

Cearley, Kenneth A. 2008. Scaled quail management in Trans-Pecos Texas. Pages 8-29 in B. J. Warnock, P. H. Dickerson, and L. A. Harveson, eds. Proceedings of the Trans-Pecos Wildlife Conference 2008. Sul Ross State University, Alpine.

## SCALED QUAIL MANAGEMENT IN TRANS-PECOS TEXAS

KENNETH A. CEARLEY, Texas AgriLife Extension Service, P. O. Box 60275, Canyon, Texas 79016, USA; [kcearley@ag.tamu.edu](mailto:kcearley@ag.tamu.edu)

**Abstract:** Scaled quail (*Callipepla squamata*) populations in the Trans-Pecos historically have not been the recipient of widespread intensive management efforts. A changing trend is apparent in the region with more operators showing an interest in managing land with priority given to scaled quail production. Management techniques and strategies for the species are not as thoroughly tested as with bobwhite quail (*Colinus virginianus*). However, even though preferred habitats differ for the two species, the primary factors associated with the successful production of either include adequate rainfall and appropriate grazing intensity. The effectiveness of rainfall can be enhanced by such practices as proper grazing and by water harvesting. Grazing management that favors scaled quail leaves enough grass cover year long, including during drought, to optimize nesting success. Other strategies and their relative merit and known degree of effectiveness are discussed.

---

### INTRODUCTION

Scaled quail, commonly called blue quail or “blues”, have often been relegated to secondary status in relation to bobwhite quail in years past but have enjoyed greater recognition recently. Hunter interest is on the upswing and likewise research activity. Running more often than flying, inhabiting more arid and more open country than bobwhites, they provide frustration for bird dog and hunter alike, thereby yielding greater bragging rights to those who get their bag limit of blues on a given day.

Lehman (1984) expressed that “blue quail seem somewhat more intelligent than bobwhites.” He declared them to be more difficult to trap and quicker to flush from hunter noises. More shots were taken at near maximum shotgun range, and the birds often flushed from ¼ mile or more away. They usually “see and run”, rather than “see and freeze” like bobwhites. Some hunters prefer the pursuit of blues because of these characteristics and the increased challenge.

### Distribution

There are two subspecies of scaled quail in Texas: the Arizona scaled quail (*C. s. pallida*) and the chestnut bellied scaled quail (*C. s. castanogastris*) (Silvy et al 2007). As the name implies

chestnut bellied quail have a patch of chestnut colored plumage on the belly, and are slightly darker and smaller than Arizona scaled quail. Chestnuts seem to prefer thorn-scrub vegetation and well-drained ridges or lowlands along drainages, Arizonas are found in greater numbers in open grassland with no more than 10-15 % brush canopy cover (Silvy et al 2007).

The 100<sup>th</sup> meridian, the east boundary of the Texas Panhandle and roughly the route of US Highway 83 in Texas, is the general line west of which reside more blues than bobs, though much of their range overlaps up to the Pecos River on the west (Cantu et al 2006, Silvy et al 2007). The portion of Texas west of the Pecos River, the Trans-Pecos, is home to mostly blues with comparatively small numbers of Montezuma (*Cyrtonyx montezumae*) and Gambel's quail (*Callipepla gambelii*), the other two species of quail endemic to Texas. Scaled quail find the region's more open habitat and more arid climate ideally suited to their needs.

Though blues and bobwhites utilize similar loafing cover, blues generally prefer a greater abundance of bare ground, a commodity seldom in short supply in the region. In contrast Reid et al (1979) found where sympatric with bobwhites, breeding blues selected the dense, shorter shrub height, whereas bobwhites were located in the more open, taller vegetation types. He explained that shrubland was negatively correlated with breeding quail numbers in the Trans-Pecos in his study not because it was unimportant but because mixed mesquite shrubland associated with wetter areas was of even greater importance.

Blue quail populations are believed to expand eastward during drought and are not as productive during normal precipitation years as bobwhites. Blues tend not to decline as quickly as bobwhites during dry years, but neither do they increase as quickly as bobwhites during wet years (Rollins 2000).

