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John C. Kinsey
Texas State University

Michael F. Small
Texas State University

Thomas R. Simpson
Texas State University

Robert M. Perez
Texas Parks and Wildlife Department

John T. Baccus
Texas State University

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John C. Kinsey
Department of Biology, Wildlife Ecology Program, Texas State University, 601 University Drive, San Marcos, TX 78666, USA

Michael F. Small
Department of Biology, Wildlife Ecology Program, Texas State University, 601 University Drive, San Marcos, TX 78666, USA

Thomas R. Simpson
Department of Biology, Wildlife Ecology Program, Texas State University, 601 University Drive, San Marcos, TX 78666, USA

Robert M. Perez
Texas Parks and Wildlife Department, Box 1081, LaVernia, TX 78121 USA

John T. Baccus[1]
Department of Biology, Wildlife Ecology Program, Texas State University, 601 University Drive, San Marcos, TX 78666, USA

ABSTRACT

Attempts to restore populations of northern bobwhites (*Colinus virginianus*) using pen-raised quail have been documented since the early 1900s. Low restoration success, based on low post-release survival rates and long distance dispersal from release sites, have proven the ineffectiveness of pen-raised quail in restoration of wild populations. The Surrogator®, a recent quail propagation tool using pen-raised quail, has been publicized as a method for increasing success rates in restoration of northern bobwhite populations by producing higher post-release survival and minimal dispersal. We tested the hypothesis that the Surrogator® is an effective means of supplementing populations of northern bobwhites in southern Texas. We raised 1,000 northern bobwhites in 2 Surrogators and conducted 2 trials in 2010 on a 990-ha ranch in Wilson County, Texas. Twenty northern bobwhites from each Surrogator were fitted with radio transmitters 12 hrs before release. We attempted to locate each bird daily for 3 weeks upon release from Surrogators followed by a reduced effort of 3 times per week until 100% mortality. Daily survival rates were low in Trial 1 (Surrogator A = 0.87 and Surrogator B = 0.96) and Trial 2 (Surrogator A = 0.83 and Surrogator B = 0.87). Mean distances traveled by post-released birds for Trial 1 were 401 and 1,416 m for Surrogators A and B, respectively. The Surrogator is not an effective means of restoring wild populations of northern bobwhites in southern Texas.

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Key words: *Colinus virginianus*, dispersal, northern bobwhite, post-release survival, restoration of population, southern Texas, Surrogator

INTRODUCTION

Northern bobwhites are one of North America's most economically important game birds, especially in the southern and Midwestern United States (Brennan 1999, Burger et al. 1999). The decline of bobwhite populations first became a matter of concern to wildlife managers in the early 1900s (Leopold 1931). Subsequently, concern grew among wildlife biologists when bobwhite populations became substantially reduced or extirpated in northern areas and a trend of declining numbers in the central part of the distribution was documented (Brennan 1993). Broad-scale data derived from Christmas Bird Counts, Breeding Bird Surveys, and state game agencies provided strong evidence of a widespread decline throughout the United States (Brennan 1991, 1993). Annual estimated declines from 1966 to 1988 in the United States averaged 1.8% per year with estimated declines of 0.7% in the central range and 3% per year in the eastern distribution (Droege and Sauer 1990).

These declines were attributed primarily to habitat loss from changing agricultural and forestry land-use patterns and expanding urbanization (Leopold 1933, Rosene 1969, Lehmann 1984, Wilkins and Swank 1992, Brennan 1993). Northern bobwhite populations in Texas have declined at an estimated rate of 5.6% per year since

[1] *E-mail: john.baccus@ttu.edu*

1980 (Texas Parks and Wildlife Department 2005) with many factors likely involved in declining populations including habitat loss and fragmentation (Veech 2006).

Wildlife biologists have attempted to restore bobwhite populations using pen-raised quail since the early 1900s with artificial propagation regarded as a quick fix (McAtee 1930, Barron 1935, Handley 1938, Nestler and Bailey 1941, Hart and Mitchell 1947, Kozicky 1993, Perez et al. 2002); however, this method proved unsuccessful for replenishing bobwhite populations. Two recognized problems associated with restoration using pen-raised birds were low survival rates post-release (averaging 8-15 days) and long-distance dispersal from release sites (Baumgartner 1944, Buechner 1950, Roseberry et al. 1987, Oakley et al. 2002).

