HUNTING SUCCESS AND NORTHERN BOBWHITE DENSITY ON TALL TIMBERS RESEARCH STATION: 1970–2001

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ABSTRACT

Hunting success, defined as number of coveys found/hr of hunting, has been used as an index of population size of northern bobwhites (*Colinus virginianus*). However, the relationship between hunting success and bobwhite density has not been documented on individual study areas. We related estimates of bobwhite density on a 445-ha section of Tall Timbers Research Station (TTRS) to the number of coveys flushed/hr of hunting, 1970–2001. To estimate density of bobwhites, we captured bobwhites in baited-funnel traps for a 2–3 week period and recaptured 15–20% of banded birds by systematically hunting the study area using pointing bird dogs. Bobwhite population sizes, calculated using a bias-corrected Peterson estimate, were converted to densities because of changes in study area size over time. Annual density estimates and hunting success ranged from 0.7–4.8 bobwhites/ha and 0.5–2.9 covey finds/hr over the study period, respectively. We assessed the variance in bobwhite abundance explained by year and hunting success using multiple linear regression. There was a significant positive relationship between covey finds/hr and bobwhite density (t_{25} = 9.070, P = <0.0001). Covey finds/hr explained the greatest amount of variation (r^2 = 0.77) in density. Our data suggest that if hunting procedures are standardized over time, hunting success may be used to index bobwhite abundance, and potentially provide crude estimates of population density.

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Key words: *Colinus virginianus,* Florida, hunting success, northern bobwhite, population density, population trends, Tall Timbers Research Station

INTRODUCTION

Records of hunting success are commonly maintained for private and public hunting areas (Vance and Ellis 1972, Brennan and Jacobson 1992, Brennan et al. 1997). Biologists have used this information, summarized as number of covey observations/unit of hunting effort, to index abundance of bobwhites (Rosene 1969, Brennan et al. 1997) and other game birds (Tapper 1992). This information may be the only available long-term index of game bird populations on certain areas (Church et al. 1993). In the Red Hills of northern Florida and southern Georgia, plantation owners maintain detailed records of hunting success, some of which span nearly 100 years (Brennan et al. 2000). While statewide indices of bobwhite abundance have been linked to statewide harvests (Schwartz 1974, Peterson and Perez 2000), the value of using hunting success as an index of bobwhite abundance on a managed area has not been assessed. Therefore, we estimated bobwhite abundance on TTRS and determined if hunting success was a useful index of bobwhite abundance from 1970–2001.

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STUDY AREA

From 1970–1997 we used a 445-ha portion of TTRS located in Leon County, Florida, to estimate bobwhite density and hunting success. During this period, the study area was divided into 2 sections, 1 north and 1 south of County Road 12. Because these areas were sometimes managed differently, and quail densities were thought to differ in some years, we analyzed data collected on each sub-section as well as on the overall area. After 1997, the study area was increased to a single 805 ha and was composed of upland pine forests (65%), hardwood forested hammocks and drains (21%), and fields (14%). Over the course of the study, prescribed fire was used annually to maintain open upland pine forests. Fields were either planted in crops, annually disked, or left fallow for multiple years. Kellogg et al. (1972) and DeVos and Mueller (1993) provide additional descriptions of the study area.

METHODS

During 1970–93, personnel at the Southeastern Cooperative Wildlife Disease Study, University of Georgia, coordinated this research project in cooperation with TTRS personnel. After 1993, TTRS personnel coordinated and conducted study activities.

Population Estimates

From 1970–01, annual bobwhite population estimates were calculated using a bias-corrected Petersen estimate (Chapman 1951; O'Brien et al. 1985, Lancia et al. 1994). Bobwhites were captured using funnel traps baited with grain, marked with numbered leg bands, and released at the capture site (Kellogg et al. 1972). Trap density was approximately 1 trap/2 ha across the entire study area. Trapping started in mid- to late-January and continued until approximately 40 to 60% of the recaptured bobwhites were banded, typically taking 2–3 weeks. Within 1 week after trapping, a second sample was collected by systematically hunting the study area. The study area was divided into 12 hunting courses. Each course was thoroughly covered by 1 hunting party (composed of 1–4 hunters and their bird dogs) until all courses were hunted. Hunters were asked to harvest 2 bobwhites from each covey, however, this rule was not in effect prior to 1975. This process was repeated until 10–25% of marked bobwhites were recovered by shooting. Between 1990 and 1994, harvest rates were 10% on the south area and 25% on the north area. Typically, the shooting sample required 2–3 weeks to complete. To estimate population size, we assumed that the population was closed, marked and unmarked bobwhites had equal capture probabilities within sampling periods, capture probabilities between capture periods were independent, and bands were not lost (Smith et al. 1982, O'Brien et al. 1985). Population estimates were converted to relative densities because study area size increased after 1997.

