

PREFERRED HABITAT OF THE BLACK-THROATED BOBWHITE *COLINUS NIGROGULARIS* IN THE MANATEE FOREST RESERVE, BELIZE

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Resumen. – **Preferencia de hábitat en *Colinus nigrogularis* in la reserva forestal Manatee, Belice.** – La Codorniz Gargantinegra *Colinus nigrogularis* es una especie muy emparentada a la Codorniz Norteaña *C. virginianus*, y posee una garganta muy negra muy obvia y listas oculares blancas. La Codorniz Gargantinegra ocurre en tres distintas poblaciones una en la Península de Yucatan en México, en Belice y a lo largo de la frontera entre Honduras y Nicaragua. Estudiamos la preferencia de hábitat de esta codorniz en la Reserva Forestal Manatee del 9 de julio al 7 de agosto de 2009. Se establecieron parcelas de 100 m² con un radio de 5.6 m en cada punto de conteo. Además analizamos la vegetación que se encontró a lo largo de cuatro líneas de 5.6 m ubicadas hacia los puntos cardinales. En 23 puntos de conteo el 43.4% del hábitat fue pastos, 10.9% de hierbas, 10.3% de árboles, 19.8% de arbustos y 15.6% de suelo desnudos. La mayor diversidad florística dentro de las parcelas fue para las hierbas (9 especies) y la menor para árboles (2 especies). El uso específico del hábitat en cuanto a comida y cobertura esperan análisis futuros.

Abstract. – The Black-throated Bobwhite, a close relative of the Northern Bobwhite *C. virginianus*, has a distinctive black throat and eye stripes with both bounded by white. Black-throated bobwhite occur in three distinct populations in the Yucatan region of Mexico, Belize and along the Honduran and Nicaraguan border. We studied the habitat preference of the Belizean population in the Manatee Forest Reserve from 9 July to 7 August 2009. At each flush point a plot (100m²) with a 5.6 m radius was established. We analyzed vegetation encountered along strips centered at the flush point and extending in the cardinal directions for 5.6 m. Results from 23 flush points indicated preferred habitat is composed of 43.4% grasses, 10.9 % forbs, 10.3% trees, 19.8 % shrubs and 15.6 bare ground. Flora diversity within the plots was greatest with forbs (9 species) and smallest with trees (2 species). Specific use of the habitat components for food and cover await further study.

Key words: Belize, Black-throated Bobwhite, *Colinus nigrogularis*, habitat preference, savanna

INTRODUCTION

The Black-throated Bobwhite belongs to the avian family Odontophoridae (Johnsgard 1988). The males have a black throat and eye band with white on head, neck, breast and belly. The females have a buffed face, with a dark band through the eye and her lower breast is white and brown (Johnsgard 1988).

The bird has a distinct vocalization of “Bobwhite.” In addition, it is relatively short, stout, with strong legs, low mobility, and a shaded color that makes it difficult to be recognized amongst the understory (Jones 2003). This species is a native of the Yucatan of Mexico, Belize, northeastern Guatemala, and southern Honduras and is also known as the Yucatan Bobwhite (Madge & McGowan 2002). The

quail is a fairly common resident on the mainland of Belize, inhabiting savannas and meadows (Jones 2003).

Under the Wildlife Protection Act of 1981, the Black-throated Bobwhite is among six bird species that can be legally hunted in Belize (Belize Forest Department 2009). Adequate studies, however, have not been done to determine the status of this species, its habitat or ecological requirements. It has been suggested that because of its restricted distribution and limited knowledge of the population dynamics, the Black-throated Bobwhite should be removed from the list of legally hunted species until more information is known (Miller & Miller 1997). The study objective was to determine the preferred habitat of the Black-throated Bobwhite in order to provide additional information to assist in effectively managing the species.

METHODS

Study Area The Manatee Forest Reserve [469 km²; N 16° 40.8' W 88° 25' 34.8"] is in the Tropical Moist Forest Life Zone of Belize in the lowland coastal plain (Fig. 1; Holdridge 1967). The coastal lowland forest consists of a mosaic of species primarily affected by soil type, drainage and fire (Eitniear *et al.* 2009). The Reserve is comprised of a mixed forest type dominated by Caribbean Pine *Pinus caribaea* and is closely associated by oak *Quercus oleoides*. The understory is very complex consisting of a variety of trees, shrubs, and grasses, including craboo *Byrsonima crassifolia*, sandpaper tree *Curatella americana*, (Farruggia, *et al.* 2008) and in some areas silver saw palmetto *Acoelorrhapha wrightii* and calabash *Crescentia cujete* (Jones 2003). Rainfall in the central region of Belize, in which the reserve is located, is seasonal. The general rainfall for this area is 200-270 cm annually, with less than 10 cm/month during the dry season from January through May (Walker 1973). Areas of the re-

serve are seasonal swamps, and inaccessible in some instances. Research was conducted in the Northeastern section of the reserve in a pine and oak dominated open-savannah (Fig. 1). The specific forest types assessed in this Northeastern section were the lowland pine woodland and savanna as well as seasonally wet meadows. The transition between the two forest types occurred quite abruptly.

