our data suggest that the breeding season may represent a critical period in the gray partridge life-cycle given its impact on the number of surviving adults and the effects of this parameter on recruitment.

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### An Evaluation of Short-term Mesocarnivore Control for Increasing Hatch Rate in Northern Bobwhite (*Colinus virginianus*)

Eddie K. Lyons<sup>1</sup>, Dale Rollins<sup>2</sup>, Jason B. Frost<sup>3</sup>, Benjamin D. Taylor<sup>2</sup>, Cody B. Scott<sup>3</sup>

We evaluated the efficacy of short-term, meso-carnivore control on predator abundance and survival of simulated nests of northern bobwhite (*Colinus virginianus*) at 4 sites in west Texas (Coke, Coleman, Parker, and Tom Green counties). We conducted predator trapping using cage traps (i.e., live-traps) for 30 days prior to nest-initiation (mid-May through mid-June) at a trap

density of 1 trap per 20 ha. Each site included a treatment (trapped) and control (non-trapped) area that comprised approximately 250 ha. We used scent stations to index predator abundance before and after trapping. We simulated northern bobwhite nests (using 3 chicken eggs) immediately following trapping, and monitored them weekly to estimate hatching rate. Despite removing 274 meso-mammals (across all sites) during the 30-day trapping period, there was no difference observed in: a) scent station visitation rates before/after trapping or b) simulated hatching rate. Contrary to our hypothesis, the proportion of nests intact at 28 days was lower on trapped sites. Trapping results may have been confounded as nest site availability was greater on non-trapped areas. However, we observed no significant relationship (linear or curvilinear) between nest survival and number of suitable nest sites. Logistic regression analysis suggested no threshold of available nest sites established at which 50% of nests survived. We concluded that trapping intensity and duration as used during this study was insufficient to permit short-term suppression of mammalian predators or increase nesting success of northern bobwhites. Thus, the efficacy of trapping to increase nest success among fragmented landscapes likely depends on the scale and/or duration of removal efforts.

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### **Economic Evaluation of Northern Bobwhite Quail (*Colinus virginianus*) Management in Southern Pine Plantations**

James A. Martin<sup>1</sup>, Bruce D. Borders<sup>1</sup>

Northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) populations have declined precipitously in recent decades. The decline can be attributed to large-scale habitat loss from agricultural intensification, forestation of grassland habitats, and development. In the Southeast, much of what was once usable bobwhite habitat is now closed-canopy pine plantation. Typical plantation pine stands have basal areas >80-ft<sup>2</sup>/acre which is detrimental to bobwhites. A large percentage of this acreage was established under the Conservation Reserve Program that promoted pine plantation establishment in the 1980s and 90s. Ironically, much of this was established for the purpose of wildlife habitat but has been mostly detrimental to early successional species such as bobwhites. Currently these pine stands are at the age that thinning could become an economically viable option. Trade-offs exist when the objectives of management include a commodity and a natural resource. However, opportunities do exist to manage profitably for timber and bobwhites under certain management regimes. The purpose of this study was to evaluate how bobwhite management may affect the internal rate of return (IRR) of existing pine plantations. We also examined how bare land values (BLV) are affected by bobwhite management from initial planting of new stands. A stand managed using traditional timber management options had a BLV = \$695/acre and IRR of 11.8%. A quail type regime, thinned three times to a residual BA of 40-ft<sup>2</sup>/acre, had a BLV = \$508/acre and an IRR of 10.4%. Landowners must be aware of the costs and benefits of integrating bobwhite management into their timber management.

