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**N**orthern bobwhites (*Colinus virginianus*) are a valuable natural resource for landowners and sportsmen. They are also an important indicator species of rangeland habitat health, and their life history has been well-studied. Despite this and despite intensive management efforts, bobwhite populations have declined over much of the bird's geographic range (including Texas) for many decades. The cause of the decline is largely associated with agricultural land-use changes and the loss of habitat to urban sprawl.

Private landowners, managers and natural resource agencies have worked hard to increase bobwhite numbers over the years. Restocking lands with pen-reared bobwhites began as early as the 1930s over much of the southeastern United States, where wild populations were diminished or extirpated. The motive of the restocking years ago was to replenish wild stocks quickly, as natural recovery was perceived to take a long time. Many states initially embraced production of pen-reared bobwhites, resulting in the release of thousands of pen-reared birds. Poor survival of pen-reared bobwhites and the high cost of production ultimately showed that improving the quantity and quality of habitat was more cost-effective and more likely to succeed in establishing viable bobwhite populations.

It is widely recognized that pen-reared bobwhites do not survive long in the wild. Their naivety in finding food and avoiding predators, and their insufficient flight speed, could explain their poor survivorship. Nevertheless, the allure of the bobwhite's high reproductive potential continues to interest landowners and managers wanting to increase populations on their property or in hunting enterprises.

# Roost Site Selection and Survival of Pen-Reared Northern Bobwhite

Little is known about the covey dynamics of pen-reared quail. We do know, however, that wild quail interact, forage and roost in groups. We believe this behavior helps them detect and avoid predators and regulate body temperature, and may help in other behaviors such as forage selection, loafing and roosting. There is insufficient information about the effects of management practices on roosting habitat or roost site selection by wild bobwhites, and roost site selection by pen-reared bobwhites has never been examined.

We began our research by describing the vegetative characteristics of selected roost sites and identifying vegetative attributes that might distinguish these areas from randomly available sites. We wanted to know, for example, if a pen-reared quail did a good job of selecting a protective roost site, or if it simply stopped in its tracks at the end of the day, not knowing if the roost site afforded protection. In addition, our researchers wanted to estimate survival of pen-reared bobwhites. Essentially, we tried to learn if inadequate roosting cover might predispose pen-reared bobwhites to predators and/or inclement weather immediately after being released, thus limiting their survival.

## Study Area

Our research was conducted in the Rio Grande Plains ecological region in Webb County, Texas, where the rangeland topography was slightly rolling. Work was done on a 6,931-acre ranch, which was managed for wildlife production and a cow-calf livestock operation. The common brush species included black brush (*Acacia rigidula*), honey mesquite (*Prosopis glandulosa*), guajillo (*Acacia berlandieri*), cenizo, (*Leucophyllum frutescens*), lotebush (*Ziziphus obtusifolia*) and guayacan (*Guajacum angustifolium*).

Buffelgrass (*Cenchrus ciliaris*), an introduced African species, was the dominant grass over much of the ranch. Plains bristlegrass (*Setaria leucopila*), pink pappusgrass (*Pappophorum bicolor*) and other natives were also present. Common forb species included various crotons (*Croton spp.*), western ragweed (*Ambrosia psilostachya*), spiny pricklepoppo (*Argemone sanguinea*), silverleaf nightshade (*Solanum elaeagnifolium*) and pigweed (*Amaranthus palmeri*).

## Methods

We purchased 60 adult bobwhites from a quail farm and subsequently housed them in a large coop located in a covered pole barn. This provided ample shade and wind flow. We fed them chicken scratch and water, using standard poultry equipment. Aside from reducing the frequency of contact with the captive quail, we made no other attempts to prevent their being around people because this is typically what happens with most ranches that release pen-reared quail.

From this group of pen-reared bobwhites, we formed three groups (coveys) containing five birds each and then released them on the ranch. The remaining bobwhites served as a replacement pool for birds killed by predators. Prior to release, quail were sexed, weighed and fitted with neck loop radiotransmitters (Fig. 1). By using a receiver and antenna, we were able to identify and track individual quail. Each group was released at an assigned location. We relocated each bobwhite group every third night. All members of each group were relocated a total of seven times

over a 62-day period from August 6 to October 27, 2003; tracking began 30 minutes after sunset and usually ended by midnight.