Long-term population decline estimates of 2.4% per year for northern bobwhites throughout North America, coupled with unsuccessful attempts to restore populations, led to development of a game-bird propagation tool called the Surrogator® (Church et al. 1993). The Surrogator provides food, water, heat, and shelter for day-old chicks through the first 5 weeks of life during which the only contact chicks have with humans is during weekly maintenance. Quail are released after 5 weeks into the wild. The artificial brooding facility was developed to enhance existing methods for releasing pen-raised game birds to supplement existing wild populations.

Wildlife Management Technologies (WMT) reported 300,000 bobwhite quail released from Surrogators in 2006 had a survival rate of 65% (WMT 2009). The company also suggests site fidelity is instilled in quail raised in the Surrogator by imprinting to an area (WMT 2009). The objectives of our study were to test whether pen-reared northern bobwhites raised in Surrogators have increased (1) survival rates and (2) minimal dispersal rates. We tested the hypothesis that the Surrogator is an effective means of supplementing populations of northern bobwhites in southern Texas.

STUDY AREA

Our study was conducted on a 990-ha, high-fenced, ranch (29° 11′ 23.53” N, 97° 49′ 22.31” W) 12.8 km southwest of Nixon, Wilson County, Texas, in the Rio Grande Plains ecological area near the northern extent of the South Texas Plains ecoregion (Gould 1975). The ranch has characteristics of both South Texas Plains and Post Oak Savannah ecoregions. Approximately 70% of the ranch has native mesquite (*Prosopis*) thickets consisting largely of honey mesquite (*P. glandulosa*), granjeno (*Celtis pallida*), black brush (*Acacia rigidula*), and various species of cacti (*Opuntia* spp.). Oaks (*Quercus* spp.) are the predominant tree cover.

Predominant grass species include buffelgrass (*Pennisetum ciliare*), bristle grass (*Setaria* spp.), windmill grass (*Chloris truncata*), sideoats grama (*Bouteloua curtipendula*), and little bluestem (*Schizachyrium scoparium*). An abundance of forbs including Texas croton (*Croton texensis*) and western ragweed (*Ambrosia psilostachya*) provided ground cover at the time chicks were released from Surrogators.

METHODS

Field Procedures

Our study was conducted in late spring and summer 2010 using 2 Surrogators. We carefully followed guidelines in the Surrogator System Guide (WMT 2009). Two trials were conducted with Surrogators placed at different locations on the ranch (~1,500 m apart) in areas we categorized as suitable northern bobwhite habitat. We defined suitable habitat as areas providing shade and ample vegetative cover for food and escape from predators (WMT 2009). All vegetation and leaf litter at each site were removed from the immediate surrounding area for ease of maintenance. A 1.83-m length x 3.05-m width x 1.52-m height fence of cattle panels was constructed around each Surrogator to keep resident elk (*Cervus elaphus*) from damaging or disturbing Surrogators. Surrogators were placed following standard guidelines (WMT 2009). The same locations were used for both trials.

Surrogator Use

Trial 1 involved placing 250 1-day-old northern bobwhite chicks purchased from Outdoor Access Quail Farm (Devine, TX, USA) in each Surrogator on 11 June. Chicks were maintained in Surrogators for 5 weeks. We conducted weekly maintenance (i.e., adding water, removing fatalities, application of ant bait, and adjustment of heat settings) during this period as recommended (WMT 2009). Each chick received a color leg-band for future identification after 5 weeks in Surrogators, and 20 randomly selected chicks from each Surrogator were each fitted with a 3.5-g necklace radiotransmitter (Advanced Telemetry Systems, Isanti, MN, USA) after which chicks were returned to Surrogators. We released chicks from each Surrogator the following morning (17 Jul) by opening all doors ~30 min after sunrise. We immediately evacuated the area allowing for a soft release (WMT 2009). We returned to each release site 12 hrs later to confirm all chicks had left the units. We used the same protocol for Trial 2. Chicks were placed in Surrogators on 27 July and released on 2 October.

