Part Three of a Trilogy

Predation and Bobwhites:

New Ground Effect and Implications for Management

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In the first two articles we introduced some predation theory as it relates to bobwhite quail and described how seminal research by several influential scientists has influenced biological perceptions about the role of predation in bobwhite population dynamics. We introduced the concept of "predator context" and discussed the importance of understanding how this context may influence local quail demographics and therefore populations. We lamented on the fact that research on bobwhite and predators lags behind other game birds and how this information void has helped produce two generally polar views on predation management. We introduced the QU-SEQSG project and presented some preliminary findings that suggest a relationship between per capita productivity and predator context. Finally, we suggest that on some areas, even with good habitat, some form of integrated predation management may be needed to maintain huntable quail populations. In this article, we update our progress on the QU-SEQSG project (see side bar - to fully understand the relevance of the sidebar, you may want to review article two in this series) and present some potential ramifications of our ideas for quail management.

The "New Ground Effect"

Back in the 70's when corporations began "investing" in eastern North Carolina, they punched 20,000 acre openings in wetland forests called pocosin and became farm owners. To create farmland, they drained the wetlands with an impressive series of ditches and canals, cut the timber, pushed up stumps and tops in windrows, burned them, and began planting corn, wheat and soybeans along ditches and windrows, all several feet below the water table! If you were a bird hunter you were smiling more often than not in the years that followed this disturbance. Local hunters tell of 30 covey days, not bothering to mess with singles, and starting from the hip - if you know what we mean. Dr. Phil Doerr at North Carolina State took the time to measure this population that eventually declined along with the windrows. To this day, however, these farms have some of the highest quail densities in the state.

Many biologists refer to this phenomena as "new ground effect." This term refers to the quick population response of game birds to creation of early-successional habitat, followed by a slow decline in populations to a sustainable "carrying-capacity" level. Many bird hunters are familiar with this phenomenon when quail populations respond to clear-cutting. The puzzling part is that the new ground effect occurs on managed lands as well. That is, creation of new habitat results in a unsustainable rise in quail numbers even with an active and ongoing management regime of burning, discing, etc. Something happens to allow for larger quail populations immediately after the creation of new habitat that is difficult to maintain over time, even with active management. The puzzle is what causes the population to "explode" to a peak, followed by a slow decline to a respectable levels, above the pre-disturbance level, but below the peak levels achieved within a few years following the disturbance. The obvious answer is habitat change, perhaps subtle, that result in a lower "quality" of habitat. On those North Carolina farms, the loss of brushy windrows is an example of habitat change. However, on managed lands maintained by burning, discing, and timbering, habitat change alone is an unsatisfying explanation. An idea growing in favor is something we alluded to in article one of this series. It is the idea that if the scale of habitat change is great enough, then we are not only increasing habitat space for bobwhite, but also reducing habitat space of generalist predators that may negatively impact growth of bobwhite populations. This means that our best population responses to habitat management come from large-scale, intensive habitat change, just the type of disturbance an early-successional species like bobwhite thrives on. This makes perfect sense given that bobwhite are an early successional species with numerous adaptations (high reproductive potential, flexible mating system, precocial young, reasonable dispersal capabilities) that equip them to

Radio-tagged hens provide critical demographic data.

rapidly respond to catastrophic disturbance events (fire, hurricane, tornado, etc.) that create large scale patches of early successional habitat. Thus large scale, intensive habitat management regimes mimic large-scale, catastrophic natural disturbance processes.

The "new ground effect", or rapid population response resulting in a population peak followed by a slow decline to a new population plateau, may be a result of differences in the temporal scale at which bobwhite and their predators respond to habitat changes. Bobwhite, given their previously referenced adaptations, immediately respond to the creation of early successional plant communities. Most of the important predators of bobwhite nests (snakes, raccoons, skunks, armadillos) and adults (foxes, feral cats, bobcats, Cooper's hawks, great-horned owls) are generalist predators for whom bobwhite constitute a relatively minor component of their diet. Populations of these important predators may respond (numerical increase) to an increasing overall prey base (e.g., small mammals, rabbits, fruits, insects) in response to the creation of early successional habitats, however, because of the lower reproductive potential (relative to quail) of these predators, there is a lag time of two to three years in growth of quail populations and growth of predator populations. During this lag period, bobwhite populations are essentially "released" from the population depressing effects of predation. For a short period, the rate of growth in the quail population outpaces the rate of growth in the predator population. A quail population during this "window of opportunity" should exhibit unusually high nest success, chick survival, and adult survival, contributing to the population growth. When predator populations "catch up" nest success, chick survival, and adult survival should decline, contributing to a slowing in the rate of growth, or a population decline.

