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POPULATION DENSITY OF THE HELMETED CURASSOW (*PAUXI PAUXI*) IN TAMÁ NATIONAL PARK, COLOMBIA

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ABSTRACT.—We estimated the population density of the Helmeted Curassow (*Pauxi pauxi*) in Tamá National Park (TNP) Colombia, using visual counts between December 2006 and December 2008. We used six line transects (1 km each) equitably distributed in a natural forest between 800 and 1,200 m asl in the southern part of the park. The sampling effort was 588 hrs with a total distance of 490 km, a detection rate of 0.06 records/hr, and an encounter rate of 0.08 individuals/km. Only solitary individuals were recorded ($n = 40$); the estimated density was 4.8 individuals/km^2. Most detections occurred in the lower strata of the forest (floor and sub-canopy) where hunters take advantage of curassows in the lower strata for successful harvest. The southern sector of TNP becomes important in the dry season. Our study suggests a large population is in TNP, but harvesting activities including removal of eggs, chicks, and juveniles, and hunting adults are affecting the reproductive rate and population of the species. *Received 6 June 2011. Accepted 2 February 2012.*

The Helmeted Curassow (*Pauxi pauxi*) occurs in Venezuela and Colombia. Its distribution in Colombia is discontinuous in the Perija Mountain Range and the Cordillera Oriental. It inhabits dense rainforest and montane cloud forest at altitudes from 500 to 2,800 m asl (Naveda-Rodriguez and Strahl 2006), but is most commonly seen within the cloud forest between 1,000 and 1,500 m asl (Hilty and Brown 1986). It has been subjected to loss of habitat and hunting pressure (Silva and Strahl 1997a, b). The latter has a negative effect on populations due to low density and slow intrinsic rate of reproduction (Silva and Strahl 1991, Renjifo et al. 2002, Brooks and Fuller 2006). The Helmeted Curassow usually avoids human presence in hunted areas (Silva 1999), making visual counts complicated and requiring intense sampling effort to obtain reliable data. The density of this species may also depend on social behavior, along with availability and quality of habitat (Buckland et al. 1993). The population has been estimated at 1,000–2,499 individuals and globally is classified as Endangered (Naveda-Rodriguez and Strahl 2006, BirdLife International 2011b). The objectives of our research were to estimate: (1) the density of Helmeted Curassows in the southern sector of Tamá National Park, and (2) the population size in a forest between 800 and 1,200 m asl.

METHODS

Study Area.—This study was conducted in Tamá National Park (TNP) (07° 27′ N, 72° 28′ W) at the northern tip of the Cordillera Oriental in the jurisdiction of Herran and Toledo municipalities, Norte de Santander, Colombia (Fig. 1). The Park contains 48,000 ha of protected area and is connected to a park of the same name in Venezuela, which together comprise the Tamá massif in the Tamá Binational Park (UAESPNN 2008). TNP has different climates due to altitudinal variation, ranging between 350 and 3,500 m asl. This area is considered an Important Bird Area (IBA# CO189) by BirdLife International (2011a).

Surveys were conducted in an area of 1,000 ha, covering ~12% of the 8,640 ha of the Helmeted Curassow distribution within TNP (UAESPNN 2008). This area is characterized by mature forest with altitudes ranging from 800 to 1,400 m asl with annual rainfall of 863 mm and a rainy season from April to September.

Field Work.—We used a line–transect method (Buckland et al. 1993) with two visual observers and repeated surveys along six line transects of 1 km each, evenly distributed in the study area. Transects were sampled between 0400 and 0800 hrs EST in one direction, and in the reverse direction between 1400 and 1800 hrs at an average speed of 1 km/1.2 hrs (70 min) surveyed at the rate of one transect/day. Survey population censuses were conducted during 2007–2008, except for May, June, and September 2007 and

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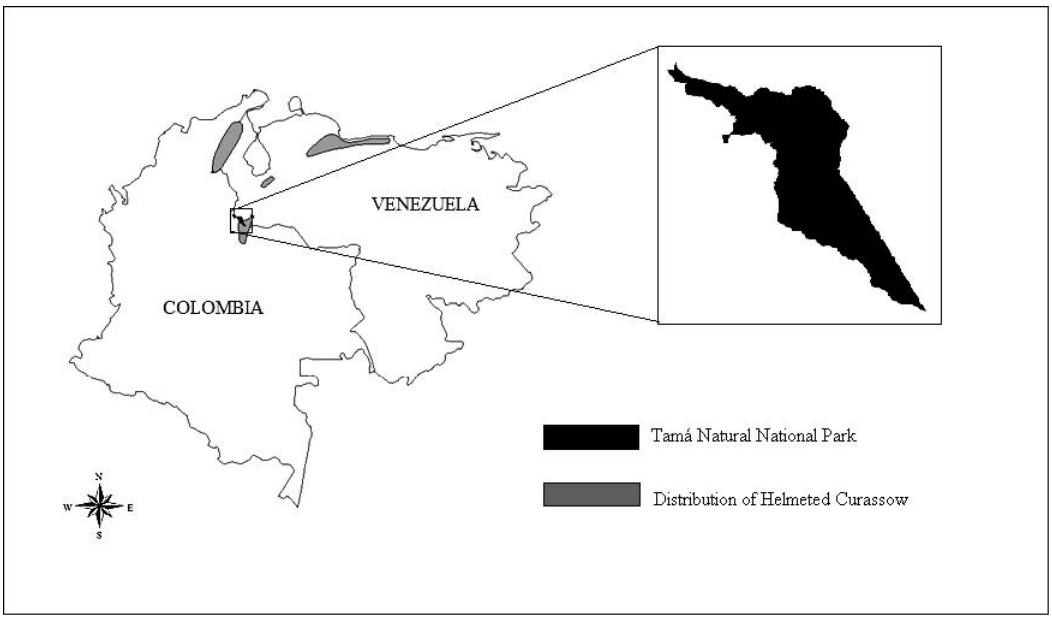

