

# Interrelationships Between Various Quail Population Measurements

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## INTERRELATIONSHIPS BETWEEN VARIOUS QUAIL POPULATION MEASUREMENTS

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## Introduction

Early investigators of the bobwhite used covey counts to measure population numbers. We do not know when quail were first censused by this method, but we do know that Leopold and Errington put much emphasis on these counts. Covey numbers and their sizes are of great importance

because to a large degree they reflect the quality of quail environment. In recent years data have been gathered on other facets of quail populations so that now it is possible to study relationships between many population measurements.

A technique for a census of "bobwhite" calls was started in 1938 by Rudolf Bennitt. Bennitt (1) and Reeves (3) reported on the relationships between whistling cocks, soils, and hunting success. Rosene (4) studied the relationship between whistling cocks in summer and coveys in the subsequent winter. Norton et al. (2) examined all previous published data and reported on whistling cocks and coveys from tracts on the Crab Orchard National Wildlife Refuge and on 2 areas in Davis County, Iowa.

The proportion of juveniles to adults in quail populations can be determined from samples of wings from birds killed by hunters. Given the total population (number of coveys X average size of coveys), the number of individuals in an age class, juvenile or adult, can be found by multiplying the total population by the percentage of that age class found in the wing samples.

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#### Study Areas and Procedures

We collected data from 2 different tracts 115 miles apart in South Carolina: Groton near Estill and Oakland Club near Pineville (Table 1). These enabled us to make some preliminary correlations to determine mutual relationships between various population measurements.

When studying these data the question arose as to the most appropriate statistic. For example, if numbers of whistling cocks in summer depended on the spring population of males, and we wished to predict the number of whistling cocks to follow a spring population of males, then a regression analysis would be in order. For this study we assumed that the paired variates we wanted to test were associated in some way but that neither variate operated as a consequence of the other. It is entirely possible that many of the 2 variates tested could be more appropriately studied as a regression, but our aim was to determine correlations for the entire 2 lots of data.

A correlation ( $r$ ) was figured from 9 sets of paired data from Groton. Thus it was possible to investigate the relationship between 36 items. Oakland Club had 8 sets of paired data, so 28 different correlations were computed.

#### Groton Plantation

Groton is privately owned and managed for quail. Records on quail have been kept from 1957 through 1970. Insecticides were used on Groton during the period of this study. In the summers of 1958, and 1959, DDT was dusted on growing soybean plants, and during the spring planting of corn in 1964, 1965 and 1966, some kernels remained on the surface of the soil at ends of rows where they were available to quail at a

critical time of food shortage. It seemed advisable to eliminate the data for these 5 years because of abnormal fluctuations in the quail population caused by the adverse effects of DDT (5).

Twelve thousand acres of this plantation are used for quail hunting. One wing was removed from each bird shot, and feather molt was studied to learn the individual's age. As a territory was hunted, covey locations were depicted by map-tacks on an aerial photograph. As hunting proceeded during the season, newly discovered coveys were recorded on an area after each day's hunt only after all previously located coveys had been found on that particular day; thus, covey numbers were conservative. Average covey size was calculated annually by repeatedly flushing and counting individuals in an adequate number of coveys. Coveys were recorded on the entire plantation making it possible at the end of the hunting season to count the number of coveys found on the transects where whistling cocks were recorded in summer.

To count whistling cocks in summer, 1 transect containing 14 stops at 0.5 mile apart was established through the center of the plantation. At each stop, quail calling "bobwhite" were plotted on an aerial photograph. Plotting was always done on the mornings of 20 and 21 June. Start was at sunrise; 8 min were spent at each listening stop and 2 min driving between stops. After 2 mornings of work, the estimated number of whistlers present was determined.

#### Oakland Club

Oakland Club lands are managed differently than Groton. This Club owns 7,000 acres and leases another 35,000. Hunting takes place on 29,000 acres. Records were kept from 1959 through 1970. Ages of quail were determined in 9 of the 12 years. All other records are continuous for the 12-year period.