Radiotracking and GPS

We used a telemetry receiver (Model D50; Advanced Telemetry Systems, Isanti, MN, USA) to locate chicks released from both Surrogators and a Garmin eTrex Vista HCx hand-held Global Positioning System (GPS) unit (Garmin Inc., Olathe, KS, USA) to obtain locations of each individual. We radiotracked chicks on alternate days for 7 days because mortality substantially reduced the number of radiotracked quail by day 7, each surviving chick was located daily for 2 weeks. Individuals were located 3 times weekly following the 3-week period until mortality reached 100%.

Analyses

We used a Maximum Likelihood Estimator (Bart and Robson 1982) to calculate daily survival rates for chicks from each Surrogator for each release (Krebs 1999). We extrapolated daily survival estimates to estimate survival to the first day of the 2010 bobwhite hunting season (105 and 33 days) and an annual survival rate (365 days).

We downloaded the 2010 National Agriculture Imagery Program Mosaic Map from the Texas Natural Resources Conservation Services (www.tnris.org/get-data) and imported it into ArcGIS, Version 9.3 (ESRI 2008). We transferred chick observation locations and Surrogator release sites from the GPS unit to ArcGIS using Garmin software obtained from the Minnesota Department of Natural Resources (http://www.dnr.state.mn.us/rlp/index.html). We created a map using layers of observation points from each release site, locations for both Surrogators, and dispersal locations of chicks released from Surrogators. We joined the observation location layer to the release site layer of both releases through a distance spatial join function. This created a distance attribute with the measured distance (m) of each chick observation to its respective release site. We reclassified observations to include chicks observed a minimum of 5 times to allow for acclimation to transmitters and to reduce any bias in dispersal distance influenced by early mortality.

We used the attribute statistic function in ArcGIS and data from the distance attribute to calculate minimum distance, maximum distance, and mean ($\pm$ SD) distance for the remaining bobwhites. We generated a scatter plot in Microsoft Excel (Microsoft Inc., Bellevue, WA, USA) depicting the relationship between number of days post-release and distance each chick dispersed from its respective release site. All activities were conducted in accordance with Texas State University-San Marcos IACUC approval # 0825_0804_26 and Texas permit #SPR-0890-234.

RESULTS

Survival

Mean weekly pre-release bobwhite mortality was < 2 mortalities per week for both surrogators combined for Trial 1. The Maximum Likelihood Estimates of Daily Survival Rates for chicks released from Surrogators A and B were 0.87 and 0.96, respectively. The 105-day finite survival rate (number of days from release to bobwhite hunting season) was > 0.01 (95% CI = 0 - $>$ 0.01) and 0.0167 (95% CI = 0.01-0.08) for Surrogators A and B, respectively. The 365-day finite survival rate for Surrogator A was 0 and > 0.01 for Surrogator B. The number of live chicks declined sharply over time from release to 100% mortality (Figs. 1, 2).

Mean weekly pre-release bobwhite mortality was 4 chicks per week for both Surrogators combined during Trial 2. The Maximum Likelihood Estimates of Daily Survival Rates for chicks released from Surrogators A and B were 0.86 and 0.87, respectively. The 33-day finite survival rate was > 0.01 (95% CI = $>$ 0.01-0.01) and 0.01 (95% CI = $>$ 0.01-0.05) for Surrogators A and B, respectively. The 365-day finite survival rate for both Surrogators was 0.

Dispersal

Released chicks readily moved from Surrogators. The mean dispersal distance from Surrogator A was 401.3 $\pm$ 263.6 m (max = 630.6 m, min = 118.4 m) and 1,416.5 $\pm$ 581.1 m (max = 2,036.3 m, min = 537.0 m) for Surrogator B during Trial 1. Dispersal data for Trial 2 had an insufficient sample size ($n < 2$).

DISCUSSION

Wildlife Management Technologies reported about 300,000 quail released from Surrogators in 2006 had a mean survival of 65% to the hunting season and quail released from Surrogators successfully reproduced during the next breeding season (WMT 2009). However, using the upper 95% confidence interval survival rate (0.08) calculated for our most successful release, 100-released northern bobwhite would have only 8 individuals survive until the first day of the next bobwhite hunting season. Thus, to acquire a favorable hunting density of 1.25 bobwhites/ha on our 990-ha study site, 153 releases of 100 bobwhites per release would be required simultaneously to have 1,222 live bobwhites available for harvest on opening day. Thus, using these survival rates, 2,000,000 bobwhites would have to be released simultaneously for 2 survivors to the next breeding season with only a 50% chance that a surviving pair would be a breeding pair. Maple and Silvy (1988), depending on the season of release, also had variable survival rates ranging from 1.9 to 58.3% for pen-raised adult northern bobwhites released in northern Texas. Krebs (2009) illustrated how single birds have a greater probability of predation than birds in a group. This was evident in our study by the lack of group cohesiveness and lower survival among chicks for the second release versus chicks from the first release.

