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## Summer Range and Habitat Preferences of Bobwhite Quail on a Southern Iowa State Game Area<sup>1</sup>

LLOYD A. CRIM<sup>2</sup> and WILLIAM K. SEITZ<sup>3</sup>

**SYNOPSIS:** Summer range and habitat preferences of bobwhite quail on a southern Iowa state game area. *Proc. Iowa Acad. Sci.*, 79(2):85-89, 1972. In June through Aug. 1971, 13 bobwhite quail (9 cocks, 4 hens) were tracked by using radio telemetry techniques to determine summer range and habitat preferences. Of the 13 birds tracked on and near the Mt. Ayr Game Management Area, 7 provided movement data for a period of greater than 4 days. Five of the 7 also provided useful information on habitat preferences. Average lineal daily movement was 442 yards. Average daily range dimensions were 248 (length of range) x 78 (width) yards, and average total range dimensions were 805

x 518 yards. Grassy upland areas were the most prominent habitat types in the range of the five birds (50%, 138 of 279 acres), followed by crops (29%, 82 acres), wooded draws and dense shrubs (15%, 43 acres), and edge such as fence rows and hedges (6%, 16 acres). Grassy upland areas were used most (36%, 131 of 361 readings), followed by crops (26%, 93 readings), wooded draws (22%, 78 readings), and edge (16%, 59 readings). For roosting cover, grassy areas again ranked first with 71% (60 of 85 readings), followed by wooded draws (13%, 11 readings), edge (9%, 8 readings), and crops (7%, 6 readings).

In recent years, there has been an increased interest in use of radio telemetry to determine range and movement patterns of wild animals. This report results from a radio telemetry study of the bobwhite quail (*Colinus virginianus* Linnaeus) in southern Iowa. The 12-week study, sponsored by a National Science Foundation undergraduate research grant, began June 1, 1971 and ended Aug. 24, 1971. Field studies were conducted on the Mt. Ayr Game Management Area, a 1158-acre public hunting area, about 6 miles southwest of Mt. Ayr, in south-central Ringgold County, Iowa.

Principal objectives were to determine the summer range and daily movements of radio-equipped bobwhites.

The topography of the upland flats prevalent throughout the area is that of rolling hills cut by drainages and streams. Oak-hickory timber covers about one-third of the area. The balance consists of crop units, such as corn, oats, clover, and grain sorghum, and of grassy areas and timbered draws. Radio-tracking activity was conducted primarily on a 400-acre tract in the southeastern corner of the public hunting area and on farmland bordering on the southern boundary of the game area.

### METHODS

#### Live Trapping

Quail were live-trapped between June 2 and Aug. 4, 1971. Traps were placed in areas of observed quail activity: i.e., along road borders, plowed sections, or grain fields. The use of a protective nylon-mesh top on the trap minimized injury to trapped quail.

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Figure 1. Transmitter and battery.

#### Radio Transmitters and Their Attachment

Radio transmitters (Davidson Co., Minneapolis, Minn.) used in this study were approximately 3 x 2 x 1.5 cm, and weighed approximately 8 to 9 g. Total weight of the transmitting unit with battery was 16 to 17 g. The transmitting antenna, a steel wire 30 cm long, projected from the transmitter top and pointed posteriorly along the bird's dorsal side. Frequencies of the transmitting units ranged from 150.815 to 150.890 mc and 151.010 to 151.840 mc in 0.015 mc intervals. Six of nine transmitters gave pulsating signals, the remaining three steady signals.

The transmitting unit was mounted between the wings on the bird's back. The harness, made of brown shoestring, encircled the bird, securing the transmitting unit in place (Fig. 1).

*Receiver*

The receiver used in this study was a 12-channel instrument with a 2-element hand-held directional antenna (Markusen Electronics, Esko, Minn.).

*Radio-Tracking Techniques*

After a bird was trapped, the battery and transmitter were connected and tested for signal strength. The transmitter unit was then attached to the bird and again tested for operation. A numbered leg band was attached and the bird released.

When released, the bird was observed for strength or abnormality of flight. Initial release position and the point at which the bird landed were recorded on cover maps. The first series of telemetry readings were secured several hours after the bird was released.