## **Population Status**

Trans-Pecos blue quail population density varies widely year-to-year, partly in response to rainfall (Bridges et al 2001) and resultant herbaceous cover. However rainfall variations alone fail to explain the existing long-term downward trend. Southwestern US populations have declined by as much as 50% since 1960 (Bristow and Ockenfels 2006). In Texas scaled quail populations have declined by an average of 1.79% per year from 1966 to 2006 (Sauer et al 2007). The Trans-Pecos possessed the highest populations of blues in Texas during the years 1994 to 2003.

There is no clear understanding of what is causing the decline (Pleasant 2003). The decline can be attributed to rangeland deterioration and changing land use, according to Silvy et al (2007), who went on to say that excessive grazing has caused woody growth to increase, lowering the value of some land to blues, and that little evidence existed to support the hypothesis that changing precipitation patterns were responsible.

Kuvlesky et al. (2002) agreed that the decline of quail populations throughout Texas, including blues, may be attributed to habitat loss due to overgrazing, and added increasing intensity of crop production, urban development, and the loss of useable space due to exotic grasses encroachment

as other contributing factors. Drought and overgrazing are also contributing factors to the reduced scaled quail populations in the Southern High Plains (Pleasant et al 2006).

Diseases may have played a role in a precipitous decline noted in the late 1980s (Cantu et al 2006, Rollins 1996, Rollins 2000), though no firm evidence exists (Silvy et al 2007). Campbell and Lee (1953) found that blues in New Mexico suffered a marked decline in 1944, coincident with the appearance among quail of unusually large numbers of the louse fly known to transmit the organism responsible for quail malaria. No evidence was found that it was markedly pathogenic to adult scaled quail, but there was some evidence that it may be seriously pathogenic for the young.

Some observers currently report a general upsurge in blue quail population densities in the Trans-Pecos. Texas Parks and Wildlife Department roadside counts show populations above the long-term mean 13 of the most recent 30 years, 4 of which were the last 4 years (TPWD 2007) (Figure 1). An upward trend was noted since 1995, the second lowest density to 1990.

One particular contributing factor may be de-stocking by ranchers due to lack of forage in the face of extended drought which peaked in the late 1990s and early 2000s, and the subsequent return of normal to above-normal rainfall. When significant rainfall eventually returned livestock numbers remained relatively low region-wide at least in part to landowners' recognition that continued deferment was needed, and the high cost of re-stocking in an upward trending cattle market. The resulting improvement in nesting cover likely played a significant role in increasing nesting success and brood survival.

## **DIGESTIVE PHYSIOLOGY**

At least a cursory knowledge of quail digestive physiology is helpful in understanding the needs of blue quail for certain habitat components and specific structural requirements of those components. The quail digestive system, like other gallinaceous birds, allows for rapid filling of a storage organ called the crop or "craw", and quick return to protective cover. This function allows quail the ability to minimize exposure to predators and to environmental extremes (temperature, ice, etc.). In the relative safety and leisure of loafing (hence the term) cover the food passes from the crop into the gizzard for pulverization and entry into the remainder of the digestive tract, much like a cow chewing her cud. In order to take advantage of this behavior in fostering quail populations proper loafing cover must be supplied by the manager as a result of land management practices applied.

The crop is also a valuable means for managers to ascertain diet at harvest, providing a snap shot of the diet at that point in time. This knowledge can contribute to the overall understanding of quail dietary needs and utilization.

## **REPRODUCTION AND GROWTH**

### **Nesting**

Adequate herbaceous cover is crucial to nesting success and chick survival. Blue quail are highly protective of their young (Lehman 1984, Buntyn 2004) but sufficient nesting cover is nevertheless necessary for protection of the clutch from predation and weather extremes.

Nesting usually peaks in June, having begun as early as April, and typically lasting until early October (Cantu et al 2006). Blue quail nest on the ground in a depression lined with grass stems and leaves and under some form of shade, sometimes under plants such as tobosagrass (*Hilaria mutica*), prickly pear (*Opuntia spp.*), and yucca (*Yucca spp.*) (Silvy et al 2007).

A New Mexico study (Evans 1997) reported that eggs were laid at a rate of one per day, an hour later each day in the daylight hours. Clutch sizes averaged 14 in west Texas (Walmo 1956). Average clutch size in Pecos County, Texas, was 13 with a range of 5-16 (Buntyn 2004). Evans (1997) reported clutch sizes in 1994 of 12-16 eggs (n=7) and in 1995, 8-14 (n=13).