Wildlife Management Technologies (2009) indicated properly raised bobwhites in Surrogator units were instilled with site fidelity and imprint on the property where released. The results of our study did not support these findings. The majority of our observations were on the study area, but we observed bobwhites with the greatest survival time occurred at greater distances from release sites, including observations on neighboring ranches and at distances much greater than the mean home range size for northern bobwhites (Brennan 1999).

The broader range of dispersal distances and dispersal distribution of northern bobwhites from Surrogator B may be explained by the difference in number of observations (Surrogator A = 43, Surrogator B = 203) and increased survival of chicks from Surrogator B compared to Surrogator A (4 and 10 weeks, respectively). Dispersal distance from respective Surrogators increased as number of days post-release increased (Fig. 2).

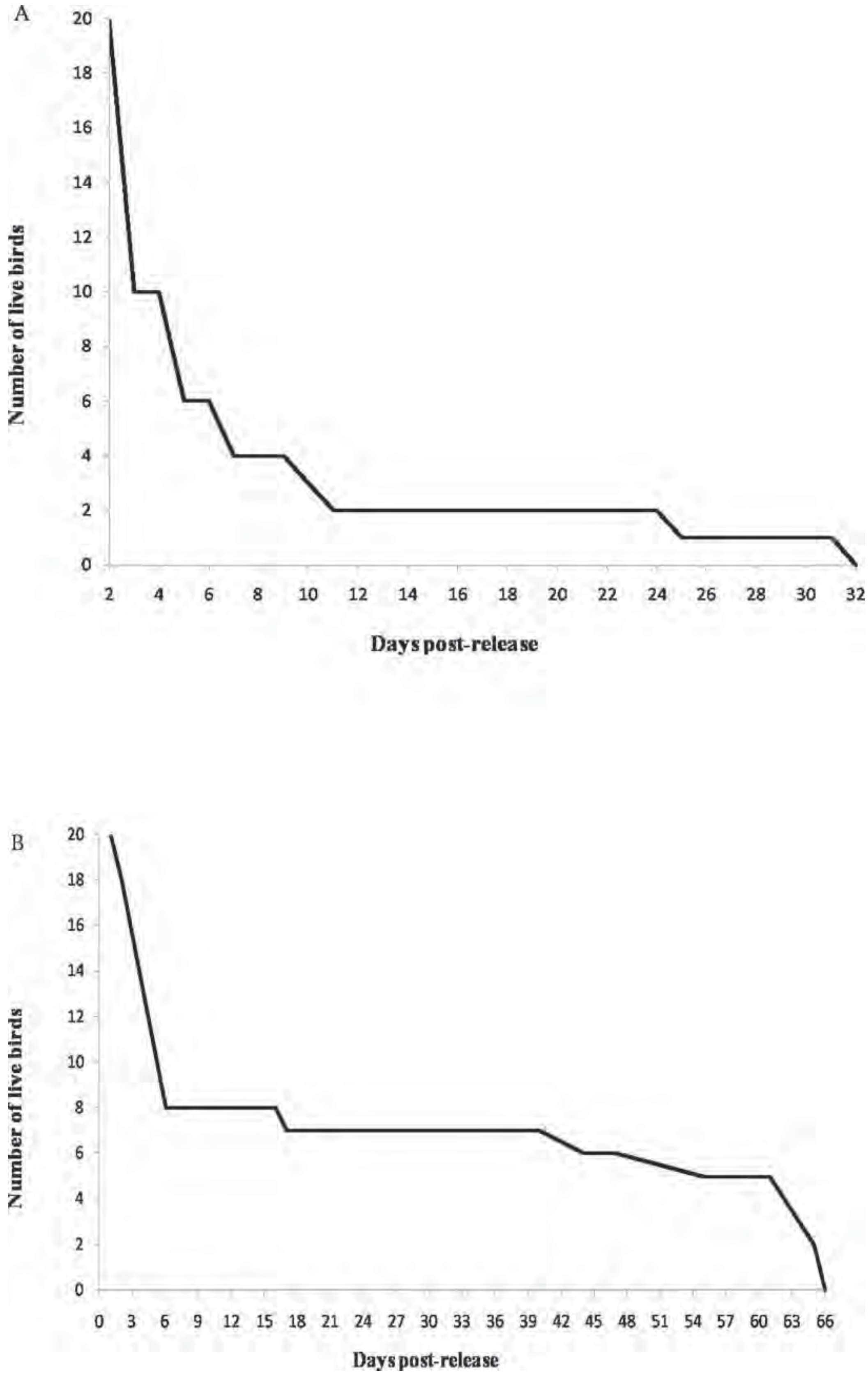

Fig. 1. Post-release survival of northern bobwhites released from Surrogator (A) and Surrogator (B) during Trial 1 in 2010 at the Sheffield Ranch, Wilson County, Texas.