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**The Texas Quail Index: A Citizen-Science Effort to Monitor Ranch-Level Quail Dynamics**

Kelly Reyna<sup>1</sup>, Dale Rollins<sup>2</sup>, Benjamin D. Taylor<sup>3</sup>, Dean A. Ransom, Jr.<sup>4</sup>, Kenneth A. Cearley<sup>5</sup>

Throughout its range, northern bobwhite (*Colinus virginianus*) are a product of private land management, hence the need to educate landowners on implementing and evaluating appropriate management practices. An underpinning of Extension education is based on the Chinese proverb: “Tell me, and I forget. Show me, and I remember. Involve me, and I understand.” We initiated a citizen-science effort to train landowners and county Extension agents to monitor quail populations and related habitat dynamics (e.g., nesting habitat) over a 5-year period (2002–2006). Cooperators received training in quail population estimation (e.g., spring cock call counts, fall covey call counts), assessment of pertinent habitat parameters (e.g., nesting habitat and hatch rates using simulated nests), and related variables (e.g., predator index via scent stations). Our goal is to develop a model using these parameters to describe variation in 2 measures of abundance: flush rates during hunting season and percent hatch-year birds in the hunter’s bag. Preliminary analyses indicate that spring call counts account for about 40% of the variation observed in fall covey call counts. Although as many as 65 sites have been involved at some point during the study, attrition among cooperators has been high (>65%) primarily because of the time commitment involved (≥60 hours annually). This summer (2006) marks the final year of the effort. Pending analyses will examine relationships among the various counts, and also compute a “survival rate” for cooperators to identify characteristics that promote completion of such volunteer efforts.

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**Relative Abundance of Invertebrate Taxa in the Diet of Northern Bobwhite (*Colinus virginianus*) Chicks on Different Landscapes in Georgia.**

David A. Butler<sup>1</sup>, William E. Palmer<sup>2</sup>, Steve J. Moreby<sup>1</sup>

Invertebrates are an important food source for gamebird chicks. However, only a few studies have examined the invertebrate component in the diet of wild northern bobwhite (*Colinus virginianus*) chicks. Detailed analysis of the invertebrate diet of chicks will allow habitat prescriptions to be formulated to the specific requirements of chick–food invertebrate groups in different landscapes across the range of the northern bobwhite. Using fecal samples collected from nocturnal–roost sites, the invertebrate diet of northern bobwhite broods on farmland ( $n = 19$ ) and on a hunting plantation ( $n = 22$ ) in Georgia during 2002 and 2003 was reconstructed and compared. The same invertebrate taxa were found in the diet of broods on farmland and on the plantation, with the orders, Coleoptera, Hemiptera and Hymenoptera accounting for approximately 80% of the invertebrate diet on both sites. Within each of the orders Hemiptera and Coleoptera, the relative abundance of the invertebrate groups differed between sites. The invertebrate composition in the diet of broods aged 1–7 days and 8–14 days did not differ on either site. Differences in the diet of chicks on the two landscapes may indicate differences in chick–food invertebrate availability, which could have implications for chick survival.

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## Northern Bobwhite (*Colinus virginianus*) and Scaled Quail (*Callipepla squamata*) Response to Environmental Quality Incentives Program (EQIP) Practices in the Shortgrass Prairie Bird Conservation Region

Eric D. Abercrombie<sup>1</sup>, C. Brad Dabbert<sup>1</sup>

The Northern Bobwhite Conservation Initiative seeks to reverse northern bobwhite (*Colinus virginianus*) declines. The goal for the Texas portion of the Shortgrass Prairie Bird Conservation Region (TBCR 18) is to add 18,933 new coveys. Rangeland provides the most potential for adding usable habitat for quail in TBCR 18. However, brush encroachment and overgrazing have caused much of the rangeland to be unusable. The Environmental Quality Incentives Program (EQIP) offers incentives for prescribed grazing, brush management, and prescribed burning. The potential benefits of EQIP projects for northern bobwhite in TBCR 18 have not been evaluated. As scaled quail (*Callipepla squamata*) are sympatric with northern bobwhite in many of these areas, it is probable that their populations may also benefit. Our objective is to examine quail population responses to brush management and grazing deferment in TBCR 18. Our study is being conducted on 8 separate study sites within 4 counties in Texas. Of the 8 study sites, 5 are being treated with brush management and 3 are being treated with grazing deferment. We estimated quail abundance on each study site using call counts and mark-recapture methods between April 2005 and February 2006. After one season of evaluating populations, we have not detected any differences ( $P > 0.22$ ) between treated and control sites. These results are intuitive when you consider the relatively short time for population response since treatment application. Further analysis over the next 2 years should provide more evidence concerning the effects of brush management and/or deferred grazing on quail abundance in TBCR 18.