To check whistling cocks on Oakland, 2 transects of 12 stops each were established using the same interval between stops as on Groton. "Bobwhite" calls were counted once on each of these transects and always on the mornings of 18 and 19 June, using the same routine as on Groton.

Unlike Groton, coveys were not plotted on a map, but when hunters and guides returned from a day in the field they reported the number of coveys flushed, thus providing cumulative records of covey flushes.

#### Results and Discussion

On Groton we heard a total of 1,156 whistling cocks on 1 transect in 10 years. In 9 years hunters found 5,070 individual coveys on the entire plantation of which 1,098 were on the whistling-cock transect. Sportsmen shot 13,547 quail in 8 years. We determined sex-age ratios (from the entire kill) and average covey size. It was possible to calculate 9 items from the original data (Table 2).

In 12 years on Oakland the 2 transects had 1,701 whistling cocks,

hunters spent 4,882 days afield flushing 26,036 coveys and killing 25,258 quail. We determined sex-age ratios for 9 of the 12 years. In all, 8 items were used in the analysis (Table 2).

#### Groton Plantation

Significant correlations were found for 21 of the 36 items investigated (Table 3). Of the 21, 14 were positive.

Previous investigators (1,2,3) have reported a positive relationship between number of cocks whistling "bobwhite" in summer and number of coveys present in the subsequent winter. Our data show a similar positive relationship between whistling cocks and coveys in the first following winter; coveys tested were those found on the same transects used for the whistling cock census. The relationship was not significant when whistling cocks were tested with coveys on the entire plantation in the second winter that followed. Cocks whistling in summer also showed a significant positive relationship with populations of males, females and subadults in the first subsequent spring.

On Groton there was a positive relationship between spring populations of males, females, and subadults when tested with coveys in transects during the first subsequent winter. These same 3 categories had a similar positive relationship with coveys on the entire plantation in the second subsequent winter. This indicates that the number of quail remaining in a given spring is related to the number of quail that will be present in the first and second winter coming after that given spring.

Total kill in 1 winter was positively related to coveys on the entire plantation 1 year later. In other words, the higher the kill in 1 year, the greater the number of coveys in the following winter; and the lower the kill, the fewer the coveys in the following winter. This appears to be contrary to the statement about the importance of spring populations. A high kill in winter should logically result in a low population of males, females and subadults in the spring. At this point in research the best explanation is that hunting pressure was so light that it had little effect on spring populations; however, hunting pressure was sufficient to have a positive effect on reproduction. It seems that up to a certain point the removal of quail by hunting is beneficial.

Significant negative correlations were shown in 2 comparisons: (A) young per adult female in the hunting season X kill in the same hunting season, and (B) percent subadults X coveys in transects. Biologists have thought that the greater the number of young per adult female in fall the higher the production in the previous summer and therefore the greater the population size in the winter and thus the better the hunting. On Groton, as young per adult female increased, the kill decreased. A negative correlation was also found between young per adult female and kill on Oakland Club, but it was not significant. This paradox needs additional study.

Table 1. Comparisons between Groton Plantation and Oakland Club.

| Characteristics                          | Groton | Oakland    |
|------------------------------------------|--------|------------|
| Acreage                                  | 12,000 | 29,000     |
| Mean population per year                 |        |            |
| Number of quail                          | 10,134 | 6,014 est. |
| Acres per bird                           | 1.2    | 4.8        |
| Whistling cocks                          | 115    | 71         |
| Percentage of subadults                  | 71.9   | 79.5       |
| Mean hunting pressure per year           |        |            |
| Covey finds per hour                     | 3.7    | 2.0        |
| Kill                                     | 1,694  | 2,105      |
| Percent of population removed by hunting | 16.5   | 35.0 est.  |

Table 2. Various quail population measurements tested.

