THE SOUTH TEXAS QUAIL STUDY: ABERRANT FINDINGS USING TECHNOLOGICALLY BASED METHODS

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Abstract: Our research project was designed to test specific hypotheses of bobwhites with regard to their movement in time and space and to obtain information on northern bobwhites that is missing or scantly reported. Specifically, our research addressed management and hunting-related hypotheses that could not be addressed using traditional methodology. Over 250 bobwhites were fitted with necklace radiotransmitters weighing <4% of their body mass and fitted with aluminum leg bands during the past year. We used mark-recapture, radiotelemetry homing technique, Global Positioning Systems (GPS), and Geographic Information Systems (GIS) to measure temporal and spatial patterns of free-ranging bobwhites throughout the year. These methodologies allowed us to determine habitat preference and avoidance by mapping locations for each radiotransmittered bird. Physical and behavioral attributes were collected during the year. Likewise, reproductive performance, such as pair bonding, nesting, incubation, clutch size, hatchability, and brood success was determined using technologically based methods with minimal disturbance to the animal. However, technological advances can be a double-edge sword. The advantages and disadvantages of these technologies must be considered prior to implementation of any study. This is critical with animals that may alter their physiological requirements, behaviors, or result in detrimental effects to their health and survival.

Introduction

Founders of wildlife management, such as Paul Errington, Aldo Leopold, Val Lehmann, and Herbert Stoddard, conducted intensive life history studies on northern bobwhites (Colinus virginianus) during the early 1900's. Although traditional methodology studies on northern bobwhites have been conducted for nearly a century (Judd 1905), we can still drive across our ranches and ask 101 questions about temporal or spatial aspects of this bird that can not be answered or biologically explained.

The goals of The South Texas Quail Project, a 4-year project, are to address basic life requirement issues of free-ranging northern bobwhites in southern Texas using band recovery, radiotelemetry, Global Positioning Systems (GPS), and Geographic Information Systems (GIS). This life history data collected using advanced technologies will be used to address more complex issues, such as distribution and dispersal patterns, population dynamics, and to provide empirical data for testing population models. The purpose of this paper is to highlight aberrant findings that may or may not have been a result of the technological equipment.

We designed our first year's research to address 2 broad categories: (1) habitat management and (2) hunting-related issues. We modeled our study after the 10-year duration Albany Project conducted in Georgia. Our management-related objectives were to determine: (1) if adult bobwhites selected or avoided specific habitat types, (2) if adult bobwhites with a brood selected or avoided specific habitat types, (3) the annual survival/mortality rate of bobwhites in root plowed and chained habitats, (4) the spatial and temporal movements during the year, and (5) reproductive performance.

Our hunting-related objectives were to determine: (1) if bobwhites alter use of habitats in response to hunting; (2) if bobwhites change their activity patterns during the hunting season; (3) if hunting is adding to the annual mortality rate; (4) which hunting patterns are detrimental to bobwhite populations; and (5) if there is an index to gauge hunting intensity on bobwhite populations.

Research was conducted on 2 sites in Brooks County, Texas. The site is within the Gulf Coast Prairie (GCP) ecoregion in southern Texas. The rainfall patterns during this past year ranged from drought conditions from April to August 1998, below average rainfall during the winter, to average rainfall during spring and summer 1999. The predominant vegatative associations in the GCP were chaparral-mixed grass, honey mesquite (Prosopis glandulosa)-mixed grass, and live oak (Quercus virginiana)-chaparral communities.

The technological methodology chosen for our study was predicted to provide accurate, decisive, and timely data regarding our hypotheses. Our study design was replicated in space and time; that is, we have 2 separate research areas that are monitored throughout the year. The research sites are 3,000 acres and separated by 3 miles. Therefore, both sites receive similar rainfall patterns and were hunted at similar intensities. However, these pastures have undergone different brush management. The "South" pasture was root plowed but strips of brush were kept during 1969. Herbicide treatment was applied twice since 1986 within this pasture. The "North" pasture was chained but strips of brush were kept during 1969. These strips were rechained in 1994.