In contrast to large-scale, intensive habitat alteration, the opposite habitat management approach is what we might call "piddling." That is, making small scale, relatively minor changes to the habitat on an area that result in relatively minor or no population response. The scale of habitat creation is sufficient to provide a little more nesting, brood-rearing, or foraging habitat, but not enough to fundamentally alter the balance between predator and prey populations. Local quail populations are not effectively released from depressing effects of the extant predation regime.

This idea has an important bearing on the appropriate scale and intensity of habitat management. Following are a few examples that we hope will help to make clear the application of the concept. The first and most important is that habitat management should be designed to simultaneously increase usable space for bobwhite and reduce the predator context thereby reducing the impact of the predators on quail and allowing bobwhite populations to achieve their biological potential.

Avian Predation and Habitat Solutions

Overwinter mortality determines the size of the spring breeding population and is one of the most important parameters influencing rate of population growth. Working in Illinois, John Roseberry suggested that overwinter mortality consistently exceeding 70% would exceed the reproductive potential of bobwhite and contribute to declining populations. Population modeling using parameter estimates from southeastern and midwestern quail populations demonstrates that a relatively minor change in overwinter mortality (5%) can have a substantial impact on rate of population growth. Researchers in the Southeast have observed that many quail populations in this region (TN, NC, MS, GA) exhibit extremely low over-winter survival. We have observed such excessive mortality that no physiologically-possible level of reproduction can result in a population increase or stave off a decrease. Much of this mortality is from avian predation and tends to peak during late fall and

Update on Predator and Habitat Project

In part two of the Predation and Bobwhite series, we described the cooperative research project undertaken by Quail Unlimited and members of the Southeast Quail Study Group. Our goal was to establish if predator abundance was related to key demographic variables of quail populations, such as nesting success, survival, nest productivity.

To accomplish this study, we monitor bobwhite survival and reproduction using radio-telemetry on areas of above average habitat (relative to the Southeast). At appropriate times, relative abundance of predators is measured using a series of scent stations for mid-sized mammalian predators. A "scent station" is a circle of sand, 1 meter in diameter, with a special scent tablet placed in the center. The odor from the tablet attracts nest predators from the local vicinity to the sand ring, at which they leave a foot print signifying their presence. The proportion of scent stations visited by nest predators provides an index to the relative abundance of mammalian nest predators among the study areas.

These figures should look familiar to those presented in Article 2, however, an additional years data has been added to these graphs. Figure 1 shows the relationship found between relative abundance of mammalian predators and the number of hatched nests produced per hen over the entire breeding season. Figure 2 demonstrates the relationship between the quail densities on our study areas and predator abundance. The x-axis on both graphs is a measure of scent station visitations by known nest predators, including racoon, armadillo, skunk, fox, opossum and bobcat.

As in 1999, the data collected in 2000 illustrate that hatching of nests by hens and total population productivity were negatively related to predator abundance even in areas of good to excellent habitat. Also included this year are estimates of population density in relation to predator abundance. There was some year to year variation, which is to be expected. However, after two years of data, when our scent station index rises above 0.20, productivity is relatively low. These data support our ideas that the predator context varies across time and space, with apparent ramifications for quail production. While these findings are interesting, they are only a beginning to unraveling the mysteries of predation as a process. It is worth noting that these findings are yet preliminary and simply represent the first step in the scientific process. Recall that earlier we said observing and characterizing a phenomenon or process is the first step in the scientific method. Furthermore, our results may change after the additional years of data. No single