Sampling Protocol Black-throated Bobwhites were identified by both sighting and vocalization while randomly walking through the northeastern sector of the reserve from 9 July to 5 August 2009 over approximately 18 days and 162 hours (Fig. 1b). The general methodology executed was similar to that of Bristow & Ockenfels (2002). At each flush point a circular plot measuring 100 m² [5.6 m radius] was established. Each observation/flush point of quail was marked with a flag. The 100-m² plot was used because it is effective in surveying species with sessile mobility. Variables were assessed at each flush point.

Parameters around Flush Points 100-m² circular plots were established around flush points by setting out 5.6 m strips of flagging tape from the center of the flush point each cardinal direction. Parameters such as the date, time, and weather condition were recorded at each flush point. The size of the covey and the sex of the quails were determined when possible. The distance from the flush point to the nearest tree was determined using a tape measure. A zero [0] was recorded for the nearest tree when the bird was found perched on the tree. The height of this nearest tree was also measured, using a clinometer. The circumference of the nearest tree (>2m tall) was measured at breast height, 1.2m from the ground, using a tape measure. The circumference of the tree was then used to calculate the diameter at breast height (DBH) of the trees. In addition, the canopy cover for the quails within the area of each flush point was assessed by walking along a 25-m transect, perpendicular



FIG. 1a. Map of the 469-km² Manatee Forest Reserve study area, located in Belize.

to the center point, placed in each cardinal direction (Bristow & Ockenfels 2002). Each 1-m mark indicated a stop point at which the canopy cover (>10 cm) was estimated using a 0-10 scale, with zero being no canopy and 10 being solid canopy. The coverage data for all 4 transects within each plot was pooled, and an average was calculated for each flush point.

Vegetative assessment Within the 100-m² plots, the percent cover of each vegetation class was determined; these vegetation types included: grasses, forbs, trees, shrubs and bare ground. The species diversity of each vegetation class was also determined. The height and circumference of the trees that were present within the plots were measured, and the average circumference was calculated when there

was more than one tree per plot. The circumference was then used to calculate the DBH of the trees. The vertical structure of the habitat at each flush point was also measured by using a density board. The density board was made using a 0.3 m (1.0 ft) by 1.8 (6.0 ft) board, with each 0.3 m (or 1 foot) painted alternately in red and white. The board was placed vertically at each flush point, and the observer stood 4 m away from the board and estimated the amount of obstruction of the vegetation against the measurements on the board. This was done in each of the four cardinal directions. The results for the North, South, East and West measurements from each flush point were pooled in order to get an average canopy cover within each plot. Additionally, voucher



FIG. 1b. Black-throated Bobwhite Flush Points in ne. section of the Manatee Forest Reserve.

specimens were collected from recurrent plant species within the flush points for *ex situ* identification. They were pressed, using standard field pressing techniques and dried for preservation. The voucher specimens were then used for identification of each plant species.

Data Analysis For each of the assessed variables, the averages and standard deviations were calculated to evaluate trends on habitats where Black-throated Bobwhites were found Manatee Forest Reserve. These variables included: covey size, distance to and DBH of nearest trees, number and height of trees within the plots, percentage [grass, forb, shrub, tree and bare ground] cover within the plots, number of [grasses, forbs, shrubs and trees] species within the plots, and total richness at each plot.

RESULTS

Covey size and composition Black-throated Bobwhites were flushed from 23 points located in the North Eastern Section, off the main trail, at the Manatee Forest Reserve (Fig. 1b). Excluding one flush point that had more than 10 birds, coveys were comprised of 1-3 quails at all other points; the average covey size was 1.5 ± 0.75 . Excluding the one point with the covey size of more than 10 birds, a total of 30 bobwhites were flushed during the study. The sex of the birds could not be determined for 61% of the flush points. However, at 17% of the points both a male and female adult quail were recorded. The remaining 22 % of points had just a single male. In addition, juvenile birds

TABLE 1. Summary of vegetation characteristics at flush points of Black-throated Bobwhites (*Colinus nigrogularis*) in the Manatee Forest Reserve, Belize, 2009.

