# Whistling-cock Indices as a Measure of Northern Bobwhite Harvest in North Carolina

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*Abstract*: Counts of whistling male northern bobwhites (*Colinus virginianus*) were conducted on standardized routes from 1981–86 at Fort Bragg Military Reservation, North Carolina. Harvest data were collected at check stations from 1967–86, and were used to monitor population fluctuations. A linear relationships ($r^2$ = 0.89, $P < 0.01$) was observed between the mean number of quail heard per station and the subsequent fall harvest. The call index and hunter success also were related ($r^2$ = 0.73, $P < 0.03$). A negative trend ($b = -0.51$, $P < 0.001$) in the mean number of calling males per station was recorded from 1981–86. Whistle-count surveys may provide a cost-effective method for predicting fall harvest levels for controlled-access management areas.

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Resource managers often require estimates of game species abundance prior to fall hunting seasons to make adjustments in season length or bag limits. During the 1930s and 1940s, counts of whistling male northern bobwhites initially were used as indicators of fall population trends of quail in the midwestern United States. Early investigations (Bennitt 1951, Reeves 1954, Rosene 1957, Kabat and Thompson 1963) documented a relationship between summer call-count surveys and the subsequent fall harvest or covey counts. Norton et al. (1961) using the data of Bennitt (1951), Reeves (1954) and Rosene (1957) and analysis of data covariance models found a significant relationship ($P < 0.001$) between hunting success and call index,

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but the call index accounted for <20% the hunting success error sum of squares. Norton et al. (1961) found regression models relating fall population size to the number of whistling cocks in summer were unreliable for setting season length or bag limits.

Preno and Labisky (1971) found no correlation ($r^2$ = 0.006) between the number of quail harvested per trip in the fall and the call index from the previous summer. Schwartz (1974) emphasized roadside counts were a better indicator of total harvest or the average season bag than were whistle counts. Kozicky et al. (1956) recommended October counts of 16-ha (40-acre) tracts with bird dogs as the only objective measure of fall population size.

However, standardized call-count routes provided reliable estimates of relative fall abundance for controlled hunting areas in Illinois (Ellis et al. 1972). Snyder (1978) documented a relationship ($r^2 = 0.951$, $P < 0.001$) between whistling-cock counts and fall harvest for a Colorado management area.

The value of whistling cock indices for predicting fall harvest or population size remains controversial. Our purpose was to determine if call-count indices could be used to predict fall quail harvest in the North Carolina Sandhills Region.

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## Methods

Fort Bragg Military Reservation lies within the Sandhills Region of Cumberland and Hoke counties, North Carolina. A longleaf pine-turkey oak-wiregrass (*Pinus palustris-Quercus laevis-Aristida stricta*) community occurs on upland sites (Wells 1928). Wetland areas contain a dense evergreen shrub community including red bay (*Persea borbonia*) and bitter gallberry (*Ilex glabra*). Gently rolling hills dominate the topography. Coarse, sandy soils are found on the ridgetops, and clays are exposed on the lower slopes and along stream channels. The reservation boundaries contain more than 55,000 ha, of which about 40,000 ha are woodland.

Biologists at Fort Bragg have recorded bobwhite harvest data at check stations since 1967. All hunters have been required to sign in and out and obtain a range pass each time they go afield. The number of quail killed was recorded on the sign-out sheets. The total reported harvest and the mean number of bobwhites killed per hunter-trip are calculated annually.

Six routes were established in 1981, 1 for each management unit. We surveyed call-count routes between 1 June and 15 July each year. Routes were replicated once in 1981, 4 times in 1982 and 1985, 3 times in 1983 and 1984, and twice in 1986. Counts were not conducted when wind velocity exceeded 19 km/hour, cloud cover

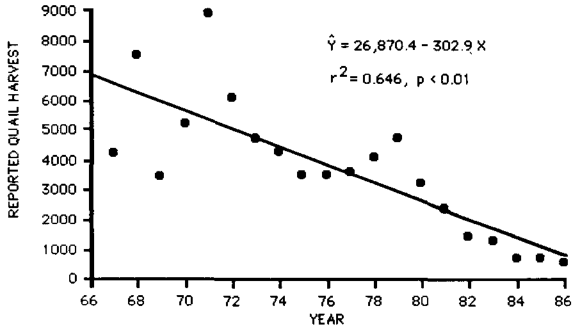


**Figure 1.** Trends in annual harvest of northern bobwhite, Fort Bragg, North Carolina, 1967–86.

exceeded 50%, or precipitation occurred. Observers started at official sunrise and completed each route in about 2 hours. Routes were 9.7 km long with 12 listening stations 0.8 km apart. Exactly 8 minutes were allowed for counts at each stop, and 3 minutes recording and travel time occurred between stations. Total number of quail and calls was tallied at each stop.