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## A Predictive Habitat Model for Northern Bobwhite (*Colinus virginianus*) in New Jersey

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The attributes of optimal northern bobwhite (*Colinus virginianus*) habitat in New Jersey are unknown. GIS-based models have become an important tool to predict locations of the most suitable habitat for a species, as well as to better understand the factors involved in a species distribution. In order to inform a newly established habitat program, we developed a predictive habitat model to relate northern bobwhite occurrence to habitat characteristics. We compared the habitat characteristics of used and unused northern bobwhite locations collected from road transect whistle counts (late May and early June, 1994–2003) using logistic regression and Akaike's Information Criteria for final model selection. The habitat attributes we evaluated included road density and vegetative composition, fragmentation, and interspersed. The final model predicts that northern bobwhite select areas with greater than 10% grassland, where grassland is highly interspersed (>60%) with barren, shrubby, and forested areas, and avoid areas with a large forest core, a high percentage of forested wetlands, and with any urban areas. Using an optimal cut-off value, the final model correctly classified 66% of used locations and 72% of unused locations. The model suggests that the extent and spatial distribution of areas predicted to be selected by northern bobwhite in New Jersey comprise adequate habitat to support a viable population. The significant habitat attributes can be used to guide habitat management decisions as New Jersey

embarks on its new northern bobwhite habitat program.

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### **Integrating Prescribed Burning and Insecticide to Reduce Fire Ant Impacts on Northern Bobwhite (*Colinus virginianus*) Chicks**

Amy A. Johnson<sup>1</sup>, C. Brad Dabbert<sup>2</sup>, Robert B. Mitchell<sup>3</sup>, Harlan G. Thorvilson<sup>4</sup>

The red imported fire ant (*Solenopsis invicta*; RIFA) has damaged wildlife populations in Texas since its infestation. Observational and experimental evidence has shown that hatching northern bobwhite (*Colinus virginianus*) chicks experience a low survival rate when exposed to a significant number of foraging RIFA. We initiated a study in southeastern Texas to determine if a reduced amount of insecticide and/or prescribed burning could decrease the foraging activity of RIFA below the threshold that causes mortality of northern bobwhite chicks. Research sites located in Calhoun, Goliad, and Victoria Counties of the Texas Coastal Plain, were divided into burned and nonburned plots. These plots were again divided into 4 subplots which randomly received one of 4 rates of Amdro® insecticide treatment. This design yielded 64 subplots in 2002 and 48 subplots in 2003. Bait cup sampling of RIFA was conducted and differences in RIFA foraging activity were analyzed among treatments. Foraging activity was responsive to Amdro® insecticide treatments. As the rate of Amdro® applied increased, RIFA foraging activity declined. Data from 2002 and 2003 revealed a reduction in the mean number of foraging RIFA in insecticide treated plots versus control plots ( $P < 0.05$ ) when testing for the main effect of insecticide treatment. In both years, the mean number of foraging RIFA collected in bait cups in burned plots was not different from nonburned plots ( $P > 0.05$ ). Our results suggest that using a reduced amount of the recommended rate of Amdro® insecticide is sufficiently effective to reduce RIFA foraging activity. Using a reduced rate of insecticide has a cost benefit for landowners treating for RIFA, but additional economic analysis of RIFA control is needed.

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### **Use of Recently Established Longleaf Pine Conservation Priority Area Stands by Northern Bobwhites (*Colinus virginianus*) in South Georgia, USA**

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In 1998, a National Longleaf Pine Conservation Priority Area (CPA) was established for the Conservation Reserve Program under the Conservation Title of the 1996 Farm Bill. The goal of this CPA was to provide additional incentives for restoring the longleaf pine (*Pinus palustris*) ecosystem. The rules incorporated into this practice (CP3a) have the potential to create habitat that will benefit northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) and other birds associated with shrub-scrub habitats. We monitored bobwhite and songbird use of 40 recently established

CP3a longleaf stands in 5 counties on the Upper Coastal Plain of Georgia using point and line-transect sampling. Most stands were 2–3 years old during the study and tree height <60–cm. Ground vegetation was dominated by exotic grasses and other agricultural pest species. Few plant species important for quail were present. We found low numbers of bobwhites and presence-absence sampling revealed an estimated occupancy rate of about 99% using point sampling, but only 50% using line transect sampling. Analysis of covariates suggested that crop history affected quail use, but field size and incorporation of Georgia DNR BQI management practices did not. We believe that ground vegetation management may be necessary to accrue full benefits of this initiative.