Variable	Range	Average	Standard Deviation (\pm)
Distance to nearest tree (m)	0-10.8	3.22	2.73
DBH of nearest tree (cm)	0-29.3	13.47	9.05
Coverage (scale of 0-10)	0-10	3.05	1.25
Number of trees	1-9	2.35	1.94
Tree height (m)	0.88-38	6.25	7.41
DBH of trees within plot (cm)	2.87-52.23	9.92	11.64
% Grass	15-80	43.39	20.83
% Forb	5-20	10.9	4.53
% Shrub	4-60	19.87	16.07
% Tree	0-55	10.3	12.4
% Bare	0-55	15.6	12.6
Total Richness	17-31	24.65	4.05
Number of grass species	2-13	6.65	2.62
Number of forb species	4-15	9.13	3.11
Number of shrub species	1-12	6.04	3.01
Number of tree species	1-4	2.04	0.93
Obstruction Height (cm)	0-187.96	50.76	31.9

were recorded at 17% of the points, all of which also had adult quail present. Additionally, a nest was found at flush site 23, with both adult and juvenile quails present.

Habitat variables Several habitat variables were assessed in relation to the general area of each flush point (Table 1). The distance to nearest tree was relatively close to the flush points with an average distance of 3.22 ± 2.73 m away from flush points (Table 1). The nearest trees had an average DBH of 13.45 ± 9.05 m. The overhead canopy coverage around the flush point had relatively low coverage with an average of 3.05 ± 1.25 on a 0 – 10 scale. Although there were frequently trees located nearby a flush point, we found an average of 2.35 ± 1.94 trees present within the 100-m² circular plots surrounding Black-throated Bobwhite locations. The average height of these

trees was 6.25 ± 7.41 m, but heights ranged considerably from 0.88–38 m. The DBH of these trees within the plots were higher than the nearest tree with an average DBH of 9.92 ± 11.64 cm.

The average percentage cover of each vegetation type within the plots, including bare ground, was determined. The predominant vegetation type was grass with grass covering an average of 43.3% of plots (Fig. 2). Shrubs and bare ground comprised the next largest vegetative coverage with an average of 19.9% and 15.6% of plots, respectively. Forbs and trees each covered approximately 10% of the plots surrounding flush locations (Fig. 2). The average obstruction height within the plots was 50.8 cm (Table 1).

From the voucher specimens collected of recurrent plant species within the flush points

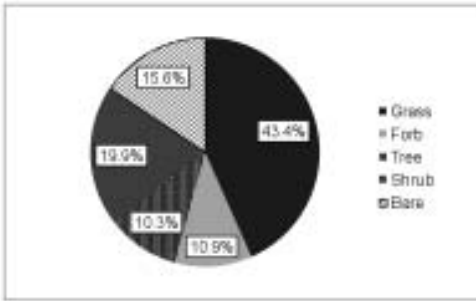


FIG. 2. The average percentage cover of each vegetation type at 23 flush locations of Black-throated Bobwhite at Manatee Forest Reserve, Belize, 2009.

a species list was created (Table 2). A total of 26 plant species were collected from 14 different families. Eight legume plants [Fabaceae] and four grass species [Poaceae] were collected. Additionally, a diversity of other flowering and fruit bearing plants were collected and identified. The average species richness of the 23 plots was approximately 24 species per plot (Table 1). The most diversity within a vegeta-

tive type was forbs having an average of 9 species per plot, while each plot had an average of about 6 grass and 6 shrub species (Fig. 3).

DISCUSSION

We found Black-throated Bobwhite coveys to primarily consist of 1-3 birds each during our sampling period which occurred during the beginning of the regular hunting season.

During this study, it was assumed that every flush point was a preferred habitat to the Black-throated Bobwhite Quail within the Manatee Forest Reserve. One predominant habitat variable of interest was the percentage of vegetative cover. Bristow & Ockenfels (2002) found vegetation cover and richness to be important in habitat selection by Montezuma Quail. Similar to the Montezuma Quail (Bristow & Ockenfels 2002), the Black-throated Bobwhite appears to be associated with dense grass coverage greater than 40%

TABLE 2. Plant species list from within 100-m² plots at 23 flush points of Black-throated Bobwhites (*Colinus nigrogularis*) at the Manatee Forest Reserve, Belize, 2009.