Once the general location of the transmitter-equipped bird was found, the investigators determined with reasonable accuracy the exact position of the bird. In many cases, three to four readings were secured from different positions to insure accurate location. Density and height of the vegetative cover the bird occupied at the time of each reading influenced how closely the investigators could get to the bird without it flushing. Habitat, time of day, location and general data on observations of the bird's behavior were recorded for each series of telemetry readings. Effort was made to determine preference for roosting cover. The number of daily location readings taken per bird varied from none to 13 for two main reasons: 1) Rainstorms often made many of the dirt roads impassable for vehicle transportation, thereby making location of birds in distant areas time consuming and difficult; and 2) when more than two birds were equipped with transmitters in widely separated areas, it was not physically possible to secure more than four or five readings per day per bird.

*Recording Range and Movement*

Often, the first series of readings of the day were secured before the bird moved from the previous night's roosting spot. After initial location, the investigators secured readings at 2- to 3-hour intervals throughout the day. The last series of readings were usually secured at or after sunset to determine night roosting habitat.

Bird movements were recorded on acetate sheets overlaying a cover map to get an overall record of daily movement and the types of habitat occupied. Two major movements were measured from the acetate record: maximum daily range (length and width) and lineal. Length of range is the greatest distance between two location points at which the bird was located. Width of range is the greatest distance between two location points whose straight line axis is perpendicular to the length axis. Daily lineal range is a measure of total movement as determined from distances between the first and successive daily location points. The outermost readings were connected, and the area thus enclosed was considered the range of the particular bird.

## RESULTS

*Trapping*

Twenty-five birds were live-trapped with 122.5 trap days of trapping, indicating a success of 0.2 birds per trap day (1 trap set for 24 hr. equals 1 trap day). Seven additional quail were trapped incidentally but were not used in this study.

The only trap mortality occurred on June 6, when 2 of 3 cocks, all captured at the same time, were found dead in the trap. The dead birds had mutilated heads and necks, injuries believed to have resulted from fighting. The third cock showed only minor head injuries. No head injuries to captured quail were noted after nylon-netting tops were put on the traps.

*Transmitters*

Close observations of flying transmitter-equipped bobwhites indicated the need for firm harness attachment. If a transmitter was attached too loosely, the unit wobbled and interfered with the bird's wing beat. When the transmitter was attached snugly, the birds often flew 30 to 40 yards farther than when it was loosely attached. In one case, the unit gradually loosened after 20 days of wear, at which time it began interfering with the bird's flight. This interference limited the bird's flight range to 30 to 40 yards, forcing it to stay near heavy cover.

Transmitter weight limited the bird's endurance on long flights but was less noticeable on short flights. This limited endurance was observed when a transmitter-equipped bird was accidentally flushed with a brood. Initially it was difficult to discern which bird was carrying the transmitter, but as the brood flew farther away, the transmitter-equipped bird was observed falling behind. In another instance a week later, the same bird was repeatedly flushed in an effort to recapture it. Each of the four successive flights covered less distance until the quail finally hid in a heavy tangle of brush where it was captured by hand.

Extra transmitter weight did not appear to stress the bird beyond its physical limits. One bird weighed 170 g after carrying the transmitter for 28 days. This weight differed only slightly from average weights recorded in other studies (Rosene 1969:40). None of the other 13 birds handled during this study showed any visible detrimental effects from carrying the transmitter.

Only one case of mortality directly connected with the transmitter was recorded. In this instance, a piece of solder holding the twin antenna wires together had loosened and become entangled on the seed head of an oat stalk. The bird in struggling had entangled several oat stems around the antenna and was found dead the next day.

*Movement and Habitat Preference*

Thirteen of the 32 birds trapped were equipped with transmitters (Table 1). Of the 6 birds tracked by radio signals less than 3 days, 2 lost their radios because of too loose a harness, 1 lost transmission for unknown reasons, and 2 were lost to suspected predation. A sixth bird was lost accidentally after only 2.5 days when its radio antenna became entangled in oat stems, resulting in death of the bird.

Seven bobwhites provided telemetry data for 4.5 to 55.7 days. Their movement during that time provided useful information on both range of activity and on habitat use.