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### **Nest Characteristics of Montezuma Quail (*Cyrtonyx montezumae montezumae*) in Central Mexico**

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The purpose of this study was to describe the nest characteristics of the Montezuma quail (*Cyrtonyx montezumae montezumae*) in Mexico. We searched for Montezuma quail nests during May–September 2003 in oak and pine-oak woodlands as well as grasslands of 8 municipalities in the northwestern region of the State of Mexico. We traveled 66 routes (3–5 km x 40-m) distributed among 17 sites. We characterized the nesting places according to the vegetation community where they were found, and georeferenced their locations (UTM) and altitude (m above sea level). We measured nest diameter, height, depth and thickness. We also recorded the form of the nest, building material, entrance orientation, and presence of shells or chicks in the nest. We found 6 nests; a total 21 eggs were collected from 2 nests and 15 hatchlings from 1 nest. We found that grasslands are the predominant vegetation community used by this species for nesting at 2,500–2,700 m altitude.

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### **Comparison of Demographics, Movements, and Habitat use of Pre–season Released Northern Bobwhites (*Colinus virginianus*) and Wild Northern Bobwhites on Groton Plantation, South Carolina**

Brad S. Mueller<sup>1</sup>, Derek Eggart<sup>2</sup>, Shane D. Wellendorf<sup>3</sup>, D. Lamar Robinette<sup>2</sup>

The pre–season release of pen-raised northern bobwhites (*Colinus virginianus*; hereafter, bobwhite) for harvest has become a common management practice in the Southeast US. However, research is limited on the effects of pre–season release bobwhites on native bobwhite population demographics and movements. On Groton Plantation, Allendale County, South Carolina, we selected two geographically isolated areas; one area had only wild bobwhites and the other area had wild bobwhites and also pen–raised bobwhites released each year in September. We radio–tagged wild ( $n = 306$ ) and pen–raised ( $n = 330$ ) bobwhites and monitored demographics and habitat use during 1996–1998. Winter survival for wild bobwhites on the control site



was higher (51%) than for wild bobwhites on the pre-season release site (26%). Pre-season release bobwhites had the lowest winter survival (10%). Per capita nest production for wild bobwhites was 1.1 nests/hen, which was similar to nest production by pen-raised bobwhites (0.9 nests/hen). However, per capita brood production for hens was lower for pen-raised bobwhites (0.32 broods/hen) than for wild bobwhites (0.49 broods/hen). On the pre-season release site, wild bobwhite harvest per hunt decreased from 1.9 bobwhites in 1996 to 0.9 bobwhites in 1998. We observed that pen-raised bobwhites increased winter mortality risk for wild bobwhites through higher hunting mortality. This reduction in the pre-breeding season population decreased summer population gains for wild bobwhites, even though productivity output was similar for wild bobwhites on both sites. The negative impacts of a pre-season release program on wild bobwhites should be considered before initiating release programs.

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### **The Shepherd Project: A Case Study of Private Management for Ring-necked Pheasants (*Phasianus colchicus*) in Montana**