Update on Predator and Habitat Project (Continued)

research project can answer all questions and this one is no different in that it has strengths and weaknesses. As more years of data are collected, we will be able to investigate many of the ideas expressed in article 2. However, thanks to the funding from quail enthusiasts and Quail Unlimited, this research has already opened the eyes of those entrenched in the "predation has no effect" paradigm and has helped in garnering additional funding for more detailed research.

late spring, during peak raptor migrations. However, given that movement data on Cooper's hawks shows a "here today gone tomorrow" pattern, the only reasonable solution is to modify the habitat to tip the balance to quail and away from hawks and owls. The objective is to make the structure of the vegetation and landscape more suitable for quail and less suitable for their predators. This is relatively easy to do. It involves opening planted pines, reducing the hardwood component in pine forests, and opening hedgerows. These habitat changes allow herbaceous ground cover to grow providing visual screening for ground foraging bobwhite. Furthermore, since Cooper's hawks are stealth predators that make short, quick strikes from the relative safety of dense tree canopies, these management practices reduce the foraging space for hawks. Unfortunately, throughout the Southeast, closed canopy forests predominate the landscape so quail are forced to the edges and sit on the edge of disaster within easy striking range of aerial predators. Therefore, this is an example of how there are habitat solutions to some predator issues and that fits nicely within an Integrated Predation Management approach.

Taking Managed Lands to a New Level

New ground effect even occurs on managed plantations in the Red Hills region. A case study of landscape modification by hardwood "clean-up" has been conducted by the Albany Quail Project over the last eight years. A continuous sample of radio-tagged birds has been monitored on a 1000-acre study area. Quail habitat management on this areas has always focused on creating good ground cover by burning, discing and timbering. However, over time hardwood trees increased on this area, which is typical of mature pine forests on old-field lands.

During the first three years of this study, radio-tagged birds revealed low overwinter adult survival and/or reproductive output. Not surprisingly, hunting success on this area was at a 30- year low. The decision was made to try and reverse this problem by cutting, piling, and burning as much of the invasive hardwood trees as possible. An immediate response was documented in the measured quail parameters, most notably in adult survival through winter. Hunting success doubled on this area after two years. After five years, the demographics and population size of the quail population had begun to decline, although not to levels prior to the initial hardwood timber harvest.

A second, more intensive clean-up operation was conducted. This time hardwood trees with no commercial value were literally pushed over, piled and burned using heavy equipment (see photographs). The population response following this habitat manipulation was dramatic. Reproductive output, as well as both summer and overwinter survival of adults reached the highest levels documented in the Red Hills and fall populations have climbed to two and a half quail/acre. Best of all, hunting success increased to record levels for the current ownership spanning the last 50 hunting seasons. Certainly the habitat has been drastically improved for quail, however we believe that the "predator context" has been changed as well. Evidence to support this includes near record high nesting success, low predator context as measured by scent stations, and nearly zero over-winter mortality from mammal or avian predators after the disturbance, a fact which is unheard of in the Southeast. This is an example of how intensive habitat change released the potential of the bobwhite to respond to favorable habitat conditions.

Ames Experience: Large scale Management Impacts demographics

How about real-world applications outside the plantation community on areas with a lower quail density. Let's take for example, Ames Plantation, near Grand Junction, Tennessee. For more than 85 years, Ames has been the home of the National Bird Dog Field Trail Championship. Every February, 30 to 40 of the nation's best all-age field trial dogs and their handlers come to Grand Junction to compete for the championship title. However, since the early 1990's bobwhite populations on Ames have steadily declined, despite extraordinary efforts by a dedicated staff of land management professionals. Although bobwhite populations on Ames were still considerably higher than run-of-the-mill agricultural land throughout west Tennessee, everyone agreed that bird populations were not as high as desired for the running of the National and were not consistent with the level of management activity expended on grooming nesting, brood rearing, and foraging habitats on the Plantation. For several decades, most of the management efforts had been directed at tweeking the management regime on open lands (fields) within the field trial course. From one year to the next managers manipulated the quantity of agricultural fields, food plots, nesting cover, or brood cover created in these fields or the amount of discing, prescribed fire, or planting applied to these fields in an effort to achieve the optimal habitat composition. For instance, Ames planted hundreds of food plots annually, eradicated invasive grasses, harrowed fallow fields for brood cover, and provided supplemental feed for quail. Yet, despite the intensity of open lands management, quail populations continued to decline. However, unnoticed because of the slow rate of change, over the years, the