Radiotelemetry Technology

It is uncertain which individual should be credited as the first to use radio-tracking for wildlife. Supposedly, the first scientific article using radiotelemetry was published in the Journal of Wildlife Management during 1959 and was entitled "Design of a miniature radio transmitter for use in animals studies" by LeMunyan et al. (Mech 1983). Many improvements in basic radiotelemetry hardware have occurred since this article (Cochran 1980, Kuechle 1982). However, the basic principles and components remained constant.

Radiotelemetry systems have 2 major parts, (1) a transmitting system, and (2) a receiving system. The transmitting system consists of a transmitter, a power source, and a transmitting antenna. The components are attached to the animal in a collar or harness. These components have become smaller and lighter which resulted in radiotelemetry studies on smaller animals. The radiotransmitters used in this project are 2 ounces and fit around the bird's neck by an elastic collar and rests above the "craw". The receiving system consists of a receiver, a power source, a receiving antenna, and an operator or a recorder.

An underlying assumption for radiotelemetry methodology is that the instrumented animal moves through its environment, responding to stimuli, and behaving similar to non-radio-transmittered animals. It is also reasonable to expect that the researcher may impact the animals through the capture, handling, and attachment of the radio transmitter. Whether or not these effects can be dismissed as inconsequential depends on the nature of the effects and the objectives of the study (White and Garrott 1990).

For the past 30 years, research studies using radio-tracking techniques resulted in data that addressed a diversity of questions. This may be a reflection of the commercial availability of radiotelemetry equipment, improvements in ready-made transmitter collars, increased acceptance of radio-tracking by professionals, or the advances in microcomputer technology to analyze data. Nonetheless, there is an abundance of information on field techniques and radio-tracking equipment, but only scant information on study design, sample sizes, and appropriate analytical procedures (White and Garrott 1990).

Global Positioning Systems

Global Positioning Systems (GPS) is a technology that employs the use of U.S. Department of Defense satellites to determine precise ground locations. This positional technology achieved its initial operating capability on December 8, 1993 when 24 GPS satellites were successfully operating simultaneously. GPS technology operates using this constellation of satellites orbiting the Earth on precise orbital paths. Each of these satellites contains nuclear clocks that are accurate to the nanosecond. Therefore, both time and orbital path information is sent in code via radio waves to earth on 2 separate frequencies.

Two separate sets of code are sent on both frequencies; one for civilian use and the other is for military use. The civilian code contains uncorrected accuracies. Therefore, "recreational GPS units" have reduced accuracy. However, the same 3 sets of data are sent from each satellite: (1) ephemerous, (2) almanac, and (3) time. The ephemerous data provides the exact location (orbital path) of the individual satellite and is updated every 2 hours. The almanac is a list of all 24 satellites in the constellation, which is sent by a single satellite to calibrate receivers and aid in mission planning. Time is sent to enable the receivers to determine the length of time it took for the signals to travel from the satellite to the receiver. Therefore, when signals are received from the satellite, a speed of light calculation is made to determine the exact distance from the receiver to the satellite. The ephemerous aids in this calculation of distance. Once the receiver has obtained data from 3 satellites a horizontal position can be determined.

Four satellites are required for the receiver to obtain a 3 dimensional position. The advantages of this methodology are numerous compared to traditionally surveying methodology. GPS systems allow for the ability to obtain continuous position fixes, accurate measurements within seconds, worldwide coverage, and 3-dimensional data. Additionally, measurements can be obtained over very long distances in which line-of-sight between ground points is not necessary. Unfortunately, there is a need for line-of-sight to the sky; it does not work under closed canopies. Additionally, GPS technology requires a second stationary receiver (base station) with 300 miles.

Geographic Information Systems

Geographic Information Systems (GIS) is defined as a system of computer hardware and software designed to capture, store, and manipulate spatial (physical features above and below the earth's surface) and attribute (tabular) data. GIS, in their automated form, originated in the 1960s (DeMers 1997). GIS instruction was limited to a select few universities. Since then the numbers and types of systems, the potential users, and the types of technical training and conceptual education have increased similar to GPS and radiotelemetry technologies.