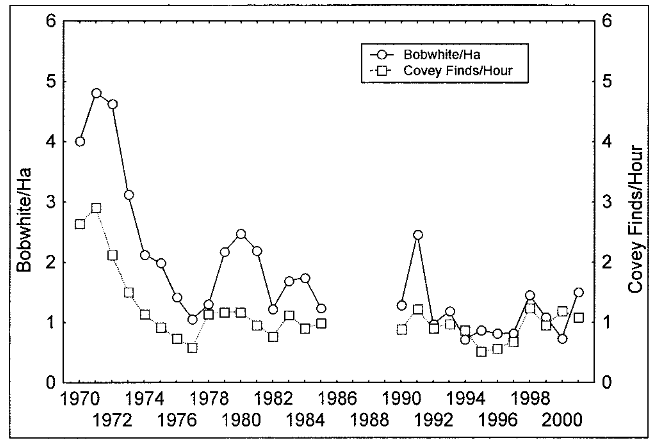

Fig. 1. Northern bobwhite density and number of hunter covey finds/hour on Tall Timbers Research Station, Florida, 1970–01.

Hunting Activity

Hunting for bobwhites on TTRS was limited to the 2–3 week period associated with recapture of banded bobwhites. Hunting methods remained consistent during each year of the study. However, personnel and dogs varied from year-to-year. Hunters walked their assigned hunting course and located coveys using pointing dogs. Hunters recorded the beginning and ending time of hunts and the number of coveys flushed. Each covey observed was considered a located covey, whether or not bobwhites were harvested. Hunting success was defined as the number of coveys flushed/hr of hunting. Hunting success for each course was averaged to determine an annual mean number of coveys flushed/hr.

Data Analysis

We assessed the relationship between bobwhite density and coveys flushed/hr using multiple linear regression (StatSoft 1996). We regressed year and coveys flushed/hr on bobwhite density. Data collected from 1986 to 1989 were not included in the analyses for the south side and the entire area because bobwhites were banded only on the north area. We used the coefficient of partial determination (r^2) to examine variation accounted for by each independent variable in our model. Residuals were tested for normality and serial correlation. Year was included in the model because error terms were serially correlated ($\rho = 0.38$) when it was not included in the model. Regression models assume error terms are independent ($\rho = 0$), normal random variables. Serial correlation of error terms ($\rho > 0$) is a common problem encountered with time series data that causes variance of error terms and regression coefficients to be underestimated (Neter et al. 1985). Serial correlation is often caused by omission of one or more key independent variables (Neter et al. 1985).

RESULTS

We banded an average of 472 bobwhites (range 127–1,139) each year between 1970–01. Population

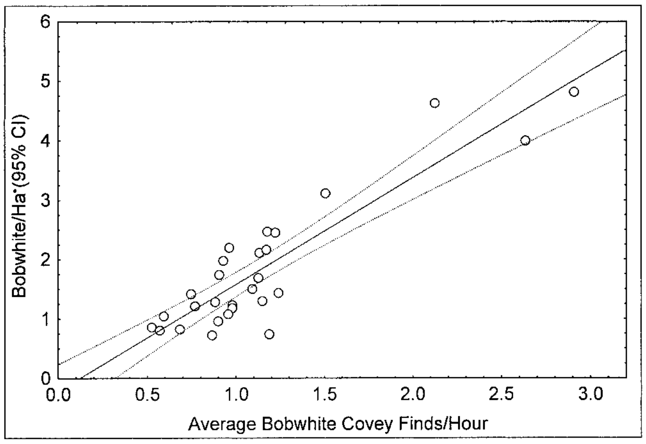

Fig. 2. Relationship between northern bobwhite density and covey finds/hour of hunting on Tall Timbers Research Station, Florida.

size and the number of coveys flushed/hr ranged from 0.7–4.8 bobwhites/ha and 0.5–2.9 coveys flushed/hr, 1970–85 and 1990–01 (Fig. 1).

Number of hunts/year averaged 45.5 (SE = 2.8). Each hunt averaged 2.3 hr (SE = 0.07). Average number of hunts/hunting course was 4.4 (SE = 0.16). Mean number of dogs used per hunting party was 2.2 (SE = 0.06). Average number of different coveys flushed/hr was 1.1 (SE = 0.1).

The overall regression of year and hunting success on density was significant ($F_{2,25} = 93.2$, $R^2 = 0.88$, $P < 0.001$). Residuals were normally distributed ($X^2 = 0.71$, $df = 1$, $P = 0.40$), were not serially correlated ($\rho = 0.02$), and were not correlated with observed density estimates ($r = 0.38$, $t_{26} = 1.87$, $P = 0.07$). Across all years, bobwhite densities were greater on the north area (1.9 quail/ha, SD = 1.35) than the south area (1.6 quail/ha, SD = 0.94), but this difference was not statistically significant (t = 1.5, $df = 24$, $P = 0.14$). Bobwhite densities on the north and south areas were correlated (r = 0.75, $P < 0.001$). The regression of year and hunting success on density was also significant for the north area ($R^2 = 0.79$, $P < 0.001$) and the south area ($R^2 = 0.70$, $P < 0.001$).