forested portion of Ames became closed canopied with "hard edges" between fields and forests. When the fields were trimmed during fall to enable judges and handlers to see bird dogs run, the quail were relegated to these "hard" edges and this had two important negative consequences. First it subjected the quail to excessive predation by exposing them to avian predators that utilized the hardwood forests. Imagine a bobwhite covey on the edge of a closed canopy forest inhabited by great-horned owls, foxes, bobcats and other predators without the benefit of grasses and shrubs to provide screening from predators. Second, the coveys using the edges of the hardwood forests could easily run into the woods to avoid classy trial dogs running the edges. Handlers are typically unwilling to let a dog run out of sight for very long. Therefore, the access of existing coveys to bird dogs (in a trial situation) was lower than the raw numbers of coveys actually on Ames would suggest. Taken together, these factors led to National Championship statistics below expectations.

With recommendations from the Ames staff and their Quail Task Force, Ames Plantation as a part of its cooperative program with the University of Tennessee, took a bold step and instigated an intensive management plan to increase their wild quail population. They began a major timber removal to open up pine stands and removed large blocks of hardwoods. This resulted in increased habitat space reduced predator abundance. They did this in an experimental fashion, cutting only one-half of the morning and afternoon courses, treating over 1000 acres of each course, while monitoring quail demographics, Cooper's hawk habits, and mammalian predation via telemetry. The results after one season as compiled by Rachel Chambers and her associates at Ames are promising. The areas receiving the intensive timber disturbance showed dramatic increases in fall covey counts relative to the uncut areas and both survival and nesting success have increased dramatically. Overwinter survival on the timber removal areas during 2000-2001 was a respectable 57%, whereas on the unmanaged areas it was 48%. This higher overwinter survival carried over into a higher nesting rate on timber removal sites. But the greatest improvement was in nesting success. Birds in the timber removal areas experienced an astonishing 60% nest success, whereas those on the control site had an abysmal 15% success.

Again, the management practice resulted in increased habitat space, but also likely reduced the generalist predator community to allow bobwhite to take better advantage of the improved habitat. Previous habitat management programs were not providing the change in the predator context to actually change quail demographics and turn around a low, stable population.

Black Prairie Experience: Adding New Habitat to an Agricultural Area

In 1995, Black Prarie Wildlife Management Area was mostly fescue pasture and crop land managed from "fence to fence." Beginning in 1996, and in the years since the Mississippi Department of Wildlife, Fisheries and Parks along with Mississippi State University began investigating quail management on Black Prairie that included fescue eradication using herbicides and fire, rotational disking of grasslands, fallow field borders surrounding crop fields and establishment of cover strips and hedgerows to help break up large (> 100 ac) fields. As expected, the quail population increased dramatically (Figure 1). The habitat enhancements provided space that was not there before and quail populations increased to a respectable quail per acre.

From the beginning, researchers at MSU have documented the quail population demographics and have observed an interesting trend to the data. In general, nesting success and survival peaked the first two years after establishment of habitat, then have steadily declined (Figure 2). Notice that nesting success was a very respectable61% in 1997, but, has declined dramatically to only 20% by 2000. Breeding season survival was very high during years following the habitat improvements, but also has declined. Populations have generally followed the demographic trends,

New Research Project Develops

Using data collected during our QU-SEQSG project, we have identified 4 areas with active habitat management programs, relatively high predator abundances and relatively low quail productivity and populations. These areas are ideal for conducting a manipulative study to determine the effect of predator removal on quail demographics, and in fact, such a study has been developed.