GPS lends itself to GIS applications because it combines positioning with attribute data capture. GIS data can also be gathered by scanning, digitizing, digital image processing and surveying. Commercially available software programs has made GIS application more user-friendly.

The modern electronic GIS has been a mixed blessing. Most of the problems related to GIS implementation today are nontechnical (DeMers 1997). It has produced a wide range of options for map design within an environment that allows relative ease of movement of the mapped objects. But it also has created some limitations on the nature of the output by restricting such items as color sets and symbol types. The permanent, hardcopy output from GIS also relies on the variety of output devices available for production. These products range in capabilities based on their ability to use on-board software to handle and translate the large data files.

Results

Movements of Adult Bobwhites

Spatial patterns of radiotransmittered northern bobwhites had specific daily, seasonal, and weather-related movements. Radiotransmittered individuals were located by homing technique. It is not apparent that these birds behaved any different during the radio-tracking. That is, there was no observed change in patterns such as flushing, running, or staying.

Temporal patterns of radiotransmittered birds during the drought tended to be associated with woody vegetation. This may be a factor of thermoregulation, cover for protection, or simply the fact that the drought restricted movements into isolated patches of suitable habitat.

Following the September and October rains, several coveys disbanded and dispersed distances that exceeded 2 miles. Initially, this coincides with the fall shuffle (Lehmann 1984). However, within a week of dispersal several nests were found. Late season nesting occurred in 16% of the radiotransmittered birds from October through mid-December. The aberrant nesting may have been a result of the severe drought conditions during the typical breeding season, but yearlong nesting has been reported in southern Texas (Lehmann 1984).

Movements of Adult Bobwhites with Chicks

Information regarding the critical stage of northern bobwhite's life is the first few weeks. Rather than attaching radiotransmitters on chicks, we relied on the adult radiotransmittered bird to locate chicks. Again, daily and weekly patterns were observed. We hypothesized that night roosting habitat would not vary significantly. However, for chicks < 7 days old, the typical habitat selected was a very dense stand of vegetation that provided vertical and horizontal screening, and perhaps increased thermoregulation. These chicks were either adjacent, under an outstretched wing, or nestled under the adult bird. It is apparent that predators were capturing the adult and presumably the chicks during this stage of development. This may indicate that insufficient dense vegetation remains to provide sufficient protection from predators. Between days 7 to 14, chicks may become more apt to thermoregulate and can be found a variety of roosting habitat. The behavior of the chicks still is to form aggregates during night roosting. After 21-days-old, chicks were commonly found in aggregates within typical adult night roosting habitats, but not forming the typical covey ring.

Fall Nests

The summer (April-August) drought of 1998 was followed by 7 inches of rainfall during both September and October. Late season nesting was observed from October to mid-December. Although rainfall is sometimes considered a spurious cause-effect for bobwhite reproduction, radiotransmittered birds within the North and South research pastures showed similar patterns in nesting, incubation, and hatch success. Clutch size averaged 12 eggs and 90% hatchability. Unfortunately, chick survival was not measured since the majority of the adult bobwhites with radiotransmitters were predated within 2 weeks post-hatching.

Twenty percent of the fall nests were incubated by males. In all cases, the males abandoned their nests and were found within 5 days with a hen and week-old chicks. Implications for these findings would suggest that males were either abandoning their nests to serve some function with another hen, or if the hen was the same bird that laid both nests, then it was a trade-off for ensuring one clutch survived. However, for this scenario to occur, the male would have to switch nests with the hen since the hen was the bird with the chicks. Unfortunately, no data were collected on the pair prior to these findings.

Fall nesting habitat was dominantly within cordgrass (Spartina spartinae). Bobwhites were using this vegetation type at a higher frequency than available. This perennial clump grass may have been chosen because of the overall poor range conditions due to the drought.

