ORNITOLOGIA NEOTROPICAL 22: 267–279, 2011

DISTINCTIVE MORPHOLOGY, ECOLOGY, AND FIRST VOCAL DESCRIPTIONS OF SIRA CURASSOW (*PAUXI [UNICORNIS] KOEPCKEAE)*: EVIDENCE FOR SPECIES RANK

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Resumen. – Morfología, ecología y descripciones de las primeras vocalizaciones del Paujíl del Sira (*Pauxi* [*unicornis*] *koepckeae*): evidencia para una especie separada. – Aquí se reportan las primeras observaciones en el campo de las vocalizaciones, comportamiento y ecología de *Pauxi unicornis koepckeae*, se hacen comparaciones de especímenes de museos y datos de campo de la forma nominativa *P. u. unicornis*. En base a las diferencias entre estas poblaciones alopátricas se sugiere que estas dos formas distintas son especies separadas. En *P. koepckeae* la protuberancia frontal es más corta, el diámetro y la forma son más pequeños, y en la cola las puntas de las rectrices centrales carecen de coloración blanca. Se describen por primera vez detalles de las vocalizaciones de *P. koepckeae*. Estas se diferencian de las vocalizaciones de *P. unicornis* en que *P. koepckeae* tiene cantos de corta duración, pocas frases, pocas notas y carece de la nota alta final distintiva que caracteriza a *P. unicornis*, y el llamado de alarma está acompañado por el movimiento horizontal de la cola (a diferencia del movimiento vertical de *P. unicornis*). La temporada alta de canto, y por consecuencia probablemente la época reproductiva, de las dos taxas se diferencian en varios meses, siendo la temporada alta de canto de *P. koepckeae* a finales de la época de lluvias y la temporada alta de canto de *P. unicornis* al principio de la época de lluvias. La población aislada de *P. koepckeae* es endémica de los Cerros de El Sira y está separada por más de 1000 km de la forma boliviana. Las dos taxas se encuentran en diferentes hábitats, siendo *P. koepckeae* residente de bosque nublado entre 1100–1435 m s.n.m., y *P. unicornis* reside en bosque húmedo y bosque montano bajo entre 400–1100 m s.n.m.. Se presentan detalles adicionales de la ecología de *P. koepckeae* incluyendo abundancia con estimaciones promedio de < 1 individuo/km^2, y un máximo de 8.3 machos vocalizando/km^2 en una posible situación de lek disperso. Es muy probable que el estado de conservación de *P. koepckeae* sea Críticamente Amenazado por su distribución geográfica muy pequeña (< 30 km^2 actualmente conocida). La principal amenaza de *P. koepckeae* es la cacería local.

Abstract. – We report the first field observations of vocalizations, behavior and ecology of *Pauxi unicornis koepckeae*, and compare museum specimens and field data to the nominate Bolivian form *P. u. unicornis*. On the basis of the differences between these allopatric populations we suggest that these two distinct forms are separate species. Casque length is shorter, and diameter and shape smaller in *P. koepckeae,* and the tail lacks white markings on the tip of the central rectrices in *P. koepckeae*. Details of the vocal signature and alarm call are described for the first time for *P. koepckeae*. These contrast with *P. unicornis* in that *P. koepckeae* has much shorter song duration and fewer phrases, fewer notes, lacks the

distinctive final loud note characterizing *P. unicornis*, and the alarm call is accompanied by horizontal tail fanning (versus vertical tail pumping in *P. unicornis*). The peak singing period, and therefore probably the breeding seasons, of the two taxa differ in timing by several months, with *P. koepckeae* song activity peaking towards the end of the wet season and *P. unicornis* peaking at the start of the wet season. The isolated *P. koepckeae* population is endemic to Peru's Sira Mountains and is separated by more than 1000 km from the Bolivian form. The two taxa are found in different habitats, with *P. koepckeae* resident in cloud forest at 1100–1435 m a.s.l., and *P. unicornis* resident in humid and lower montane forest at 400–1100 m a.s.l. Additional detailed findings on *P. koepckeae* ecology are presented, including abundance with average estimates of < 1 individual/km^2, and a peak of 8.3 vocalizing males/km^2 in a potential exploded lek situation. Conservation status of *P. koepckeae* is quite likely Critically Endangered in light of the very small geographic distribution (< 30 km^2 currently accounted for). The main threat to *P. koepckeae* is local hunting. *Accepted 20 April 2011*.