| Groton                                         | Oakland Club              |
|------------------------------------------------|---------------------------|
| 1. Summer whistling cocks                      | 1. Summer whistling cocks |
| 2. Coveys in transects in winter               | 2. Total kill             |
| 3. Total kill                                  | 3. Young per adult female |
| 4. Young per adult female                      | 4. Percent subadults      |
| 5. Percent subadults                           | 5. Coveys found           |
| 6. Spring population of males                  | 6. Coveys per party day   |
| 7. Spring population of females                | 7. Total gun days         |
| 8. Spring population of subadults              | 8. Kill per gun day       |
| 9. Coveys on entire plantation<br>1 year later |                           |

Table 3. Calendar diagram showing sequential relationships of data.

| Location and<br>starting season | First year                     |                                                                                                                                                                          | Second year                                                                               |        |                                      |
|---------------------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------|--------------------------------------|
|                                 | Summer                         | Winter                                                                                                                                                                   | Spring                                                                                    | Summer | Winter                               |
| Groton                          | 1. Whistling<br>cock<br>census | 2. Coveys in<br>transects<br>3. Total kill<br>4. Young per<br>adult female<br>5. Percent<br>subadults                                                                    | 6. Population of<br>males<br>7. Population of<br>females<br>8. Population of<br>subadults |        | 9. Coveys on<br>entire<br>plantation |
| -----                           |                                |                                                                                                                                                                          |                                                                                           |        |                                      |
| Oakland Club                    | 1. Whistling<br>cock<br>census | 2. Total kill<br>3. Young per<br>adult female<br>4. Percent<br>subadults<br>5. Coveys found<br>6. Coveys per<br>party day<br>7. Total gun days<br>8. Kill per<br>gun day |                                                                                           |        |                                      |

Table 4. Significant correlations at Groton.

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At the .05 level

- .76 Percent subadults X coveys in transects.
- + .73 Spring population males X coveys on entire plantation.
- .67 Young per adult female X spring population of females.
- + .71 Spring population subadults X coveys on entire plantation.
- .70 Young per adult female X coveys on entire plantation.
- + .74 Summer whistling cocks X coveys on transects.
- + .74 Summer whistling cocks X spring population of females.
- + .78 Summer whistling cocks X spring population of subadults.
- + .77 Spring population of females X coveys on entire plantation.
- .74 Young per adult female X total kill.
- + .78 Total kill X coveys on entire plantation 1 year later.

At the .01 level

- + .80 Summer whistling cocks X spring population of males.
  - + .88 Spring population of males X coveys in transects.
  - + .86 Spring population of females X coveys in transects.
  - + .87 Spring population of subadults X coveys in transects.
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Table 5. Significant correlations at Oakland Club.

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At the .05 level

- + .63 Summer whistling cocks X kill.
- + .71 Young per adult female X percent subadults.
- + .67 Kill X total gun days.
- + .69 Summer whistling cocks X coveys found.

At the .01 level

- + .77 Summer whistling cocks X coveys found per party day.
- + .78 Total gun days X coveys found.
- + .78 Kill per gun day X coveys found.

At the .001 level

- + .90 Kill X kill per gun day.
  - + .96 Kill X coveys found.
  - + .91 Kill X coveys found per party day.
  - + .89 Kill per gun day X coveys found per party day.
  - + .90 Coveys found X coveys found per party day.
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## Oakland Club

The data for Oakland presented the opportunity to make correlation tests for 4 of the same items as were measured on Groton (Table 2) and, in addition, to find relationship between these 4 items and hunting success. Oakland had a lower population, lower hunting success, and a higher kill (Table 1) so the same correlations as tested on Groton can be expected to vary on Oakland in their amount of significance.

On Oakland Club all significant correlations were positive (Table 4). Summer whistling cocks were closely related to coveys found, similarly to Groton, but on Oakland whistling cocks were significantly related to kill. This was not so on Groton. Numbers of birds shot (kill), amount of time spent afield, and coveys found were significantly interrelated.

Young per adult female was significantly related to percent sub-adults on Oakland, which was not the case on Groton.

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## SUPPLEMENTAL PAPERS

## MAXIMIZING EDGE AND COVERTS FOR QUAIL AND SMALL GAME

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Abstract:

A computer-generated table is presented, enabling the land manager to maximize on a given acreage the length of edge and the number of coverts (or corners where 3 or more cover types come together).