Bruce Kania<sup>1</sup>, Frank Stewart<sup>2</sup>

The Shepherd research farm is headquarters for Floating Island International, a company that produces floating wetlands for water quality and wildlife enhancement. Primary goals for the 100-ha farm include an exploration of how agriculture can be more integrated with wildlife to achieve a more sustainable landscape. One of the measures of this transition is ring-necked pheasant (*Phasianus colchicus*) abundance. During 1998 to 2006, 3 areas of development have been undertaken: changes in farming methods, habitat development, and predator control. The main change in farming has been a reduction of irrigated annual and pasture from 73% of the land area to 13%. Major crops are more diversified and include corn, sorghum-sudan grass, barley, Maximilian sunflower, and alfalfa. Other habitat management changes include delayed mowing and incomplete harvest. During 7 years, the main predators removed were raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), feral house cat (*Felis domesticus*), red fox (*Vulpes vulpes*), and coyote (*Canis latrans*). Estimates of pheasant abundance were made during the hunting season, when male only harvest was halted and hens were >75% birds observed. Harvest using this method increased from 14 in 1998 to 207 in 2005. We believe this integrated approach, with its use of less intense agricultural methods, creates a diversified landscape that is beneficial to pheasants and enhances wildlife habitat for a variety of other species.

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### **Genetic Investigation of Northern Bobwhite (*Colinus virginianus*) Populations in Tennessee**

Nikki Panter<sup>1</sup>

Despite the extensive research on the biology of northern bobwhite (*Colinus virginianus*), abundance of the species has been on a decline for several decades. This study focused on possible loss of genetic diversity resulting from habitat fragmentation and introduction of pen-raised birds.

Two microsatellite loci were used to examine six wild and two pen-raised populations of northern bobwhite in Tennessee. Objectives were to use microsatellites to compare heterozygosities of and genetic differentiation among the study populations. Observed heterozygosities were less than or equal to expected heterozygosities for all populations at both loci except for the Wolf River Wildlife Management Area (WMA) population at Quail14. Quail13 had an average of 14.75 alleles across all populations, and Quail14 had an average of 4.0. Inbreeding was indicated for all populations and loci except for East Tennessee and Cordell Hull WMA populations at Quail13 and the Pen Raised A population at Quail14. Isolation of studied populations was inferred except for the Cordell Hull/East Tennessee and Wolf River/Arnold Air Force Base populations. Allelic and genotypic distribution comparisons revealed differences between populations except for the Fort Campbell/East Tennessee and Wolf River/Arnold Air Force Base pairs. While pen-raised and wild populations exhibited different allelic distributions, there were similar numbers of alleles and heterozygosities. Methods to improve northern bobwhite habitat and abundance must take into account the genetic composition of populations of concern. When determining harvest limits, habitat improvements, translocations, and release of pen-raised birds, managers should be aware of genetic consequences of these actions.

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### **Evaluation of the Subsistence Hunting on Some Natural Populations of *Crax alberti* (Cracidae), in the Northern Colombian Andes.**

Jose M. Ochoa<sup>1</sup>, Isabel Melo<sup>1</sup>, Hugo F. Lopez<sup>2</sup>, Patricia Velásquez<sup>1</sup>

The blue-billed curassow, (*Crax alberti*), an endemic Colombian bird, is critically endangered at a global level due to the hunting and the deforestation. However, nobody had ever quantified the hunting effect on its natural population. During 2003 and 2004, we evaluated the subsistence hunting in three places of the north Colombian Andes. We used a structured opinion poll directed to local hunters. The hunters recognized a total of 44 mammals species and 98 birds species as game animals. *Crax alberti* was placed twelfth from 80 species hunted from 2002 to 2003, and it was hunted mainly to be consumed and to be maintained in captivity. Fifty-seven individuals of this species were hunted. The site with the biggest forest patches had the highest extraction rate: 2.3 individuals/hunter/year. The other two sites had an extraction rate of 0.7 individuals/hunter/year, and 0.1 individuals/hunter/year. In the site with highest extraction rate, the hunters considered that the species was not endangered, but in the other two sites, which had smaller forests, the hunters believed that the populations had diminished the last two years. Most of the hunting events were concentrated in the breeding season. In this time the males are booming and consequently they are more easily observed. We concluded that the species is high endangered at local level. The hunting and forest loss can be causing synergetic effects on the populations.