Incubation for a period of 22-23 days (Evans 1997) is mainly by the female, rarely by the male (Schemnitz 1961). Buntyn (2004) found nest success of 77% and a hatch rate of 75%. Pleasant et al (2006) reported in the Southern High Plains of Texas 50 nests with 44% success in 1999, 56 nests with 64% success in 2000. Males will incubate the nest when the mate is dead (Evans 1997).

### **Brooding and Growth**

Immediately after hatching chicks follow the parents away from the nest site, possibly in an effort to avoid attracting predators by the associated sounds and smells of the nesting site. Both parents accompany the brood, often with the male on a high perch serving as a sentinel, the female feeding with the young (Shemnitz 1961).

Double brooding is much less common with blues than bobs (Rollins 2000), though anecdotal evidence points toward the occasional occurrence. Evans (1997) reported no evidence of second broods.

In the Southern High Plains of Texas chick presence with the hen at 21 days was found to be negatively associated with cool and wet weather (Pleasant et al 2006). Juveniles usually reach 50% of adult body weight by 6 weeks, 90% at 13 weeks (Cain and Beasom 1983).

### **Diet**

The diet of blue quail largely consists of seeds of forbs (commonly referred to as “weeds”) and woody plants, and mast and fruits of plants such as tasajillo (*Opuntia leptocaulis*) (Rollins 2000) and leafy green plant material (“greens”). Insects, a high quality food for quail of all ages, is particularly important for chick survival and growth. Most chicks feed on insects during the first weeks of life, relying on them along with greens to such a degree that it is possible that chicks may die due to lack of insects and greens during drought (Silvy et al 2007).

A New Mexico study (Schemnitz et al 1998) found annual and perennial forb seeds were the main components of the diet, along with seeds of woody plants. Snakeweed (*Gutierrezia spp.*) seed ranked first, Russian thistle (*Salsola kali*) second. Most were eaten in similar amounts in dry, wet, and average precipitation years. Exceptions were insects and snakeweed, which were consumed in greater amounts in wet years, and white thorn acacia (*Acacia constricta*) and goosefoot (*Chenopodium spp*) were eaten in higher amounts in dry years.

Lehman (1984) reported that in South Texas, west of 98<sup>th</sup> meridian, bobwhites and blues ate many of the same foods, blues utilizing somewhat more mast (more than 61% of diet) and greens (3%).

## **HABITAT REQUIREMENTS**

Successful management of blue quail is dependent on a site's "habitability" (Cantu et al 2006), or usefulness by way of the provision of suitable, useable habitat, year round, and in close proximity to one another (Rollins 1996, Cantu et al 2006). Rollins (2000) suggested that managers recognize existing habitat that contains high densities of blue quail and strive to maintain the integrity of those sites. To the extent possible managers should replicate those conditions across the landscape.

No studies have been done to determine the minimum population size or the minimum area required to sustain quail populations (Silvy et al 2007). But, regardless, food, cover, and water, well-interspersed across the landscape, are the essential habitat components. Cover is by far the most important of the three and must be addressed by the manager in an ongoing deliberate effort.

Schemnitz (1984) reported common shrubs in good quail habitat include yucca, four-wing saltbush (*Atriplex canescens*), littleleaf sumac (*Rhus microphylla*), skunkbush sumac (*Rhus trilobata*), beargrass (*Nolina microcarpa*), and various cacti (*Opuntia spp.*).

In Arizona Bristow and Ockenfels (2006) noted that greater amounts of visual obstruction and lower percentages of tree canopy cover best predicted scaled quail sites. They recommended that practices that reduce grass species (diversity) and cover and increase tree cover may reduce habitat quality and availability in southeastern Arizona. A maximum brush canopy cover of 6%, and greater than 25% grass canopy at the 8 inch height, was suggested as optimum.

Reid et al (1993) showed that mesquite (*Prosopis spp.*) habitats were especially important to scaled quail in the Trans-Pecos, by virtue of the greater density of breeding males that occurred there during the breeding season compared to other habitat types.

## **Nesting**

Limited research involving relatively small sample sizes has shown an apparent benefit of pricklypear to quail for nesting sites (Cearley 1999). Carter (1995) found 8 of 12 scaled quail nests were located in prickly pear clumps. One explanation was the mechanical protection from

predation that was provided by prickly pear spines, another was that in the drought conditions that persisted during the study the prickly pear provided relic stands of bunchgrass within the clumps. Slater (2001) likewise concluded that prickly pear provided a degree of mechanical protection against nest predators and protected grass growth for nesting, especially in areas of marginal nesting cover.

