

again. However, from personal conversations with several hunters that hunted in the study area during both the early and latter periods of the season, the authors were assured that the flight characteristics of the quail released prior to the legal season resembled more the characteristics of native quail. These hunters also stated that the flight habits of the quail released just prior to hunting left much to be desired.

Data obtained on the movements of pen-raised quail after their release indicate that they will move. Since the quail released in each of the nine release areas were recovered throughout most of the remainder of the study area, and since there was no apparent concentration of the quail within a specific area, no conclusions can be made regarding the causes of such movements. Possibly some of this movement was prompted by the need for the quail to know the area in which they were to live, and such should be considered when attempting to release quail on a small area with the expectation of them remaining close to the release site. Of course, some of the movements could have resulted from a search for a better habitat.

In the opinion of the authors, pen-raised birds should be released, when possible, well in advance of the quail hunting season. While the percent of quail recovered may be slightly lower than that realized from quail released just before hunting, the quality, size and palatability of the earlier released quail may greatly offset any other advantages thought to be obtained from the "release and shoot" technique.

BOBWHITE QUAIL: TOTAL HUNTER KILL COMPARED TO NUMBER RETRIEVED^{1, 2}

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ABSTRACT

Thirty-one different hunters using 24 different bird dogs flushed 5691 bobwhites (*Colinus virginianus*) in 572 man hours of hunting. Hunters fired 2639 shots and retrieved 846 bobwhites (3.1 shots/bird retrieved). For every three birds in the bag, one dead or crippled bird was left in the field. All hunting was done on an area which had a bobwhite density greater than one bird per acre.

INTRODUCTION

During management studies of bobwhite quail, the authors found it necessary to determine mortality due to hunting since a total kill of approximately 25 percent of the population was desired. Figures derived from this study should be generally applicable to quail hunting on other private lands as well as game management areas operated by state agencies.

METHODS

The study site consisted of approximately 1100 acres located in a limestone region of broken terrain in northern Leon County, Florida.

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Approximately 85 percent of the area was open timberland consisting primarily of live oak (*Quercus virginiana*) and mature pines (*Pinus echinata* and *Pinus taeda*), but with hardwood thickets (*Liquidambar styraciflua*, *Quercus nigra*, *Nyssa sylvatica*, *Sassafras albidum*) up to approximately 25 acres in size scattered over the area. The woodland was burned annually and ground cover usually was less than 36 inches in height. The remaining 15 percent of the total area was in fields of which about half were planted in corn (*Zea mays*) and half left fallow each year.

Data for the present paper were gathered during the hunting seasons of 1969, 1970, and 1971. Thirty-one different hunters participated during the three seasons, and hunting parties usually consisted of three men with three dogs. Some hunters were novices, whereas others had over half a century of experience. Twenty-four different dogs, including six-month-old puppies as well as experienced dogs, were used. Twelve and 20 gauge shotguns were most popular but a few 16 and 410 gauge guns also were used. The quail population was greater than one bird per acre during each of the three years of the study.

After each covey rise a record keeper noted the number of birds flushed, shots fired, birds retrieved, birds knocked down but lost, and birds feathered. At the end of the hunting period the total number of man hours spent hunting was computed.

Birds shot and retrieved obviously are lost from the population, and most will agree that those knocked down but not retrieved are dead or will die. The findings of Long (1940:91) permit the conclusion that most small gallinaceous game birds which are hit, but continue their flight, subsequently die under natural environmental conditions. Also, birds often are hit and show no sign of it. Total mortality therefore was estimated in the present case by addition of number retrieved, number shot down but lost, and number which lost feathers but kept flying. Crippling loss, for the purpose of this paper, is defined as the sum of the number of birds shot down and lost plus the number of birds which were feathered but kept flying.

RESULTS

In 572 man hours of hunting, 5691 bobwhites were flushed. A total of 2639 shots was fired, 846 quail were retrieved (75.9 percent of total kill), 109 were shot down but lost (9.9 percent of total kill), and 157 were feathered (14.2 percent of total kill). Thus the hunter left one dead or dying bird in the field for every three he retrieved. The average number of shots fired for each bobwhite retrieved was 3.1.

DISCUSSION AND CONCLUSIONS

The crippling loss revealed herein of approximately 24 percent of the total kill is quite close to the 20 percent estimated by Rosene (1969:185) for bobwhites. Parmalee (1953:343) found that approximately 21 percent of the bobwhites killed in east Texas were left in the field. He considered those birds shot down and not retrieved, but did not count those which were hit and kept flying. Missouri hunters, in answer to a mail survey (Bennett 1945:197), reported that almost 10 percent of the total kill was shot down but unretrieved. Thus, general agreement allows the assumption that an average of one bobwhite will be left dead or dying in the field for every three in the hunter's bag.

Crippling loss estimates for other game species are similar to those for bobwhites. Other estimates are: pheasants—15.6 percent (Nelson and Swanson 1941:44) and 25 percent (Erickson 1951:38); doves—31 percent (Hammond 1954:7); ducks—22.5 percent (Bellrose 1953:339); black brant—32 percent (Murrell 1962:32).

Our experience with crippling loss in bobwhites compels us to agree with investigators working on waterfowl (Barske 1956:53-55; Bellrose 1953:338; Lee 1956:51; Murrell 1962:33) that: (1) lack of trained dogs increases crippling loss, (2) greater numbers of and more competition between hunters increases crippling loss, (3) dense vegetation

increases crippling loss, and (4) skilled hunters lose fewer birds as cripples.

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THE INFLUENCE OF CONTROLLED BURNING ON NESTING PATTERNS OF BOBWHITE IN WEST TENNESSEE

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Controlled burning has been widely used for managing plant succession in the southeastern United States. This technique has been particularly useful for retarding the encroachment of hardwood species in plantations of southern pines (*Pinus* sp.), and for maintaining herbaceous plant associations in early stages of succession. The results of controlled burning generally have been favorable for bobwhite populations, whether the burning was done for their benefit or for managing pine. More specifically, controlled burning in the deep South has increased the production of wild legumes, an important class of quail foods, and has reduced the amount of litter on the soil surface, enhancing the quail's ability to locate its food.

Controlled burning, however, may induce changes in a plant community which are not beneficial to other aspects of the quail's life history. The removal of dead grass leaves and stems, for example, reduces the amount of suitable nesting material available to quail during the first part of the nesting season, and may render areas unsuitable for nesting. Stoddard's data reworked by Rosene (1969:64) indicated that 91 percent of 581 nests were situated on areas not burned the spring immediately preceding the nesting season. Rosene (1969:63) noted also that 80 percent of 650 nests he observed were in areas containing sufficient dead grass for constructing the nest form, and implied that these areas were not burned during the preceding winter or spring. Klimstra and Scott (1957) stated that virtually all of the 352 nests which they studied in southern Illinois were constructed of dead vegetation from

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