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**The Ecology and Behaviour of Released Captive-reared Gray Partridges (*Perdix perdix*) - a Joint D.Phil. Project Between the Wildlife Conservation Research Unit, Oxford University and The Game Conservancy Trust**

Elina Rantanen<sup>1</sup>, Stephen J. Browne<sup>2</sup>, Philip Riordan<sup>1</sup>, David W. Macdonald<sup>1</sup>

The aim of this research project is to study the settlement, survival, reproduction and anti-predator behavior of released captive-reared gray partridges (*Perdix perdix*) on sympathetically managed farmland. The project will investigate the effectiveness and feasibility of partridge releases for increasing gray partridge numbers in the U.K. and thus contributing to achieve the U.K. Biodiversity Action Plan targets for this species. Using The Game Conservancy Trusts release methods, gray partridge pairs, coveys or broods will be released on selected study farms where appropriate management has been undertaken to increase and maintain good nesting and brood-rearing habitat. Released birds will be intensively monitored in order to collect detailed information on their movements, dispersal and habitat use as well as reproductive and anti-predator behavior. The studies will be conducted between 2006-2008 in Oxfordshire and Gloucestershire, in the South and West of England. This project presents an opportunity to investigate possible causes of reduced survival rate and breeding success previously detected in released captive-reared gray partridges. Gray partridge release studies of this kind have not been previously conducted in such detail, and we anticipate obtaining valuable knowledge on the process of releasing captive-reared gray partridges. We are hopeful that the results of this study will contribute significantly to improving guidelines for future gray partridge reintroductions and conservation. This poster will provide an overview of the study and will include some preliminary results from the first releases in April 2006.

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**Integrating Northern Bobwhite (*Colinus virginianus*) and Grassland Bird Habitat Enhancement Practices on University of Missouri Agriculture Experiment Stations: An Educational Model That Puts Knowledge Into Action Through Use of Demonstrations**

Tim Reinbott<sup>1</sup>, Robert A. Pierce, II<sup>2</sup>, Bill White<sup>3</sup>, Brad Jacobs<sup>3</sup>, Nadia Navarette-Tindall<sup>1</sup>

Over the past fifty years, advances in agricultural production negatively influenced habitats for northern bobwhites (*Colinus virginianus*) and grassland bird species. Farming systems, once beneficial for northern bobwhite, greater prairie-chicken (*Tympanuchus cupido*), Henslows sparrow (*Ammodramus henslowii*), eastern meadowlarks (*Sturnella magna*), and many other wildlife species, provided a diversity of early successional habitats. With increases in farm size, intensive tillage and weed control, and more efficient harvest practices, many producers have been able to stay in business, but early successional habitats have been reduced. The Bradford Research and Extension Center (BREC) at the University of Missouri has led the way in agronomic research and Extension. During 2005, the BREC expanded its mission to address the educational needs of the whole agricultural community, which includes implementing demonstrations and management that enhances wildlife habitat while complementing the agronomic objectives of the farm. Wildlife populations are dependent on the management decisions made by private landowners. Most farms contain areas that can be managed for wildlife species dependent on early successional plant communities. Recently at BREC, wildlife habitat management demonstrations have

been developed and successfully integrated with ongoing agricultural objectives without reducing farm profits. Examples include native prairie restoration, native warm season grass management, covey headquarters establishment, fence row management, and tall fescue pasture renovation. In addition, landowners of adjacent properties are implementing practices that benefit northern bobwhite. We report results of this program and showcase how this educational approach can serve as a model for integrating wildlife considerations with ongoing agricultural objectives at other Agricultural Experiment Stations.

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### Herbaceous Buffers and Corn and Soybean Production: Farmer Attitudes and Benefits Accrued