Blue quail seem to resort to pricklypear for nesting when other “traditional” bunchgrass sites are unavailable, e.g. after fire or overgrazing. On range typically over-grazed or in semi-arid, drought prone areas, some pricklypear should be maintained since the likelihood of an adequate density of bunchgrass nest sites may be low (Cearley 1999).

Evans (1997) working in southern New Mexico reported that 90% of blue quail nests found were in high mesquite dunes and the other 10% in soaptree yucca (*Yucca elata*). Of those in mesquite, 50% were in active pack rat nests. Buntyn (2004) radio-marked 207 blue quail hens in Pecos County and reported 85% of nests were in tobosagrass.

## **MANAGEMENT CONSIDERATIONS**

### **Water Harvesting**

A major consideration in the arid Trans-Pecos is making the most of the limited rainfall which is characteristic of the desert region. Management strategies aimed at accomplishing this can benefit overall rangeland health and may benefit scaled quail populations.

Soil ripping along landscape contours, perpendicular to slopes, on large scale bare areas has significantly increased grass production in and along the ripped areas (Ueckert and Petersen 2002). Water infiltration is increased, erosion reduced, and rangeland restored to better hydrological condition with this method. The specific effects on quail populations have not been studied thoroughly, but the practice stands to contribute significantly to successful scaled quail management in some areas.

Spreader dams and berms, originally employed for erosion control, have likewise yielded increased herbaceous production as a result of the concentration of rainfall runoff and improved conditions for infiltration. Buntyn (2004) studied the impact of moist soil management on scaled quail reproductive success and survival in Pecos County with radio-marked hens. Moist soil sites supported greater vegetation biomass and arthropod abundance, but nesting success and hen survival were similar among the two. Spreader dams did not appear to influence survival or hatch rates. He concluded that screening and nesting cover was more important than mesic microhabitats afforded by spreader dams. Conservative grazing management, providing abundant nesting cover across the landscape, may be a more important factor.

### **Moist Soil Management**

The slight overflow of water troughs, or the earthen overflow pools nearby water storage tanks at windmills provide dependable production of greens, insects, and cover. Such small scale management can be effective when utilized in conjunction with landscape level strategies.

## **Grazing**

Undoubtedly livestock grazing influences scaled quail populations in Texas. Especially important is the amount of herbaceous plant material left for cover after grazing. All periods of the year are important, even drought. There is little consensus on which grazing system is best (Silvy et al. 2007), but Rollins (2000) suggested moderate (40+ acres per animal unit) to light (>75 acres per animal unit) grazing intensity to benefit blue quail. Livestock grazing strategies should seek to increase availability of potential nesting sites if quail management is important (Slater 2001). Moderate livestock grazing may be beneficial by enhancing the variety and abundance of forb plants (Schemnitz et al 1998). Gambel's and Montezuma quail benefit from conservative grazing practices as well (Harveson 2004).

## **Predators**

Predation likely has the greatest impact during nesting. Both hen and clutch are especially vulnerable during egg-laying and incubation. Prescribed trapping of potential nest predators holds promise for affecting quail production positively (Silvy et al 2007), though the practice remains unproven for blue quail (Rollins 2000). Intensive removal of mammalian predators in the western Rio Grande Plains resulted in no significant effect on blue quail (Guthery and Beasom 1977).

Fragmented habitats and higher predator populations may be overwhelming bobwhites' (and likely blues') ability to cope with predation (Rollins 1999). Pleasant et al (2003) showed precipitation was negatively associated with nest predation in the Southern High Plains, failing to support the moisture-facilitated nest predation hypothesis, the idea that wetter conditions favor predation (Pleasant et al 2003).

## **Food Plots**

Food has seldom been shown to be a limiting factor in quail populations. Typically food plots are more risky and hence less effective overall in the more arid regions in which blues reside. Rollins (2000) notes that they generally cannot be grown when needed most, unless irrigated, yet if successfully implemented they will probably be utilized, just as quail will readily use agricultural crops such as wheat and sorghum, given that the plots are no more than 75 yards or so from escape cover.