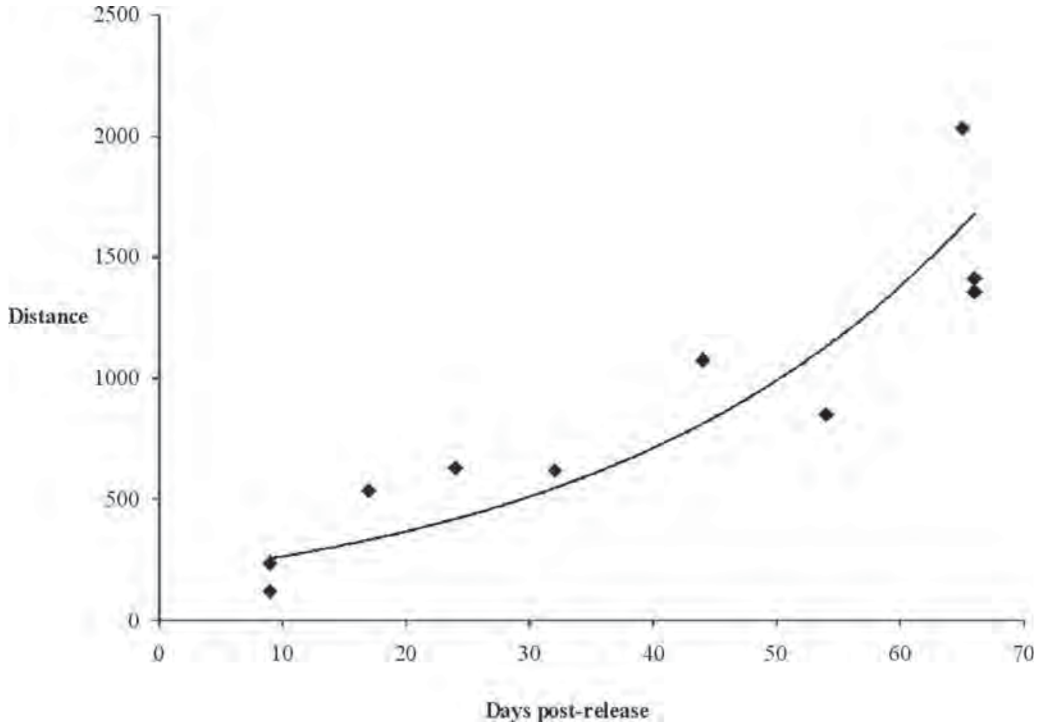

Fig. 2. Relationship between days of survival post-release and dispersal distance (m) from release site of northern bobwhites released from Surrogators during Trial 1 in 2010 at the Sheffield Ranch, Wilson County, Texas.

MANAGEMENT IMPLICATIONS

We rejected the hypothesis that the Surrogator is an effective method for supplementing populations of wild northern bobwhites in southern Texas. The Surrogator has become a tool used by landowners with varying success, and we sought to provide information for landowners and Texas Parks and Wildlife biologists for informed decisions for purchase and potential use of this propagation tool. We recommend a best practice for maintaining consistent bobwhite populations by investing in habitat management that increases native bunchgrasses and forbs, managing grazing by livestock, use of prescribed burning, and control of harvest of the annual production of northern bobwhites.

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