Key words: Cerros del Sira, cracid ecology, endemic avifauna, Horned Curassow, Helmeted Curassow, *Pauxi unicornis*, *Pauxi pauxi*.

INTRODUCTION

Pauxi unicornis koepckeae was first recorded in 1969 in the Sira Mountains, Huanuco, central Peru, based on collected specimens never observed in nature by the scientists who described it (Weske & Terborgh 1971). Both *P. u. koepckeae* and the nominate race of Horned Curassow (*P. u. unicornis*; found in central Bolivia) differ from the only other member of the genus, Helmeted Curassow (*P. pauxi*; found in northern Columbia and Venezuela), in plumage and other characteristics (Weske & Terborgh 1971). *P. pauxi* has a more bulbous, thicker, and larger casque and lacks the well developed low crest of curled, shiny black feathers found in both other populations. *P. u. koepckeae* differs from *P. u. unicornis* in that it has an ellipsoidal casque inclined posteriorly instead of an erect cone-shaped casque. *P. u. koepckeae* also has less white at the tip of the tail than either *P. u. unicornis* or *P. pauxi* (Weske & Terborgh 1971).

It is now believed that a report of a potential sighting of a *Pauxi* in southeast Peru (Foster *et al.* 1994 & reported in Collar *et al.* 1992) was not regarded as even a probable record by the original observer, T. Parker (Gastañaga & Hennessey 2005). There is thus no reliable evidence that any member of the *Pauxi* genus occurs in Peru other than in the Sira Mountains (Gastañaga & Hennessey 2005).

Efforts to rediscover *P. u. koepckeae* have resulted in six expeditions to the Sira Mountains since 2000, with only the latter half of the trips being successful in finding the form in nature. Searches for the curassow during an extensive ornithological expedition in 2000 proved unsuccessful (Mee *et al.* 2002). In the fall of 2003, Asociación Armonía initiated a conservation project targeting this curassow, completing a local information survey in Peru (Gastañaga & Hennessey 2005, Hennessey 2005). MGC traveled to the El Sira Communal Reserve (within the Sira Mountains) to seek local information on the *P. u. koepckeae* population. Twenty-five local indigenous people around the isolated Sira Mountains described the first detailed records of *P. u. koepckeae* in the country for 34 years with some people reporting that they had hunted the species recently, but there were no encounters with a living bird. MGC returned with RM in October 2004 to search for the curassow, but again found none despite two months of fieldwork.

In March 2005, MGC conducted a brief education project with four local communities in the area of the El Sira Communal Reserve where the curassow had been reported. During this trip she investigated a

reported hunting site and saw the curassow alive in nature, and heard three more individuals vocalizing (Gastañaga 2006, Gastañaga *et al.* 2007). This represented the first time the species was observed in Peru by a scientist, and the first scientific record of the species existence since its initial discovery in 1969 (Gastañaga 2006, Gastañaga *et al.* 2007). In October 2005, MGC returned to the site, encountering two individuals and recording one on video, providing the first physical evidence of the continued existence of the population for 36 years (Gastañaga *et al.* 2007).

Here we provide information about *P. u. koepckeae* based on the first field observations of their appearance, vocalizations, and behavior. We compare these to observational and acoustical information from the nominate Bolivian endemic *P. u. unicornis* in nature, and compare the few museum specimens of all three congeners. With the availability of new information, it is important to re-evaluate taxonomic classification. Given the geographic separation of the two taxa, we examine whether these two populations should be classified as separate species. Additionally we discuss the conservation status of both the *P. u. koepckeae* and *P. u. unicornis* populations.

METHODS

Study area. Endemic to Peru, *P. u. koepckeae* occurs in the Sira Mountains, Dept. Huanuco, central Peru (Fig. 1). These mountains are isolated from the Andes Mountains, contain high levels of biodiversity and endemism, and are a high global conservation priority (Terborgh & Weske 1975). The type locality for *P. u. koepckeae* is the Rio Llulla Pichis watershed on the western slope of the range (9°26'S; 74°45'W; Weske & Terborgh 1971). More recently, this curassow was found in other regions of the Sira Reserve including Quimpichari on the western slope (Gastanaga *et al.* 2007) and at the headwaters of the Río Iparia on the eastern slope (9°27S; 74°34'W; Graham 2009). Fieldwork for our study took place in the Quimpichari area and at two additional areas known as Golondrina and Casa Real.