## **Supplemental Feeding**

Supplemental feeding rarely results in increased production of bobwhites over unfed populations in controlled studies. However, as insurance against environmental extremes (cold, winter precipitation), at worst it is a neutral practice—it won't hurt (Cantu et al 2006). The effect of supplemental feeding is largely unknown in blues (Rollins 2000). Henson (2006) studied quail

feeder use in Coke, Fisher, Stonewall counties. Fourteen mammals and 18 avian species were observed at feeders. Raccoons accounted for 43.2% of all time spent at feeders, bobwhite and scaled quail, 5.4%. Strategic implementation of feeders was suggested to minimize non-target consumption. Rollins (2000) observed ready use of quail feeders by quail, and noted their increased availability to hunters. He photographed 3 week-old chicks at quail feeders in Irion County. Adults frequently used deer feeders in fall and winter months. Supplemental feeding may increase predation of blue quail at or in the vicinity of feeders, but adequate research specifically addressing the issue is lacking at this point.

## **Brush**

Blues may need less brush than bobwhites (Rollins 2000). The availability of loafing cover is a prime consideration/requirement, for example some growth forms of mesquite, and lotebush (*Ziziphus obtusifolia*). He suggested that managers recognize the structure of places that support high quail densities and maintain their integrity. Strive for at least one loafing covert per 50 ac., preferably up to 1 per ac. Leaving at least 10% of the brush intact is a good rule of thumb. Mechanical clearing is preferred over chemical use because of forb stimulation as a result of soil disturbance produced by mechanical methods. Track-mounted grubbers offer an effective selective means of mechanical brush removal. Individual plant treatment with herbicide is another preferred selective method.

Food production can be managed by brush manipulation. Early successional species which are primary food sources for blues are encouraged by the soil disturbance associated with mechanical brush control, winter disking, and livestock grazing (Rollins 2000). Strip disking during the months of December through February close to woody cover is effective. Mesquite, catclaw (*Acacia* spp.), hackberry (*Celtis* spp.), and chittam (*Bumelia lanuginosa*) are important shrubs/trees to maintain, supplying important foods seasonally.

## **Water**

There is no evidence that water increases quail populations. Blue quail will drink water when it is available, but they can procure all of their water requirements from preformed water such as dew or metabolizable water in their food, such as insects and greens (Schemnitz 1961, Rollins 2000). Allowing livestock water troughs to overflow slightly provides ground level access to water and encourages weedy growth near the trough while enhancing insect populations.

Krausman et al. (2006) points out that water catchments—guzzlers—although useful tools, have not always yielded the expected results. Our understanding of the effects of water developments on wildlife populations is largely dependent on anecdotal observations and a few studies that have shown correlations, not cause-and-effect. He noted that wildlife water developments are used by a wide array of species and do not appear to present a high risk of predation for animals that visit them. The availability of natural and man-made water sources affects habitat use, though other factors can be more important.

Anecdotal evidence points to quail concentration around all types of water sources. Schemnitz (1961) found movements relative to known water sources to be ¼ mile to 1 ½ miles.

## **Harvest**

Hunting is unlikely to significantly reduce blue quail populations in the Trans-Pecos due to the rough country they inhabit (Rollins 2000). Nevertheless if there is concern that hunting activity might be additive (birds are killed that would have otherwise survived through the winter), rather than compensatory (birds are killed that would have died before the next breeding season from other mortality factors) some adjustment in hunting tactics might be in order. Consider lessening hunting pressure during the months of January and February—that portion of the year when natural mortality is often high due to unfavorable weather and food and cover being in short supply.

The ratio of juvenile quail to adults in the bag can serve as a gauge of nesting success and breeding capital for the coming year. Adults and juveniles are too variable to use weight as a determining factor in judging their age (Cain and Beasom 1983). In fall and winter juvenile quail older than 20 weeks can easily be distinguished from adults by wing feather replacement. Primary covert feathers with buff colored tips are found on juveniles. Adults are a uniform slate gray (Cain and Beasom 1983). A high percentage of juveniles in the bag (e.g 70% or more) indicates a successful breeding season. A low percentage (e.g. less than 30%) suggests poor reproductive success (Cantu et al 2006).