Family	Species
Asteraceae	<i>Calea cf. trichotoma</i>
Cyperaceae	<i>Cyperaceae 1, Cyperaceae 2, Rhynchospora barbata,</i>
Dilleniaceae	<i>Curatella americano</i>
Fabaceae	<i>Chamaecrista kurthiana, Zornia reticulata, Chamaecrista flexuosa, Eriosema crinitum, Pithecellobium pachypus, Glicidia sepium, Chamaecrista diphylla, Mimosa cf. asperata</i>
Fagaceae	<i>Quercus oleoides</i>
Hypoxidaceae	<i>Curculigo scorzonifolia</i>
Malpighiaceae	<i>Byrsonima crassifolia</i>
Myrtaceae	<i>Calyptranthes chytraculia</i>
Oxalidaceae	<i>Oxalis frutescens</i>
Poaceae	<i>Poaceae 1, Poaceae 2, Poaceae 3, Paspalum sp.</i>
Polygalaceae	<i>Polygala longicaulis</i>
Rubiaceae	<i>Spermacoce sp.</i>
Tunericaceae	<i>Turnera aromatica</i>
Zamiaceae	<i>Zamia sp.</i>

Note: 1 =

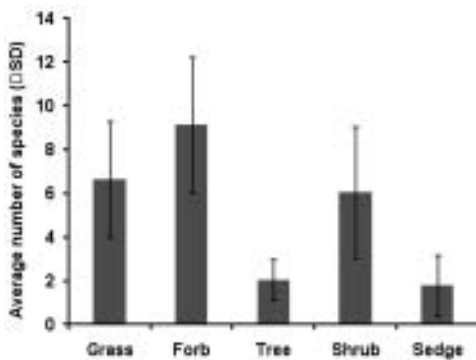


FIG. 3. The average number of plant species (± 1 SD) per 100-m² circular plot where Black-throated Bobwhites were flushed on the Manatee Forest Reserve, Belize, 2009.

on our study area, and of which is comprised of about 6 different species. Bunch grass provides the most cover for quail, especially during the summer, since the plant is at its highest density and height during this season (Bristow & Ockenfels 2002). Additionally, bunch grasses are a common nesting substrate for many quail species such as Northern Bobwhites (Brennan 1999).

Forbs provide important food sources for quail. Black-throated Bobwhites in our study were using areas with approximately 11% forb composition, and this vegetation type provided the most diversity in number of species per sample. The average amount of herbaceous cover should be >10%, which has been suggested as the minimum for bobwhite nesting and brood habitat (Riddle *et al.* 2007). The increase in abundance and diversity of forbs is essential for the survival of bobwhites, as this secures the availability of food resources for bobwhite chicks and during the brooding season increases the probability of chicks successfully capturing arthropods (Burke *et al.* 2007). Arthropods constitutes >80% of bobwhite chicks diet during the first two weeks of their life as it provides them with the necessary protein, amino acid, water and energy needed for their survival and growth (Burke

et al. 2007). Brood habitat quality can directly affect bobwhite population growth (Burke *et al.* 2007). High quality brood habitats have high species richness, with a diversity of forbs, and sufficient bare ground which allows for the foraging of chicks to catch arthropods (Burke *et al.*, 2007). We found Black-throated Bobwhites using areas composed of approximately 15% bare ground. As we observed with Black-throated Bobwhites, a combination of forbs, grass, shrubs, and bare ground were all important components of the habitat selection of Northern Bobwhites in Texas (Kulvlesky *et al.* 2002).

The vegetation obstruction height is another important habitat variable linked to the high percentage of grass, as well as the high percentage of shrub cover we found at Black-throated Bobwhite locations. The average obstruction height at sites was approximately 50 cm. For many quail species, their primary predator avoidance strategy is to remain motionless and rely on their cryptic coloration and sufficient overhead cover to reduce detection (Brennan 1999, Bristow & Ockenfels 2002). Thus, obstruction height is speculated to be linked to security from predators, and for Montezuma Quail, it is thought that the higher the canopy of the understory the less likely the quail will be preyed on by both ground and avian species (Bristow & Ockenfels 2002).

Areas with too much overhead canopy are thought to provide ideal habitat for both mammalian and avian predatory species (Seckinger *et al.* 2006). Hence, it is recommended that the forest be maintained in an early successional community that not only creates potential usable space for Northern Bobwhite, but also maintains this dense understory which may reduce predation risk (Seckinger *et al.* 2006). We found Black-throated Bobwhites in areas with low overhead canopy, in addition to the dense grass and shrub understory.

Although we document habitat Black-throated Bobwhites were present in, this study

should serve as a baseline for future work. Our study examined bobwhite use at only one site without comparisons to other locations or locations without quail. We assumed that on a given day, each quail and/or covey sighted was a different one and thus independent of other observations made during the survey and that each flush point was representative of preferred Black-throated Bobwhite. Additionally, this study only captured a small portion of a single season. However, we found Black-throated Bobwhites at Manatee Forest Reserve in Belize to be utilizing habitats with similar characteristics to other grassland quail species. Black-throated Bobwhites were located in areas with low overhead canopy and a dense, diverse understory typical of early successional habitats. Future work should focus on carefully designed studies comparing bobwhite habitat use across different study areas. Detailed observations of Black-throated Bobwhite habitat use from telemetry studies would really enhance the current state of knowledge on this species.

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