For the overall regression, the coefficient of partial determination indicated year was negatively related to density ($r^2 = 0.39$, $t_{25} = -4.0$, $P < 0.001$). Coefficient of partial determination for covey flushes/hr of hunting indicated it was positively related to bobwhite density ($r^2 = 0.77$, $t_{25} = 9.070$, $P < 0.001$) (Fig. 2).

DISCUSSION

Hunting success was strongly related to bobwhite density on TTRS. Several factors associated with this study may have facilitated the observed relationship between hunting success and density. For example, standardization of hunting, a short hunting season, and relatively constant habitat conditions that were conducive to flushing coveys all remained relatively constant from year-to-year.

For hunting success to be a suitable index of abundance, the probability of observing a covey while hunting needs to remain relatively constant from year-to-year. Over the course of this study, ground cover vegetation on TTRS was maintained by use of prescribed fire and mowing. Therefore, habitat conditions over the duration of this study were conducive to flushing coveys on all portions of the study area. In a similar habitat type, Sisson et al. (2000) found that the probability of finding a covey was relatively consistent from year-to-year using pointing dogs (range 40–60%). Therefore, with standardized hunting methods, number of coveys flushed/hr of hunting should be a reasonable index of bobwhite population density. Our study suggests that on managed bobwhite plantations, hunting success is a reasonable index of bobwhite density.

A second important factor of this study was that yearly hunting occurred during a relatively short period of time. Therefore, avoidance behavior of bobwhites to hunters may not have been as severe as on a heavily hunted study area (Radomski and Guthery 2000). Hunting intensity on TTRS remained low among years such that most coveys probably interacted with hunters <5 times/season. However, despite low hunting effort, coveys on TTRS tended to run or flush wild as hunters approached, similar to behavior observed by Sisson et al. (2000). There is little evidence that covey avoidance behavior should bias indexing bobwhite populations using hunter success. However, this factor should be considered on heavily hunted management areas, especially if hunting pressure is increasing and hunting success is declining (Brennan and Jacobson 1992). Therefore, we suggest that to avoid covey avoidance behaviors biasing indices, managers consider using only an early portion of a hunting season (e.g., first 14 days) to assess hunter success, rather than an entire season.

We assumed that hunters did not use previous knowledge of bobwhite capture sites to influence hunting behavior. If hunters choose areas to hunt based on previous experience gained from capturing quail, relationships between bobwhite density and hunting success could simply be an artifact of our study design. To avoid this potential bias, we strictly enforced that hunters completely covered their assigned area. However, as with most managed hunting areas, hunters were likely to be familiar with covey locations because of past hunting experience. But, because habitat was well distributed over each hunting course, it was more likely that hunters simply hunted the area they were assigned. Overall, we believe this assumption was reasonable and that the relationship between hunter success and bobwhite density was probably not an artifact of hunter knowledge of covey locations.

We assumed that the Petersen estimator provided an unbiased estimate of bobwhite abundance on TTRS. O'Brien et al. (1985) concluded that methods used during this study met assumptions for the Petersen estimator, except possibly the assumption of equal catchability for individual quail (aggregation behavior and trapping methodology precludes meeting this assumption). Because the methods used to mark and recapture bobwhites were independent, potential bias created by trap response or capture heterogeneity was minimized (O'Brien et al. 1985). However, variance estimates may be negatively biased because lack of capture probability independence is a function of aggregation behavior of bobwhites that exist as coveys throughout the winter.

MANAGEMENT IMPLICATIONS

Information to index long-term trends of non-migratory species can be difficult to obtain (Church et al. 1993). To assess bobwhite abundance, private and public bobwhite managers commonly collect hunting success information (Brennan and Jacobson 1992, Brennan et al. 2000, Fies 2001) because it is relatively easy to collect. Further, biologists and managers may be wary of not collecting data that have been collected for many years and may prove useful in the future. We suggest that number of coveys flushed/hr of hunting may be an useful index of bobwhite population size for management areas if: (1) habitat conditions are relatively constant over time, (2) hunting success is measured at similar times each year, and (3) hunting methods and pressure are relatively constant or standardized. Managers should recognize that changes in hunting methods and habitat conditions over time could influence the annual probability of hunters flushing a covey, which could reduce the explanatory value of this index. If habitat conditions change over time such that the probability of hunters flushing coveys has likely changed, then using covey flushes/hr to index bobwhite populations may be ill advised.

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