Linear regression models were used to compare whistle-count indices and harvest data and to determine trends in calling rates over time.

## Results

Examination of harvest records (Fig. 1) indicated a decline in quail numbers post-wide from the early 1970s through 1986. The mean number of bobwhite killed per hunter attempt (Fig. 2) was calculated to adjust for variability in hunter effort. A hunter attempt was equivalent to a trip afield and ranged from a few hours to a hunter-day. Again, a negative trend was obvious.

Regression analyses were performed on the mean number of quail heard per station from 1981 to 1986 to examine trends by management unit over time. A regression model with a single line for the pooled route data was compared with an alternative model with a separate line for each of the 6 routes (Kleinbaum and

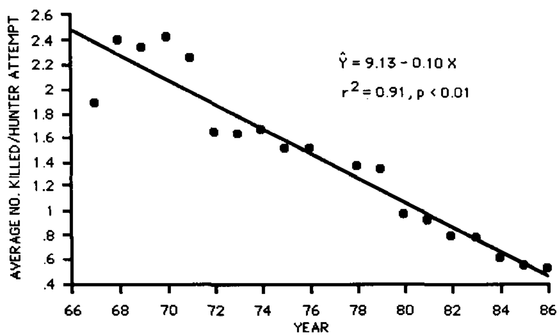


**Figure 2.** Trends in northern bobwhite hunter success, Fort Bragg, North Carolina, 1967–86.

**Table 1.** Trend analyses of the mean number of northern bobwhite heard per station for management unit call-count routes, Fort Bragg, North Carolina, 1981–86.

| Route | b | $r^2$ | $t$ | Probability |
|---|---|---|---|---|
| Northeast | +0.116 | 0.038 | +0.344 | >0.500 |
| Manchester | −0.945 | 0.871 | −5.185 | 0.007 |
| Normandy | −0.416 | 0.411 | −1.670 | 0.170 |
| River | −0.836 | 0.681 | −2.920 | 0.044 |
| Boundary | −0.322 | 0.333 | −1.413 | 0.232 |
| Mott Lake | −0.380 | 0.711 | −3.136 | 0.035 |
| Post-wide | −0.510 | 0.447 | −5.164 | <0.001 |

Kupper 1978:188–208). We could not reject the single line model (F = 1.27, $P > 0.25$), and used the simple linear regression equation to ascertain post-wide trends. The slope of this line was negative ($b = -0.51$, $P < 0.001$), indicating a decline in the average number of calling males per station. Regression coefficients were negative for 5 of 6 routes (Table 1).

A post-wide mean number of quail heard per station was determined annually (Fig. 3), and a 95% confidence interval was calculated. The overall mean number of bobwhite heard per station was a reliable predictor of total annual harvest (Fig. 4, $r^2 = 0.89$, $P < 0.01$) and the average kill per hunter attempt (Fig. 5, $r^2 = 0.73$, $P < 0.03$). The mean number of calls heard per station was an indicator of the number of quail tallied at each stop (Fig. 6, $r^2 = 0.79$, $P < 0.01$).

## Discussion

The greatest decline in quail numbers occurred between 1979 and 1984 (Fig. 1), overlapping the initial years of this project. Since 1984, the mean number of calling males has remained relatively stable (Fig. 3), and if the 1981–82 data are omitted from the post-wide regression analysis (Table 1), the resulting slope is not significant ($b = -0.138$, $t = -0.899$, $0.4 < P < 0.2$). The relationship of call counts and harvest needs to be evaluated for stable and increasing quail numbers.

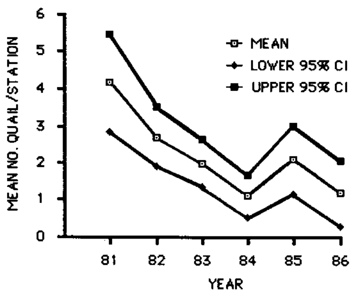


**Figure 3.** Mean and 95% confidence interval of northern bobwhite heard per station on management unit call-count routes, Fort Bragg, North Carolina, 1981–86.