Roosting quail were located by homing in on radio signals. Roosting areas were marked with plastic flagging and with Global Positioning System (GPS) coordinates to help relocate specific roosts for habitat measurements the following day. When bobwhites were killed by predators, we then released the replacement bird(s) at the same location as the first covey.

We placed roost site locations in a Geographic Information System (GIS) to determine covey movements and area of use for each group of quail. This enabled

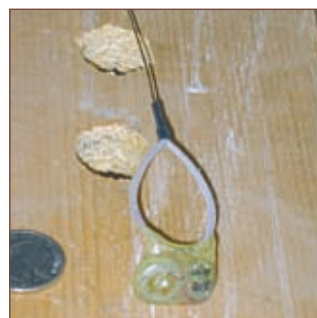


Figure 1. Pen-reared bobwhites were weighed and fitted with a neck-loop radiotransmitter prior to release. Transmitters are about the size and weight of a quarter.



us to create detailed digital maps of the ranch, allowing the movements of the quail to be plotted over time. Roost sites were relocated the following morning, and exact roost sites identified by the presence of fecal droppings. In addition to the actual roost site, we evaluated a random location within 50 yards of the roost to simulate where a quail might have roosted if it made no selection based on habitat features. Transects 17.5 yards long were established in the four cardinal directions at the roost and random sites to measure habitat features (Fig. 2). Additionally, we estimated daily survival of pen-reared quail released on the ranch.

## Results

The probability of the survival of pen-raised bobwhites declined steadily over time; survival to 61 days was very low. Only three hens from the original 15 birds initially released survived the entire time. Mortality was highest for group 1, with 15 birds (including replacement birds) dying. Groups 2 and 3 lost nine and ten birds, respectively. Hawks and mammals preyed on bobwhites, but because of the lack of remains between tracking periods, predators could not be reliably identified.

Researchers tracked bobwhites and located 40 night roosting sites. We found 19 cases where the birds roosted alone, 13 times when two birds roosted together and eight times when the roost contained three or more birds. In a given time frame, birds from group 1 roosted singly 61.5 percent and in coveys 38.5 percent of the time. Bobwhites from group 2 roosted singly 47.4 percent and in coveys 52.6 percent of the time. Birds in group 3 roosted singly 25 percent and in coveys 75 percent of the time. Birds from groups 2 and 3 intermingled with each other, and on six occasions some roosted communally with wild bobwhites.

Group 1 selected roost sites within an area of 81.94 acres with minimal brush clearing. Group 2 used 220.4 acres that overlapped the 82.81 acres used by group 3. Groups 2 and 3 were in an area that included treated brush strips and, thus, contained more open habitat than group 1 used. Individual birds used areas of 0.86 to 39.44 acres.

We found that pen-reared quail selected roost sites that had less forb cover within a 1-yard radius than the random sites. At a 4-yard radius around the roost site, pen-reared quail selected areas having more visual obstruction and more grass cover than at random locations. Beyond 4 yards, vegetative characteristics of bobwhite roosts were highly variable, and there was no clear difference between habitat values of actual roost sites and their paired random simulated sites.

## Findings

Pen-reared bobwhites apparently selected their roosting areas based on some habitat features in close proximity. Roost sites had less forb cover at a 1-yard radius around the roost, and more grass cover and visual obstruction within 4 yards around the roost. Forbs were often single-stemmed and sparsely branched with small leaves. We also found that some grew relatively flat to the ground, providing little screening protection from predators. Many of the grasses, including the dominant buffelgrass, grew in clumps or bunches. They offered more visual obstruction and thus better concealment from predators.

Pen-reared bobwhites did not stay together in the five-bird coveys in which they were released, as nearly half (47.5 percent) of the roosts consisted of only one bird. At other times birds



Figure 2. A Robel range pole, which marks the position of the roost site, was used to measure visual obstruction of vegetation. Line transects were established in the four cardinal directions to assess habitat features surrounding roost sites.