Cock No. 40408 was monitored for 2 weeks before transmission was lost. The transmitting unit was not recovered. During the tracking period, the cock had an average daily range of 206 x 82 yards and an average lineal movement of 415 yards. The bird's total range covered 745 x 396 yards, including 31 acres. The habitat within the bird's range consisted of 14 acres of crops (45%), 9 acres of grasslands (29%), 6 acres of woods and brush (19%), and 2 acres of

TABLE 1. SUMMARY OF BOBWHITES EQUIPPED WITH RADIO-TRANSMITTERS ON THE MT. AYR GAME MANAGEMENT AREA, IOWA, IN JUNE THROUGH AUGUST 1971

| Bird number | Sex | Date transmitter attached | Channel | Time transmitted (Hours) | Time transmitted (Days) | Comments  |
|-------------|-----|---------------------------|---------|--------------------------|-------------------------|---|
| 40406       | F   | June 4                    | 1       | 13                       | (0.5)                   | Bird lost radio (loose harness)                       |
| 40407       | M   | 6                         | 1       | 4                        | (0.2)                   | Transmission lost, suspected predation                |
| 40411       | F   | 17                        | 3       | 4                        | (0.2)                   | Bird lost radio (loose harness)                       |
| 40412       | M   | 25                        | 3       | 59                       | (2.5)                   | Bird died when antenna became entangled in vegetation |
| 40422       | F   | July 14                   | 5       | 3                        | (0.1)                   | Transmission lost, cause unknown                      |
| 40423       | M   | 21                        | 7       | 21                       | (1.0)                   | Suspected mammalian predation                         |
| 40408       | M   | June 6                    | 2       | 326                      | (13.6)                  | Transmission lost, cause unknown                      |
| 40413       | M   | 19                        | 3       | 109                      | (4.5)                   | Suspected mammalian predation                         |
| 40416       | M   | 29                        | 3       | 40                       | (1.7)                   | Bird caught by hand, radio removed and replaced       |
| "           |     | July 1                    | 4       | 634                      | (26.4)                  | Bird nightlighted, radio removed and replaced         |
| "           |     | 27                        | 8       | 663                      | (27.6)                  | Bird caught by hand, radio removed and bird released  |
| 40421       | M   | 8                         | 3       | 107                      | (4.6)                   | Suspected feral cat predation                         |
| 40427       | M   | 23                        | 7       | 738                      | (30.8)                  | Suspected mammalian predation                         |
| 40443       | M   | Aug. 4                    | 9       | 456                      | (19.0)                  | Field investigation terminated                        |
| 40444       | F   | 4                         | 6       | 456                      | (19.0)                  | Field investigation terminated                        |

hedgerows (6%). Habitat use consisted of 27% crops (17 of 64 telemetry readings), 28% (18 readings) grassland, 20% (13 readings) brush, and 25% (16 readings) hedgerows. Of 11 roosting sites recorded, 3 (27%) were in crops (red clover and oats), 2 (19%) were in grasslands, 3 (27%) in brush, and 3 (27%) were in hedgerows.

Cock No. 40413 was tracked 5 days before it was killed and eaten by a predator. Its remains with the transmitter were found in cover of nettles (*Urtica dioica*)<sup>1</sup> and buckbrush (*Symphoricarpos orbiculatus*). Death is believed to have been caused by a mammal and not by a raptor because of the dense cover where the remains were found. The daily range was 276 x 85 yards. Average daily movement covered a lineal distance of 386 yards. Its total range was 367 x 320 yards. Total movements covered 6 acres. Because of a short period of tracking and the small range indicated, habitat use by the bird was not figured.

Cock No. 40416 was tracked 1.7 days after which the bird was recaptured and fitted with a second transmitter to replace the first which had been attached too loosely. The second transmitter functioned 26 days after which time the bird was recaptured and a third transmitter attached. After 28 additional days of tracking, the bird was recaptured and the transmitter removed at the end of the study. Based on 55.7 days of tracking, average daily range of this cock was 245 x 74 yards. Average lineal distance was 475 yards. The bird ranged in an area 1205 x 900 yards, encompassing 94 acres. Farmland provided almost all the cock's range. For analysis, the habitat was classed in two categories: (1) improved pasture and (2) row crops, red clover, and oats. Improved pasture accounted for 48 acres (51%) of the bird's range, crops for 42 acres (45%). Hedgerow constituted 1 acre, and brush 3 acres (3%). Pasture provided 34% (51 of 152 readings), crops 39% (59 readings), hedgerows 13% (20 readings), and brush 14% (22 readings) of the habitat in which the bird was found. Roosting data indicated a prefer-

ence for pasture (74%, 26 of 35 readings), followed by crops (mainly red clover and oats) (9%, 3 readings), hedgerows (11%, 4 readings), and brush (6%, 2 readings).