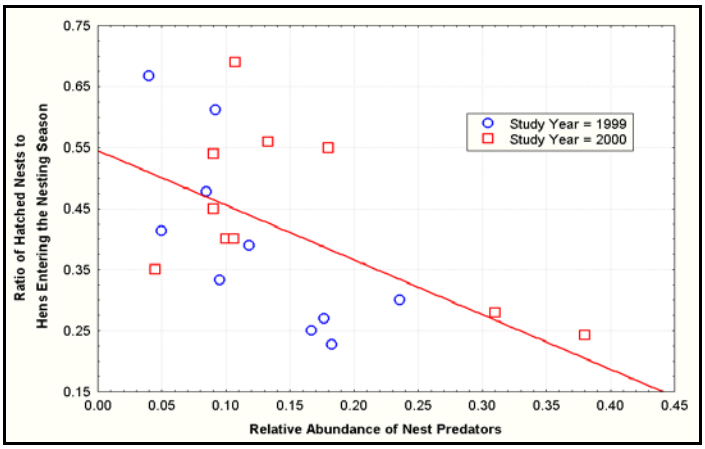
This landmark study is a cooperative venture by U. S. D. A. Georgia Wildlife Services, University of Georgia, Auburn University, and Tall Timbers Research Station with the resources from Quail Unlimited permitting continued assessment of predator abundance. This study is based on a "cross-over" design where over the first three years, predator removals will occur only on sites one and three, and over the last three years, predator removals will occur only on sites two and four. In this way, we can determine the effect, if any, predator abundance has on quail demographics and abundance. Of course, both spring and fall quail population estimates, nesting rate, nest success and adult and chick survival will be monitored. In addition to monitoring mammalian predators, the research team is measuring habitat use and abundance of rat snakes, recently found to be a major nest predator on our study areas. This is important because snakes could possibly compensate for, or "take the place of", target nest predators (such as armadillos and racoons) removed from the study areas. To help test this idea, the team is monitoring nest predators using micro-video cameras.

This comprehensive study of predator management is the first of its kind for bobwhite quail. Thanks to support by Quail Unlimited's chapters and Quail Unlimited, this project is strengthened by having "pre-treatment" data to help the research team select the best possible study areas.

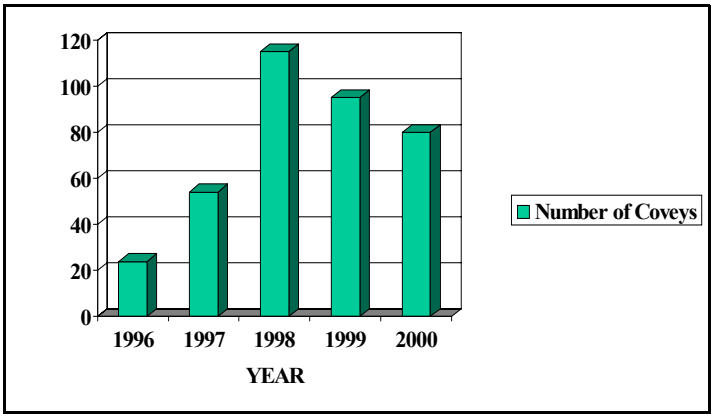
peaking in year two, then beginning to decline, but remain above pre-habitat levels. What is going on here?

This example of the new ground effect may look familiar to those that have managed CRP lands grasslands in the Midwest or in the South. Conversion of large blocks of cropland to CRP grasslands often results in a tremendous quail response during the first two-three years, only to be followed by a disappointing decline in numbers. Many landowners are puzzled by this apparently inexplicable decline. However, they fail to notice the subtle changes. Initially, the converted cropland is a huge patch of annual weeds and legumes. During the first two years bobwhite populations respond. As the grass stand develops, litter accumulates, bare ground declines, annual weeds are replaced by perennial grasses, and rodent populations increase, providing a tremendous prey base for predators. Again, there is a lag time between response of bobwhite and predators. Such a process fits the model that at predator communities are responding numerically to the new habitat, but at a different time scale than quail. Black Prairie is an example of beginning with an intensive agricultural landscape and a relatively low quail and predator community. Establishment of even moderate amounts of habitat usually results in immediate quail population responses. A doubling over baseline numbers in one year is typical. Quail populations on Black Prairie increased by six fold over two years. However, over time, the generalist predator communities also begin to inhabit the area and predator context increases, quail demographics decline, populations fall to a lower level than soon after the habitat was established. In this case, a new disturbance or predation management may help to avoid the long-term declines.