Table 1. Habitat features measured around actual roost sites of pen-reared bobwhite quail and simulated roosts at random locations.

Habitat Features
percent grass cover
total grass height
percent forb cover
total forb height
percent brush cover
brush height
percent bare ground
percent rock
percent litter
visual obstruction
average area per brush plant
brush basal area
brush diameter at breast height

roosted communally, occasionally with members of the other pen-reared groups and even with wild bobwhites. Roosting sites with wild bobwhites were not noticeably different in habitat features than those selected by pen-reared birds, but sample sizes were small. We were not able to determine whether bobwhites from group 1 suffered the highest mortality rate because of their roosting pattern or if it was a result of earlier mortality of group members.

Southern Texas is one of the last strongholds of wild bobwhites, and the rangeland used in this study was successfully managed for production of wild bobwhites. Even though habitat conditions were good, many pen-reared bobwhites did not survive the first 9 days of the investigation. Mortality in wild bobwhites is high, and roughly 80 percent annual mortality at the population level can be expected.

However, it is unclear why habitat differences were not detected beyond the 4 yards closest to the roost site. Perhaps it was because roost sites were readily available throughout the area, or because survivors learned where to roost or gained an advantage by roosting with wild bobwhites. Only three birds survived by the end of the study, and they were in the group that roosted 62.5 percent of the time in coveys. Pen-reared bobwhites may have some innate survival instincts. Also, they can be accepted into wild coveys, which could offer some survival advantage.

Survival of pen-reared birds is poor compared to that of translocated wild or resident native bobwhites. Our study supports one done by the Texas Parks and Wildlife Department. It found that half of pen-reared and first-generation bobwhites died within 10 days in southern Texas. By contrast, wild resident and translocated birds reached 50 percent mortality in 72 and 47 days, respectively. Another study by Texas A&M University-Kingsville also found that pen-reared birds had lower survival than did wild bobwhites in southern Texas.

Wild bobwhites have many advantages over pen-raised individuals. They are survivors from living in the wild. Unlike pen-raised birds, they are familiar with the habitat and food resources, are fit and wary of predators, and have social bonds with other members of their species.

## Recommendations

Landowners and managers should refrain from releasing pen-reared bobwhites for bolstering numbers, as few birds will survive and become incorporated into wild bobwhite populations. Pen-reared bobwhites do show some selection for the immediate surroundings of their roost sites even though they have no prior experience on which to base their selection. However, mortality of these birds is extremely high even under relatively good habitat conditions.

Droughts are common in southern Texas, which makes range conditions harsh and reduces the number of bobwhites on poorly managed land. Consequently, managers are under pressure to increase quail numbers. Although instant gratification may be gained by releasing pen-reared bobwhites, success will be short-lived. Stocking has low success in good habitats and will certainly not be successful in poor habitats.

Funds and energy would be better used by improving the quantity of forbs and grasses at every opportunity. The high reproductive rate of wild bobwhites will restock the range if their survival rate is improved. Livestock managers might consider reduced stocking rates or deferred grazing. An alternative is to implement a rotational grazing system while incorporating prescribed burning and ground disturbance (through shallow disking) or brush management (with mechanical or herbicide methods). These actions will likely enhance cover for wild bobwhite quail and negate the need to release pen-reared quail.

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## Glossary

**covey** – a group or flock of quail

**forb** – a broad-leaved plant (other than a grass or woody vegetation) commonly call a weed

**global positioning system** – a system of satellites used to determine positions on the Earth

**homing** – the act of steering to a location based on a signal

**line transect** – a method to assess vegetation characteristics at points along a determined path

**litter** – fallen leaves and twigs of grasses, forbs and woody vegetation, which form a layer of decaying matter

**pen-reared** – animals raised in captivity using animal husbandry techniques

**roost site** – place or location where bird(s) rest overnight

**visual obstruction** – concealment provided by vegetation as it blocks the view of a quail or roost site



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