Cock No. 40421 was tracked 4.5 days, but then was lost to suspected predation. In the 4.5 days, the bird traveled a total of 1120 yards, with a known range of 725 x 220 yards.

Cock No. 40427 was tracked for 30 days, during which period its daily movements averaged 301 x 85 yards, with a lineal distance of 455 yards. Total range for the period was 1240 x 770 yards and encompassed 75 acres. Habitat occupied by this cock consisted of grasslands (37 of 75 acres, 49%), brush (19 acres, 25%), crops (12 acres, 16%), and hedgerows (7 acres, 9%). Grasslands received the most use (21 of 61 readings, 34%), followed by brush with 33% (20 readings), hedgerows with 25% (15 readings), and crops with 8% (5 readings). Data on roosting indicated a preference for grasslands (14 of 20 readings, 70%), followed by brush (5 readings, 25%), and hedgerows (1 reading, 5%).

The sixth and seventh birds (cock No. 40443 and hen No. 40444) were captured together and tracked successfully, and are believed to be a mated pair. A transmitter was placed on each. Both units were monitored for 19 days, at which time the study was terminated. On Aug. 17, 13 days after tracking began, the hen was flushed from a nest containing 14 eggs. On Sept. 6, about the 19th day of incubation, the nest was destroyed. Transmission was lost about Sept. 13, 40 days after the radio was attached. The radio and leg band were recovered when the bird was shot in the hunting season of October 1971.

Average daily movement of the cock (No. 40443) was 273 x 75 yards, with 470 yards lineal distance. During the 19-day, intensive-tracking period, the cock ranged 863 x 679 yards, occupying 62 acres. Habitat occupied by the cock consisted of grasslands (56%, 35 of 62 acres), brush (19%, 12 acres), crops (18%, 11 acres), and hedgerows (6%, 4 acres). Grasslands were used the most (32%, 13 of 40 readings),

TABLE 2. SUMMARY OF MOVEMENT OF RADIO-TRACKED QUAIL ON THE MT. AYR GAME MANAGEMENT AREA, IOWA, IN JUNE-AUGUST 1971

| Bird number | Sex | Length | Ave. daily range (yards) |        | Total range (yards) |       | Transmitter time |      |
|-------------|-----|--------|--------------------------|--------|---------------------|-------|------------------|------|
|             |     |        | Width                    | Lineal | Length              | Width | Hours            | Days |
| 40408       | M   | 206    | 82                       | 415    | 745                 | 396   | 326              | 13.6 |
| 40413       | M   | 276    | 85                       | 386    | 367                 | 320   | 109              | 4.5  |
| 40416       | M   | 245    | 74                       | 475    | 1205                | 900   | 1337             | 55.7 |
| 40421       | M   | —      | —                        | —      | 725                 | 220   | 110              | 4.6  |
| 40427       | M   | 301    | 85                       | 455    | 1240                | 770   | 738              | 30.8 |
| 40443       | M   | 273    | 75                       | 470    | 863                 | 679   | 456              | 19.0 |
| 40444       | F   | 186    | 65                       | 448    | 487                 | 340   | 456              | 19.0 |
| Average     |     | 248    | 78                       | 442    | 805                 | 518   | 504              | 21.0 |

followed by brush (30%, 12 readings), crops (22%, 9 readings), and hedgerows (15%, 6 readings). Data on 7 nights of roosting showed that 6 were in grasslands and 1 in brush.

The hen (No. 40444) was known to occupy an average daily range of 186 x 65 yards and 448 yards lineal distance. Total range for the entire period was 487 x 340 yards, enclosing 11 acres. Habitat occupied by the hen consisted of 53% grasslands (9 of 17 acres), 18% brush (3 acres), 18% crops (3 acres) and 12% hedgerows (2 acres). Of the habitat occupied, the hen used grassland the most (64%, 28 of 44 readings), followed by brush (25%, 11 readings), crops (7%, 3 readings), and hedgerows (4%, 2 readings). Roosting data indicated a preference for grasslands with all 12 known sites occurring in this habitat type.