Distinguishing forms. Field and museum data, including morphology, observations, and video recordings, collected for *P. u. koepckeae* (Gastañaga 2006, Gastañaga *et al.* 2007, MacLeod *et al.* 2006; DMB, MGC, & RM unpubl. data) were compared to similar data collected for *P. u. unicornis* (Gúzman *et al.* 1999, MacLeod & Duguid 2000, MacLeod *et al.* 2005, 2006). Detailed methods are provided in the respective publications, and below for the previously unpublished data.

Museum data. Only adult males were compared to standardize measurements and compensate for a lack of female specimens. While sample sizes were adequate for *P. pauxi* (N = 6), only two samples were available for each of the other two taxa, and one of the *P. u. unicornis* specimens was a captive individual as no others were available despite queries to major museums throughout the world. All measurements were taken with vernier calipers (± 1 mm). Casque ornamentation is an important sexually selected trait for most species of Curassows (cf. Buccholz 1991) therefore this character was the main focus for comparison.

Fieldwork. In addition to the observations reported in 2005 (Gastañaga *et al.* 2007), MGC and RM collected field data during three expeditions to the Sira Mountains in 2006 and 2008. The following sites were covered during 42 total days of field work: Casa Real (9°18'S; 74°48'W; 920–1200 m a.s.l.) was surveyed 7–12 October 2006 (6 survey days total), Golondrina (09°20'S; 74°49'W; 550–1225 m a.s.l.) was surveyed 15–26 July and 18–25 October 2006 (17 survey days), Quimpichari 1 (09°23'S; 74°48'W; 700–1150 m a.s.l.) was surveyed 2–6 August and 9

FIG. 1. Site where *P. u. koepckeae* occurs in the Sira Mountains, Peru, along with range of *P. u. unicornis*.

November 2006 (6 survey days), and Quimpichari 2 (09°22'S; 74°47'W; 1150–1550 m a.s.l.) was surveyed 7–12 August and 31 October–8 November 2006 as well as 17–23 March 2008 (13 survey days). The 2006 data were collected in conjunction with an Asociación Armonía biodiversity assessment of the Sira Mountains, with team members from other groups reporting any curassow encounters they had as well. Fieldwork took place from approximately 06:00–17:00 h. Recently opened or already existing trails were used as line transects at each site to map possible curassow territories in the area based on sightings and audio detection of singing birds. Eleven transects were walked at least three times each (three transects per site except for two transects at Casa Real) to ensure detection of curassow territories. Transects covered an altitudinal range between 550–1550 m a.s.l. (with additional casual observations up to 1700 m), and the complete range of forest habitats in the area (primary cloud forest, montane forest, and elfin forest as described by Terborgh & Weske 1975). Two video cameras (Sony Handycam 990x and Cannon MVX25i) were used to record visual data in the field, and sound recording equipment (Sharp Minidisk MT280E recorder with a Sennheiser ME 66 uni-directional shotgun microphone) was used to record vocalizations. For each curassow detected, we noted the date, time, habitat type, altitude, location, distance from observer, number of individuals, whether heard or observed (and, if observed, we noted plumage and other morphological characteristics), age and sex (if identifiable), behavior, and whether audio or video recordings were made or other physical evidence such as feathers found. Field notes for each singing

TABLE 1. Variation in tail, culmen, and casque morphology among separate forms of *Pauxi*. All data provided as mean (range) and sample size, respectively, from top to bottom rows within individual cells. Specimens measured: *P. u. koepckeae* – AMNH 802108 (holotype specimen), CORBIDI AV-1198; *P. u. unicornis* - ANSP 138764 (holotype specimen), DWA 9A116; *P. pauxi* - HMNS 1898, AMNH 156311, 216559, 471584–471585, 525536.

Pauxi males	Dorsal central tail rectrices white	Exposed culmen	Culmen tip to top of casque	Maximum diameter of casque	Casque length
koepckeae	No	37.2	84.2	21.4	45.3
	1	(35.3–39.1)	(83.6–84.9)	(20.4–22.5)	(45.0–45.7)
		2	2	2	2
unicornis	Yes	36.5	99.3	24.6	56.8
	2	(35.6–37.2)	(98.9–99.7)	(23.0–26.3)	(55.0–58.6)
		2	2	2	2
pauxi	Yes	35.0	95.2	36.3	60.5
	6	(33.5–37.3)	(87.0–104.1)	(29.8–44.0)	(57.2–62.3)
		6	6	6	6

bout included the number of notes, song length, pattern and vocal characteristics. The 2008 expedition involved seven days of fieldwork at the Quimpichari site in March 2008 by MGC & RM, using the same methods described above for 2006. Recordings were analyzed using Raven 1.2.1 sound analysis software (Charif *et al.* 2004).