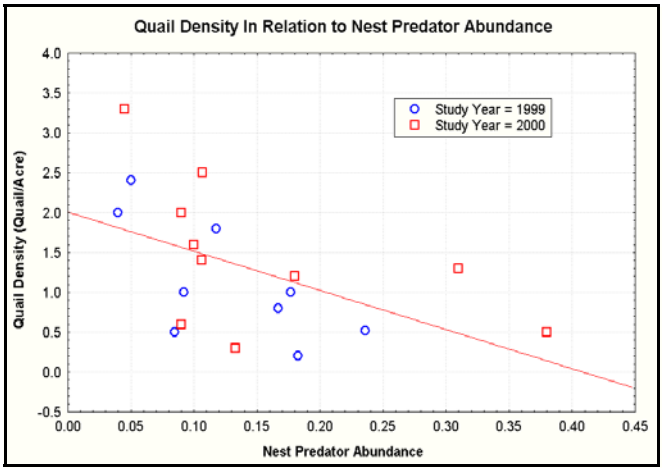
The quail response to new habitat depends on the scale of habitat management and the predator context. If predator contexts are low, as on intensive agricultural landscapes, then quail typically respond to habitat management. If predator contexts are high, as in landscapes dominated by forests and mixed agricultural landscapes, then quail may only respond to habitat management that increases habitat space while simultaneously reducing the predator context. Either way, the new ground effect is temporary, as a new generalist predator community responds to the early-successional habitat. These examples do suggest that some form of predator management may be needed to sustain high levels of bobwhite on some managed lands. Whether predator management is warranted or not, the greatest quail population response is likely to occur from large scale, dramatic changes in usable space for quail and a reduction in predator context. Following these kinds of changes, quail populations will likely increase dramatically, peak at some much higher level, then decline and stabilize at some new higher population level. At this point, the choice regarding predator management is one of "what level of quail populations are acceptable to achieve the landowners objectives." Regardless of the predator management decision, the first step is to create the habitat space through proactive, landscape-level habitat management. In any of these cases that we have discussed, predator management, in the absence of the drastic habitat changes, would likely have had little effect on bobwhite population levels.



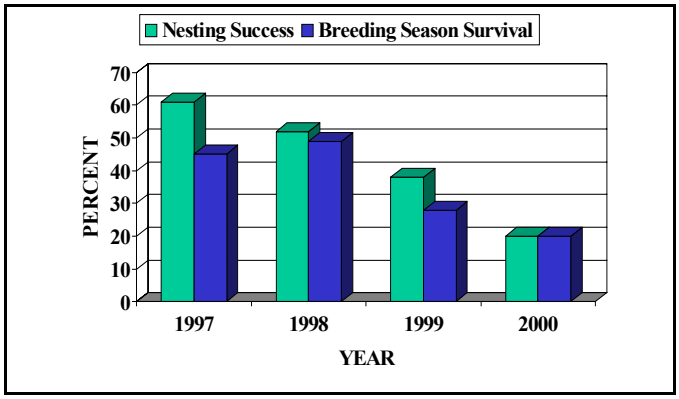
This graph shows the ratio of the number of hatched nests per hen entering the nesting season for different areas with active habitat management programs. Each point represents an area where mammalian nest predator abundance was measured along with survival, nesting rate and nest success of bobwhites. The data suggest that hen bobwhites are more likely to hatch nests when predator abundance is low.



Bobwhite population trend on Black Prairie WMA following initiation of habitat management in 1996. This pattern of a rapid population increase followed by a population decline is a common phenomenon known as the "new ground effect."



This graph shows the relationship between nest predator abundance and quail abundance on our study areas for both years. The data suggests that on areas with active habitat management, quail density is related to predator abundance.



Nesting success and nesting season survival of bobwhite quail on Black Prairie WMA following initiation of habitat management. Note how both peaked one to two years following establishment of habitat, then declined. Could an increasing predator community be responsible for these trends?

Palmer, W.E., L.W. Burger and D.C. Sisson. 2000. Predation & Bobwhite: new ground effect and implication for management: part three of a trilogy. *Quail Unlimited Magazine* Vol. 21 (3):42-47, 49