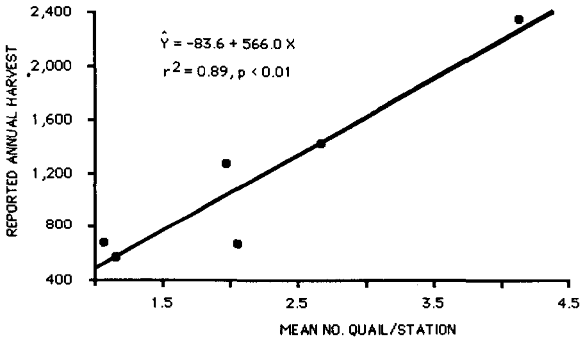


**Figure 4.** Relationship between the mean number of northern bobwhite heard per station on management unit call-count routes and the subsequent harvest, Fort Bragg, North Carolina, 1981–86.

Counts for the northeast route did not coincide with trends observed in other management units (Table 1). This area was separated from the remainder of the post by the village of Spring Lake and the Fort Bragg housing area. Lower hunting pressure resulting from increased driving distances or differences in habitat quality may have contributed to this dissimilarity. Quail populations apparently remained stable along the northeast route, but we were unable to determine the cause of this disparity.

Ellis et al. (1972) and Snyder (1978) observed that the relationship between the mean number of calls and quail counted deteriorated rapidly when >7 males per station were heard. It was more difficult for observers to distinguish between individual quail at higher densities. At Fort Bragg, the mean number of different males heard per station did not exceed 6 birds. Increased variability in calling appeared to occur when the mean was greater than 3 quail per station (Fig. 6). When this level is surpassed, it may be appropriate to use the mean number of calls rather than the number of whistling males as the count index.

Norton et al. (1961) argued that call-count estimates lacked a statistical basis and were unreliable. This criticism appears unjustified for sites with controlled access and reliable harvest data. Snyder (1978) obtained a near-perfect correlation ($r^2 = 0.951, P < 0.001$) between call indices and bobwhite harvest. Nearly complete

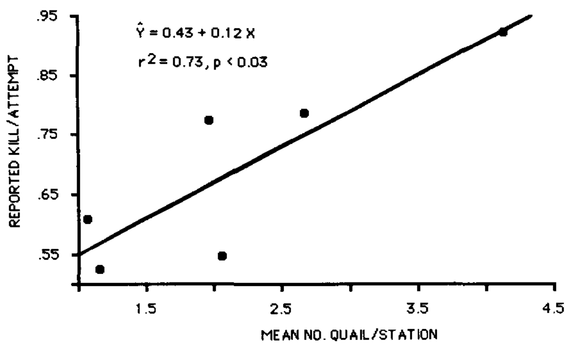


**Figure 5.** Relationship between the mean number of northern bobwhite heard per station on management unit call-count routes and the average number of quail killed per hunter attempt, Fort Bragg, North Carolina, 1981–86.

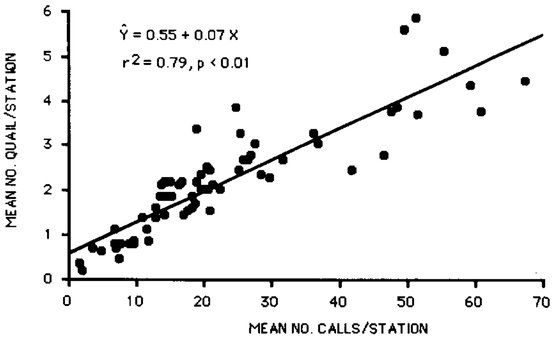


**Figure 6.** Relationship between the mean number of northern bobwhite counted and average number of calls heard per station on management unit routes, Fort Bragg, North Carolina, 1981–85.

quail kill records from check stations on the controlled-access management area made this situation similar to Fort Bragg. The significant linear relationship between the call-count index, harvest (Fig. 4), and hunter success (Fig. 5) may be a function of the control over the hunter population and reporting rates. Spot checks during the 1985 quail season indicated 85% to 90% of the sportsmen correctly completed sign-out sheets and provided usable harvest data. This relationship requires further testing on other controlled-access management units.

It appears feasible to calibrate the count index for specific harvest levels. If this is true, season lengths or bag limits may be altered to reduce or increase the predicted harvest depending upon the number of calling males heard during June and early July. The effect of various management strategies on the actual bobwhite kill (i.e., shortening the season 2 weeks), also requires further study. Additional research in a variety of habitat types is required to determine if calibration of call-count indices and harvest data is possible for other areas.

O'Brien et al. (1985) proposed a capture-removal method to obtain reliable estimates of bobwhite population size. Unfortunately, this technique is very labor and cost intensive, and provides estimates of quail numbers only for a relatively small, well-defined area. It will not be practical for state agencies requiring region-wide estimates at a minimal cost. The lack of standardized methodology for obtaining annual bobwhite relative abundance information continues to be a problem in the southeastern United States. Whistle-count surveys may provide a cost-effective alternative if indices can be calibrated with harvest levels in other states.

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