## **Monitoring**

To objectively assess the progress of management efforts aimed at enhancing quail populations a strategy of monitoring their impact on habitat should be employed (Wright et al 2005). Habitat monitoring is a useful activity which can include some or all of the following (listed in descending order of importance): fixed photo points to monitor brush management effectiveness over time; precipitation records; nest clump surveys; cover surveys; forb and grass diversity measurements; and grass stubble-height surveys. Managers can choose which are feasible for their use.

Without some form of monitoring progress can be very difficult to determine. The information accrued can provide for more educated decisions, hopefully avoiding unnecessary expenditures of capital and effort, and will point out which are effective and feasible candidates for continuation. Wright et al (2005) outlines procedures for monitoring quail habitat, as does Reyna et al (2006), whose work also includes means to assess potential nest predation.

Rollins et al (2005) shows how to survey quail populations. Direct counts such as roadside counts, helicopter surveys, covey flush rates, drive counts, line-transect, and mark-recapture are discussed with particular attention to the relative usefulness of each to various situations and needs. Indirect counts such as call counts, age ratios, and artificial nests are likewise presented.

## **SUMMARY**

Dedicated land managers who desire to enhance and/or and sustain scaled quail populations in the Trans-Pecos should give particular attention to grazing management, and the amount of grass remaining at all times of the year, even during drought. Nesting success is critical for healthy quail populations and is largely dependent on adequate nesting cover. In the drought-prone region, management efforts aimed at maximizing the effectiveness of rainfall may also contribute significantly to scaled quail production. Observe plant communities and structure in your area known to produce high scaled quail densities, and strive to replicate them to the degree feasible across the landscape.

## LITERATURE CITED

- Bridges, A. S., M. J. Peterson, N. J. Silvy, F. E. Smeins, and X. B. Wu. 2001. Differential influence of weather on regional quail abundance in Texas. *Journal of Wildlife Management* 65(1):10-18.
- Bristow, K. D. and R. A. Ockenfels. 2006. Fall and winter habitat use by scaled quail in southeastern Arizona. *Rangeland Ecology and Management* 59(3):308-313.
- Buntyn, R. J. 2004. Reproductive ecology and studies of scaled quail in the Trans-Pecos region of Texas. M.S. Thesis. Angelo State University, San Angelo, Texas. 58 pp.
- Cain, J. R. and S. L. Beasom. 1983. A guide for aging scaled quail. Texas Agricultural Experiment Station, Texas A&M University, College Station. B-1447. 8 pp.
- Campbell, H. and L. Lee. 1953. Studies of quail malaria in New Mexico and notes on other aspects of quail populations. New Mexico Department of Game and Fish, Santa Fe. Project W-41-R. 79 pp.
- Cantu, R., D. Rollins, and S. P. Lerich. 2006. Scaled quail in Texas. Texas Parks and Wildlife Department, Austin. PWD BK W7000-1183. 32 pp.
- Carter, P. S. 1995. Post-burn ecology of northern bobwhites in west Texas. Thesis. Angelo State University, San Angelo, Texas.
- Cearley, K. A. 1999. Does pricklypear protect quail nests? Pages 96-98 *in* K. A. Cearley, ed., Proc. Preserving Texas' Quail Heritage into the 21<sup>st</sup> Century Symposium, 13-15 October 1999, Abilene. Texas Cooperative Extension, San Angelo. 163 pp.
- Evans, C. A. 1997. Reproductive biology of scaled quail (*Callipepla squamata*) in southern New Mexico. M.S. Thesis. New Mexico State University, Las Cruces. 74 pp.
- Guthery, F. S., and S. L. Beasom. 1977. Responses of game and non-game wildlife to predator control in South Texas. *Journal of Range Management* 30:404-409.
- Harveson, L. A. 2004. Ecology and management of west Texas quail. Pages 26-28 *in* F. Hernandez and D. Doan-Crider, eds., Proc. Texas Quail Short Course III. Texas A&M University, Kingsville.
- Henson, K. D. 2006. Species visitation at free-choice quail feeders in west Texas. M.S. Thesis. Texas A&M University, College Station. 61 pp.
- Krausman, P. R., S. S. Rosenstock, and J. W. Cain III. 2006. Developed waters for wildlife: science, perception, values, and controversy. *Wildlife Society Bulletin* 34(3):563-569.
- Kuvlesky, W. P., T. E. Fulbright, and R. Engel-Wilson. 2002. The impact of invasive exotic grasses on quail in the southwestern United States. Pages 118-128 *in* S. J. DeMaso, W. P. Kuvlesky Jr., F. Hernandez, and M. E. Berger, eds., Quail V: Proceedings of the Fifth National Quail Symposium. Texas Parks and Wildlife Department, Austin.