DISCUSSION

Relatively little is known of summer bobwhite movements. Several investigators have reported on summer mobility on the basis of data obtained by mark-recapture methods (Murphy and Baskett, 1952; Loveless, 1958). Although Bartholomew (1967) radio-tracked bobwhite coveys during January through March in southern Illinois, no telemetry studies to date have involved summer bobwhite movements.

Of 13 birds equipped with transmitters, only 7 were tracked for a period exceeding 4 days (Table 2). For this 7-bird group, average daily range was 248 x 78 yards with a lineal distance average of 442 yards. Average total range

TABLE 3. HABITAT USE PREFERENCES OF BOBWHITE QUAIL ON AND AROUND THE MT. AYR GAME MANAGEMENT AREA, IOWA, IN JUNE-AUGUST 1971

| Bird number | Sex | Habitat in occupied range | Utilization (percentage used) |                   |                   |
|-------------|-----|---------------------------|-------------------------------|-------------------|-------------------|
|             |     |                           | (percentage available)        | (percentage used) | (percentage used) |
| 40408       | M   | Crops                     | 45                            | 27                | 27                |
|             |     | Grasslands                | 29                            | 28                | 19                |
|             |     | Brush                     | 19                            | 20                | 27                |
|             |     | Hedgerow                  | 6                             | 25                | 27                |
| 40416       | M   | Grasslands                | 51                            | 34                | 74                |
|             |     | Crops                     | 45                            | 39                | 9                 |
|             |     | Brush                     | 3                             | 14                | 6                 |
|             |     | Hedgerow                  | 1                             | 13                | 11                |
| 40427       | M   | Grasslands                | 49                            | 34                | 70                |
|             |     | Brush                     | 25                            | 33                | 25                |
|             |     | Crops                     | 16                            | 8                 | 0                 |
|             |     | Hedgerow                  | 9                             | 25                | 5                 |
| 40443       | M   | Grasslands                | 56                            | 32                | 86                |
|             |     | Brush                     | 19                            | 30                | 14                |
|             |     | Crops                     | 18                            | 22                | 0                 |
|             |     | Hedgerow                  | 6                             | 15                | 0                 |
| 40444       | F   | Grasslands                | 53                            | 64                | 100               |
|             |     | Brush                     | 18                            | 25                | 0                 |
|             |     | Crops                     | 18                            | 7                 | 0                 |
|             |     | Hedgerow                  | 12                            | 4                 | 0                 |
| Average     |     | Grasslands                | 50                            | 36                | 71                |
|             |     | Crops                     | 29                            | 26                | 7                 |
|             |     | Brush                     | 15                            | 22                | 13                |
|             |     | Hedgerow                  | 6                             | 16                | 9                 |

was 805 x 518 yards. Our data indicate range of summer movements of individual birds did not differ markedly from ranges determined by mark-recapture methods. Five of the 7 (71%) birds tracked had total ranges of less than one-half mile; i.e., both length and width ranges were less than one-half mile. Murphy and Baskett (1952) in Missouri found that, of 32 birds (28 cocks, 4 hens) trapped, marked, and recaptured, 28 individuals (88%) moved less than one-half mile. Florida quail studies (Loveless 1958) found 393 of 460 (85%) marked quail moved less than one-half mile.

Even though average daily lineal movements were about one-quarter mile, daily lineal movements in excess of one-half mile were common. Although data for comparison of cock and hen movements are inconclusive, average daily range and total range of the incubating hen were less than those ranges of a cock tracked during a comparable time period.

Six of the 13 radio-tracked birds furnished useful information on summer habitat preferences (Table 3). Of four habitat categories, grassland areas were the most prevalent within the bird's ranges and were the most used. Crops were the next most prevalent type and ranked second in use. Brush habitat, third most prevalent, ranked third in use. Hedgerows were the least present and the least used.

Grassland areas were the habitat type used most for night roosting sites with over 71% of the roosting sites. The species most prevalent in this habitat type were wild bergamont (*Monarda fistulosa*) and ironweed (*Vernonia baldwini*), with a ground cover of bluegrass (*Poa pratensis*). This type

of cover, generally very dense, may have been selected for protection from predators. The higher forb overstory also may have provided some protection against inclement weather while the bluegrass understory provided almost total concealment.

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