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Progress toward northern bobwhite (*Colinus virginianus*) conservation is heavily dependent on row crop farmers' willingness to adopt buffer programs. Farmer decisions to enroll in buffer programs are heavily dependent on economic factors and farmers' perception of threats by pests. To shed light on these issues, we studied pests and crop yield in corn and soybean fields with, and without buffers, in central Missouri during 2000–2002. We surveyed 750 Missouri landowners in 2005 for willingness to adopt buffers. In the field study, buffers were 9–m wide and planted to three different mixtures: 1) tall fescue (*Festuca arundinacea*); 2) cool–season mixture, including orchard grass (*Dactylis glomerata*), timothy (*Phleum pratense*) and red clover (*Trifolium pratense*); and 3) warm–season mixture, including little bluestem (*Andropogon scoparius*), side oats gramma (*Bouteloua curtipendula*) and lespedeza (*Lespedeza stipulacea*). Field areas used as controls had the 9–m buffer area planted to corn or soybeans. Crop yield was measured 3, 9, 12, 18, and 27 m into the field. Corn and soybean yields sampled at 3 meters into the field were significantly less ( $\alpha = 0.05$ ) than yield from all other distances. Among treatments, there were no significant differences in corn or soybean yields when years were combined. The warm–season buffer significantly reduced infestation of European corn borer in adjacent corn fields. Landowner willingness to replace margins of cropland with grass buffers was low, with 39% indicating they were very or somewhat likely to adopt this practice. We discuss these results in the context of steps that need to be taken to increase adoption of cropland buffer programs.

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### Assessing Measures of Northern Bobwhite (*Colinus virginianus*) Productivity

Susan N. Ellis-Felege<sup>1</sup>, William E. Palmer<sup>2</sup>, Loren W. Burger, Jr.<sup>3</sup>, John P. Carroll<sup>1</sup>

Radio–telemetry studies evaluating northern bobwhite (*Colinus virginianus*; hereafter, bobwhite) populations often report reproductive parameters. However, inconsistencies in reporting these parameters across studies limit their value for understanding population dynamics or comparing bobwhite population dynamics among ecosystems. Because individual parameters are

not independent, they can be misleading if used to estimate productivity and recruitment. We reviewed 13 published studies that reported reproductive parameters based on radio-telemetry samples. Most studies (84.6%) reported nest success, nesting effort, hatchability, and clutch size. Nest success using the “>1 egg hatched” definition was the most common reproductive parameter reported (92.3%). However, this has not been found to be a reliable measure of chick production. Few studies reported breeding season survival, an important parameter for understanding chick production. Few attempted to incorporate alternative reproductive strategies, such as male incubation and double-brooding, when assessing bobwhite population productivity. We compare population productivity measures using telemetry data from 10 years of research and demonstrate how individual parameters co-vary and can be misleading. We also demonstrate how, during some years, male incubation can increase population productivity significantly, and therefore cannot be ignored. Finally, we demonstrate how fall age ratio data are often unreliable measures of chick production. We recommend reporting bobwhite productivity using a per capita chick production which links reproductive parameters and survival. Consistency in reporting information on reproductive parameters and recruitment will improve our understanding of bobwhite reproductive strategies.

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### Use of Supplemental Feed by Northern Bobwhite (*Colinus virginianus*) in the Red Hills Region of Georgia and Florida

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Supplemental feeding of northern bobwhites (*Colinus virginianus*; hereafter bobwhite) is a common management practice in the southeastern U.S.A. However, little is known about the frequency or amount of consumption of feed. We examined crop contents from 160 bobwhites collected in January and February of 2002 and 2003 from Tall Timbers Research Station, Tallahassee, FL, and Pebble Hill Plantation, Thomasville, GA. Milo was spread on part of the study area along forest roads throughout the winter. Eighty birds were collected from areas receiving regular supplemental feed, and 80 were collected from areas receiving no feed. Both groups used a diversity of mast species including seeds of milo, partridge pea (*Chamaecrista* spp.), oaks (*Quercus* spp.), pine (*Pinus* spp.), and milk pea (*Galactia volubilis*). Bobwhites collected in unfed areas had a mean crop content weight of  $2.09 \pm 0.37$  g, whereas birds collected in fed areas had a weight  $2.86 \pm 0.55$  g. Natural mast abundance was low in 2002 and high in 2003. We found that bobwhite crop contents from unfed birds averaged  $1.75 \pm 0.53$  g and  $2.27 \pm 0.48$  g in 2002 and 2003, respectively, whereas, mean crop weight on fed sites was  $2.86 \pm 0.78$  g during both years. Furthermore, milo made up 61.82% of all seeds taken from fed quail, whereas it only accounted for 7.13% of the seeds from unfed birds. These results suggested that supplemental feed affected the composition of the diet in all years, but likely provides more food resources in years when natural foods are scarce.

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