- Lehmann, V. W. 1984. Bobwhites in the Rio Grande Plain of Texas. Texas A&M University Press, College Station. 371 pp.
- Pleasant, G. D. 2003. Nesting ecology, health, and survival of scaled quail in the Southern High Plains of Texas. M.S. Thesis. Texas Tech University, Lubbock. 80 pp.
- Pleasant, G. D., C. B. Dabbert, and R. B. Mitchell. 2003. Evaluation of the moisture-facilitated nest depredation hypothesis in a semi-arid environment. *Wilson Bulletin* 115(3):343-346.
- Pleasant, G. D., C. B. Dabbert, and R. B. Mitchell. 2006. Nesting ecology and survival of scaled quail in the Southern High Plains of Texas. *Journal of Wildlife Management* 70(3):632-640.
- Reid, R. R., C. E. Grue, and N. J. Silvy. 1979. Competition between bobwhite and scaled quail for habitat in Texas. *Proc. Annual Conference Southeastern Association Fish and Wildlife Agencies* 33:146-153.
- Reid, R. R., C. E. Grue, and N. J. Silvy. 1993. Habitat requirements of breeding scaled quail in Texas. Pages 137-142 in K. E. Church and T. V. Dailey, eds., *Quail III: Proceedings of the Third National Quail Symposium*. Kansas Department of Wildlife and Parks, Pratt.
- Reyna, K. D. Rollins, B. Taylor, and D. Ransom Jr. 2006. The Texas quail index: a citizen science effort to monitor ranch-level quail dynamics. Pages 4-11 in D. Ransom Jr., J. Sanders, and S. B. Lyda, eds., *Proc. Red River Quail Symposium*, 11-13 October 2006, Wichita Falls, Texas. Texas Cooperative Extension, San Angelo, and Oklahoma State University, Stillwater. 126 pp.
- Rollins, D. 1996. Ecology and management of blue quail in Texas. Pages 93-103 in W. E. Cohen, ed., *Proc. Texas Quail Short Course II*. Texas Agricultural Extension Service, Texas A&M University, College Station.
- Rollins, D. 1997. Applied landscaping: A primer for brush sculptors. Pages 127-32 in D. Rollins, D. N. Ueckert, and C. G. Brown, eds., *Proc. Brush Sculptors Symposium*. Texas Agricultural Extension Service. San Angelo.
- Rollins, D. 1999. Is there a place for predator control in quail management?: a point. Pages 45-48 in K. A. Cearley, ed., *Proc. Preserving Texas' Quail Heritage into the 21<sup>st</sup> Century Symposium*, 13-15 October 1999, Abilene. Texas Cooperative Extension, San Angelo. 163 pp.
- Rollins, D. 2000. Status, ecology, and management of scaled quail in west Texas. Pages 165-172 in L. A. Brennan, W. E. Palmer, L. W. Berger, Jr., and T. L. Pruden, eds. *Quail IV: Proceedings of the Fourth National Quail Symposium*. Tall Timbers Research Station, Tallahassee, FL.
- Rollins, D., J. Brooks, N. Wilkins, and D. Ransom Jr. 2005. Counting quail. Texas Cooperative Extension, Texas A&M University, College Station. B-6173. 11 pp.
- Sauer, J. R., J. E. Hines, and J. Fallon. 2007. The North American Breeding Bird Survey, Results and Analysis 1966-2006. Version 10.13.2007. USGS Patuxent Wildlife Research Center, Laurel, MD.
- Schemnitz, S.D. 1961. Ecology of the scaled quail in the Oklahoma panhandle. *Wildlife Monographs* 8.
- Schemnitz, S. D. 1994. Scaled quail (*Callipepla squamata*) in A. Poole and F. Gill, eds., *The Birds of North America*, no. 106. Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