FIG. 1. Geographic distribution of Helmeted Curassows.

May, September, and October 2008, for total of 245 days in the 17 months sampled.

Data were collected upon each visual contact with a curassow. The perpendicular distance from the bird to the nearest point of the transect was measured with a standard metal tape; the meeting point with the bird was estimated when the observation was not directly perpendicular and walked to measure the perpendicular distance to the nearest point of the transect. Other data recorded included time of the encounter, number of individuals observed, and the forest stratum in which the bird was observed (floor, understory 6–20 m, or canopy $>$ 20 m).

Data were analyzed using Distance 5.0 (Thomas et al. 2006). Density estimates and resulting population estimates were obtained by selecting the best detection curve model based on Akaike Information Criterion (AIC), which is based on the Kullback–Leiber model (Akaike 1981).

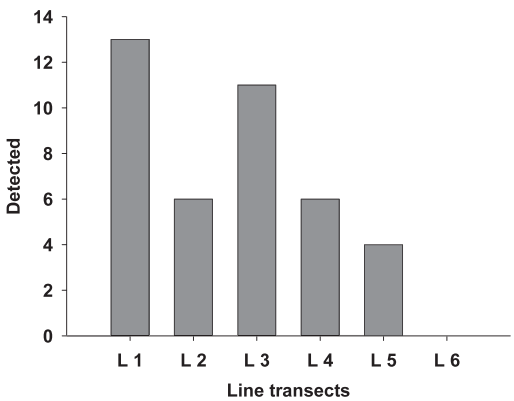

FIG. 2. Number of individual Hemeted Curassows detected in each transect in Tamá National Park, Colombia.

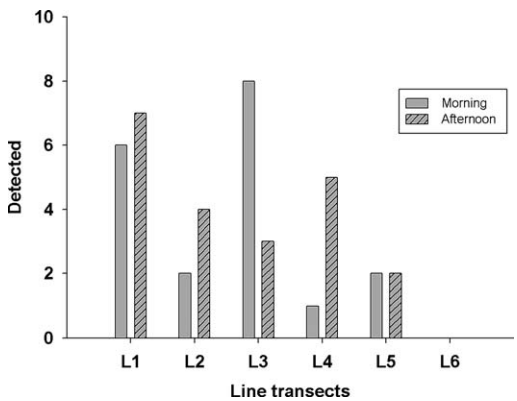

FIG. 3. Pattern of detections of Helmeted Curassows in morning and afternoon in Tamá National Park, Colombia.

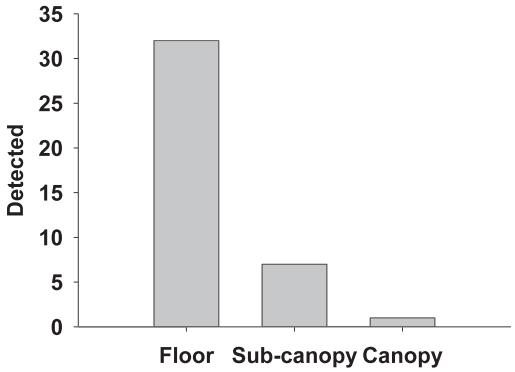

FIG. 4. Number of individual Helmeted Curassows detected in different strata of the forest in Tamá National Park, Colombia.

RESULTS

Forty visual records of Helmeted Curassow were obtained during 2 years along 490 km of line transect surveys with a sampling effort of 588 hrs, a detection rate of 0.06 records/hr, and an encounter rate of 0.08 individuals/km. Only single birds were observed. Birds were seen in all transects except L 6, at perpendicular distances ranging from 1.2 to 30 m. More contacts were made on transects L 1 and L 3 (Fig. 2). No individuals were recorded by sound; 52.5% of the detections were obtained in the morning, and 47.5% during the afternoon (Fig. 3). Thirty-two individuals were observed on the ground during the census, seven were in the subcanopy, and one was observed in the canopy (Fig. 4).