Spring Nests

Nesting was observed during the last week of March 1999. The March and April nests had an average of 16 eggs and 95% hatchability for those eggs that were not predated. There were 2 nests that exceeded 21 eggs; both these nests were predated. Nest predation increased during May and June. The average clutch size from May-July was 14 eggs with 90% hatchability for those eggs not predated. During the spring nesting, males incubated 10% of the nests.

Nesting habitat during March and April was dominantly within cordgrass. However, nests found in May-July were not under any dominant vegetation type. That is, nests were found within grass clumps consisting of threeawn and paspalum, and within forbs such as goldenweed and ragweed. Also, nests were located under woody vegetation and cactus. However, no differences in hatchability or predation rates were observed.

Aberrant Nesting

One nest this spring was incubated by a pen-released hen from the adjoining landowner. The hen was released during a hunt in mid-December approximately 3 miles from the nest site. It was paired with a male that was recently translocated 60 miles as part of another study. The male was predated after the hen laid its fifth egg. The hen skipped laying an egg the next day, but subsequently laid an egg-per-day for the next 2 days. However, it was located about 100 yards from the nest after the 7th egg was laid. The following day it was 400 yards from the nest. A few days later it was over 500 yards from the nest, and within that week, the hen was not found using radiotelemetry. It was searched from an airplane equipped with radiotelemetry receivers and still not found. To this date, it is still not found.

Broods during the fall were often in association of the adult pair, plus an additional adult bird. This finding was not evident during the spring. The associated bird was typically the first bird to flush. It was common to have both males and females as the additional bird with the brood.

A nest this spring was incubated by a radiotransmittered hen. Typical protocol was not to flush or disturb the nest after the initial finding. After determining the radiotransmittered hen was not at the nest, the nest was checked to determine its status. A non-radiotransmittered hen was flushed off this nest. The original radiotransmittered hen conducted the remainder of the incubation.

In July, a mated pair was monitored daily. The male and female were found in close proximity and always alone. During the last week of July, both the male and female were found incubating 2 different nests. We are anxious to see the outcome of these nests and if the pair will rejoin if both clutches are successful.

Predation

Mammalian predators were identified by evidence remaining at the mortality-signaled radiotransmitter. That is, the radiotransmitters are designed with a mercury switch that changes the pulse of the radiotransmitter after it remains stationary for > 8 hours. Evidence of mammal predators includes: (1) tooth impressions on the radiotransmitter, (2) tracks at the predation site, or (3) feathers that are scattered in a pattern indicative of a chase. Nearly 75% of all predation was classified as mammalian.

Avian predators were identified by: (1) bent or crimped radiotransmitter antenna, (2) decapitation, (3) wing removal, (4) radiotransmitter collected from a tree branch, or (5) radiotransmitter collected from a nest or fledgling. Nearly 20% of all predation was classified as avian. There were temporal patterns of avian predation. Notably, during great horned owl fledgling stages and during peak hawk migrations.

Conclusion

As with any scientific endeavor, the critical step in the implementation of a study is careful design. The technological advances in circuitry, computers, and satellites have become incorporated into new gadgetry used by wildlife scientists. Radiotelemetry, GPS, and GIS are nothing more than specialized techniques available to the researcher; not necessarily better than the tradition techniques available for collecting information.

However, these technological advances allow for observations that may not be detected using the traditional methodology. These observations can lead to new hypotheses, assuming these techniques are not altering individual's physiological, behavioral, or social patterns. Physiological significance of aberrant findings may indicate that northern bobwhites are capable of significant reproductive performance when environmental conditions are met. Behavioral significance of aberrant finding is not adequately studied in northern bobwhites. Therefore, the interaction between behavioral and physiological conditions must be addressed. The evolutionary significance for movement patterns in time and space, mating strategies, and predation in northern bobwhites is not yet fully understood. The significance of aberrant findings to researchers needs to be further researched to determine the frequency of such findings. And lastly, studies must be conducted to determine "why" such findings occur in nature.

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