- Schemnitz, D. S., J. L. Dye, and M. Cardenas. 1998. Fall and winter foods of scaled and gambel's quail in southwestern New Mexico. New Mexico State University, Las Cruces. Agricultural Experiment Station Bulletin 777. 15 pp.
- Silvy, N. J., D. Rollins, and S. W. Whisenant. 2007. Scaled quail ecology and life history. Pages 65-88 in L. A. Brennan ed., Texas Quails. Texas A&M Press, College Station. 491 pp.
- Slater, C. S., D. Rollins, R. C. Dowler, and C. B. Scott. 2001. *Opuntia*: a "prickly paradigm" for quail management in west-central Texas. Wildlife Society Bulletin 29(2)713-719.
- Texas Parks and Wildlife Department. 2007. Quail forecast: Trans-Pecos. [http://www.tpwd.state.tx.us/huntwild/hunt/planning/quail\\_forecast/forecast/trans\\_pecos/](http://www.tpwd.state.tx.us/huntwild/hunt/planning/quail_forecast/forecast/trans_pecos/). Accessed 10 June 08.
- Ueckert, D.N. and Petersen, J.L. 2002. Water conservation for restoration of wildlife habitats. Pages 101-114 in Harveson, L.A., Harveson, P.M. and Richardson, C. eds., Proc. Trans Pecos Wildlife Conference. Aug. 1-2, 2002. Sul Ross State University, Alpine, Texas.
- Wallmo, O. C. 1956. Ecology of scaled quail in west Texas. Texas Game and Fish Commission, Austin, and A&M College of Texas, College Station. Project W-57-R. 58 pp.
- Wright, B. D., J. C. Cathey, and R. K. Lyons. 2005. Habitat monitoring for quail on Texas Rangelands. Texas Cooperative Extension, Texas A&M University, College Station. B-6172. 17 pp.

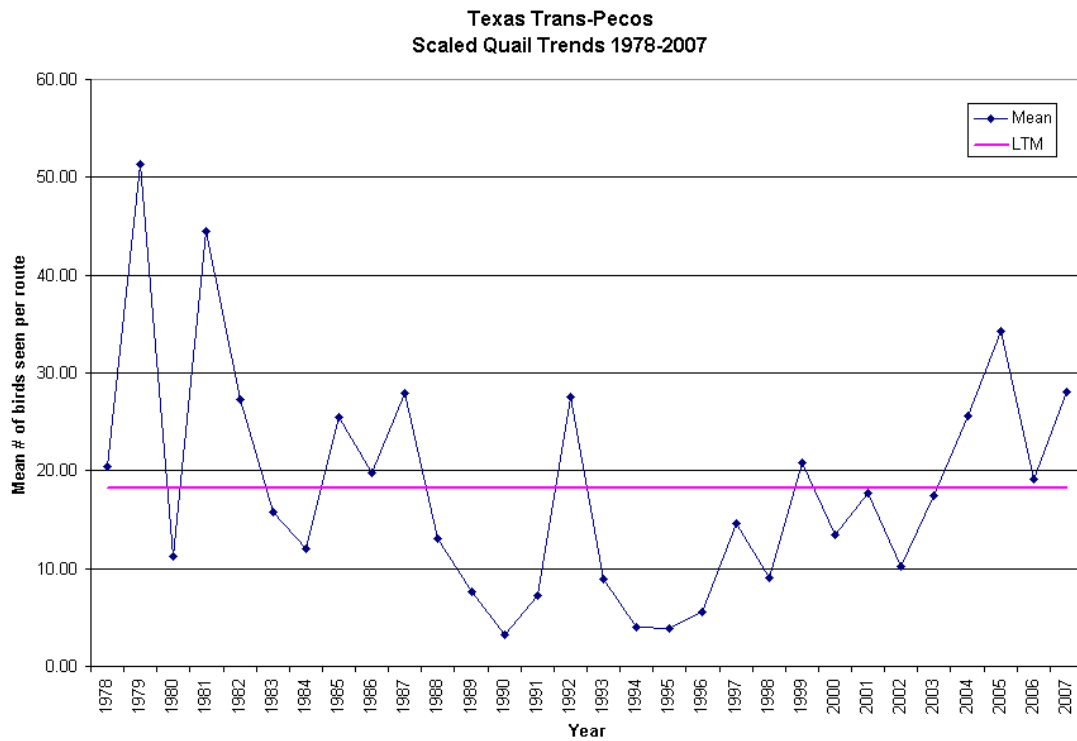


Figure 1. Texas Parks and Wildlife Department roadside count results showing numbers of scaled quail in the Trans Pecos region from 1978 to 2006 using randomly selected, 20-mile roadside survey lines.