We obtained a density of 4.8 individuals/km^2; the model Half-normal cosine adjustments order 2 was the lowest Akaike Information Criterion (Table 1) with an effective band width (ESW) of 7.988 m (Table 2). We truncated detections $>$14 m perpendicular to the transects to obtain an adequate detection curve (Fig. 5)

DISCUSSION

This study is the first to document the distribution of Helmeted Curassows in Colombia. Reports on the population density of Helmeted Curassow in Venezuela range from 2 to 8 individuals/km^2 (Silva and Strahl 1991). Our study reports a density of 4.8 individuals/km^2, the first for TNP, and is in the range of densities estimated for the species. However, there were differences within the methodologies used, scale of sampling, and type of analyses, which can affect density estimates (Strahl and Silva 1997)

Franco-Maya and Alvarez (2002) estimated a population of Helmeted Curassows between 3,850 and 15,400 individuals in Colombia, based on a potential area of 1,925 km^2 and an estimated population of 2–8 individuals/km^2 reported by Silva and Strahl (1991). If the potential habitat of the species is occupied and has the density reported in our study, the population would be 9,240 individuals in Colombia, indicating there may be an important population in TNP. The number of individuals may be lower considering 30% of the habitat is estimated to have been lost due to agricultural expansion in the Andes and hunting pressure in TNP (Franco-Maya and Alvarez 2002). Additional work is needed to assess the current potential distribution in Colombia, as well as information about the subspecies *Pauxi p. gilliardi* in the Serrania del Perija to identify the current status of populations in Colombia.

There is no clear information on habitat use and behavior of the Helmeted Curassow. Visual detections obtained in our study indicate most individuals were in the lower strata of the forest (floor and sub-canopy); hunters take advantage of curassows using the lower strata to harvest individuals (Setina et al. 2010). Poaching was common in the dry season as well as harvesting

TABLE 1. Detection models for Helmeted Curassows in Tamá National Park, Colombia.

	Model 1	Model 2	Model 3
	Half-normal	Half-normal - cosine adjustments order 2	Half-normal - cosine adjustments order 2, 3
Value likelihood (Ln)	−92.535736	−91.379085	−90.889244
Akaike Information Criterion (AIC)	187.07147	186.75816	187.77849

TABLE 2. Effective band widths of transects used to detect Helmeted Curassows in Tamá National Park, Colombia.

Model	Estimate	%CV	95% Confidence interval
Half-normal cosine Adjustments order 2			
AIC	186.75816		
ESW (m)	7.988	30.07	4.398–14.508
Density	4.8	41.40	2.11–11.56 ind/km^2

eggs, chicks, and juveniles from TNP (Franco-Maya and Alvarez 2002, Setina et al. 2008).

The Helmeted Curassow is considered rare and locating individuals requires a large sampling effort in sub-Andean forest. The sub-Andean topography varies and is challenging to traverse and it can be difficult to encounter curassows along established transects. One of the six transects (L 6) had no visual records. Curassows likely avoided this transect because it was along the forest edge near human settlements. Observations on other transects occurred during the dry season and were inside the forest. The study area borders a stretch of the Margua River, which is an important resource for humans and wildlife during the low-water season. Studies of phenology, food availability, and additional surveys are needed in other areas to identify important areas for Helmeted Curassows.

The TNP administration should consider strengthening their educational programs and initiating a process of learning about conservation biology with residents of the buffer zones of the park. Our study suggests there may be an important population of Helmeted Curassows in TNP, but activities such as egg extraction and poaching may be affecting the reproductive rate and consequent population stability of the species. It is also necessary to strengthen inter-institutional agreements between the administration of TNP and academic institutions to generate knowledge of the species to improve conservation efforts.

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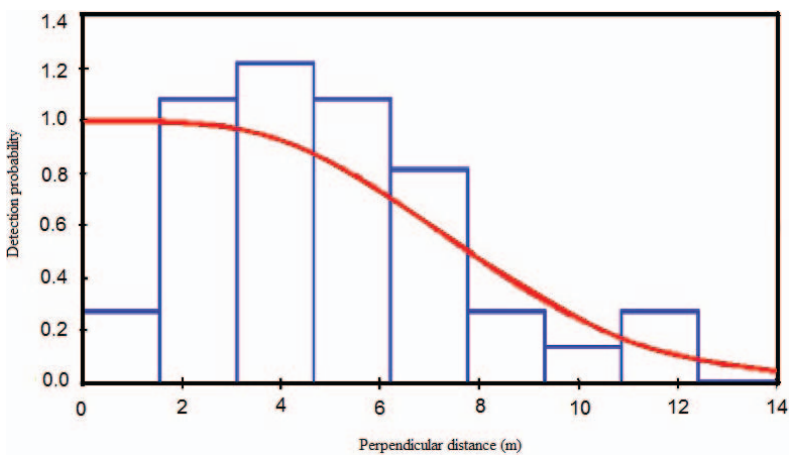

FIG. 5. Detection probability curve of Helmeted Curassows in Tamá National Park, Colombia using DISTANCE 5.0.

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