RESULTS

Morphology. The main morphological differences between *P. u. koepckeae* and the other species in the genus *Pauxi* are variation in casque, tail, and culmen (Table 1). In comparing the available specimens, the casque of *P. u. koepckeae* is narrower in diameter (21.4 mm) and shorter in length (45.3 mm) than in *P. u. unicornis* (24.64 and 56.83 mm, respectively). Additionally, the hypotenuse from the tip of the culmen to the top of the casque is shorter (84.2 mm) in *P. u. koepckeae* than in *P. u. unicornis* (99.32 mm). Field observations (N = 9) and video recordings (N = 2) in the wild indicate that differences in the casque shape and size are the best diagnostic characters in the field (Fig. 2). In both specimens and field observations of *P. u. koepckeae* the tail lacks white markings on the dorsal tip of the central rectrices, which is not the case for the other forms of *Pauxi*.

Vocal description. Vocalizations differ between the two taxa (Table 2 and Fig. 3) and our description is the first for the vocalizations of *P. u. koepckeae*. In March 2005 (Gastañaga *et al.* 2007), up to four individuals were heard singing simultaneously, and up to three individuals singing at different times in October 2005. This prompted more detailed studies in 2006 and 2008, when *P. u. koepckeae* was heard singing 18 times. The song of *P. u. koepckeae* is made up of low frequency, booming notes, where the sequence is a series of four notes followed by a pause of approximately 2 s, repeated every 4–5 s. The first note is the loudest, with subsequent notes much quieter. At any distance > 20 m from a singing bird, only the first note of the sequence could be heard clearly, but because the note is repeated regularly at 4–5 s intervals it is still possible to use the length of song to easily distinguish it from the song of other curassow species in Peru and Bolivia.

FIG. 2. Photos showing distinctive casque morphology of populations of genus *Pauxi* in Peru (A and B: two wild individuals) and Bolivia (C: one captive individual in Santa Cruz Zoo, Bolivia) (photos: M. Gastañaga, J. Mendoza, and R. MacLeod).

Given the low frequency of the song, distance from the singing birds, and extreme background noise due to rivers in spate and weather (e.g., wind and rainfall), we were unable to produce a sonogram showing all four notes. Nonetheless a recording of *P. u. koepckeae* was obtained with three notes detectable (Fig. 3a).

In addition to the song, *P. u. koepckeae* was observed making two other vocalizations. On three occasions, a long series of short sharp Ksop! alarm calls were made while an individual was perched in a tree after being disturbed by the observer. This alarm call was accompanied by a horizontal fanning of the tail feathers concordant with each call. On one occasion, *P. u. koepckeae* gave a series of repeated low, sharp bark-like calls (like the alarm call of a Brocket Deer (*Mazama* sp.) which were given before being flushed by an observer and flying away.

Seasonal variation in singing. Vocal surveys were carried out from July to March, with data collected in each month except December and January when the peak of the rainy season makes the Sira Mountains largely inaccessible. The greatest song activity based on the number of individuals heard singing and duration of songs, was in March when up to four individuals could be heard singing simultaneously for periods of several hours. In contrast, song activity was relatively low in October and November, with only one individual heard singing at a time and all song bouts lasting less than 2 min. In July and August, song activity was negligible with song bouts by single individuals lasting only a few seconds.

Habitat and altitudinal distribution. No *P. u. koepckeae* were found in the Casa Real area during two October expeditions (2004 and 2006). In mid-July 2006, *P. u. koepckeae* was heard vocalizing briefly on two consecutive days at Golondrina (~ 1000 m a.s.l.). We believe it was the same individual because the sound came from the same location on both days. There were no further encounters in the remaining eight days of survey work in July or in seven days of surveys in October 2006, nor had there been any encounters in nine days of fieldwork in October 2004. The individual detected therefore did not appear to represent a resident population.

At Quimpichari, we heard at least two different individuals (from two separate loca-

TABLE 2. Variation in vocal signatures of *P. u. koepckeae* and *P. u. unicornis*. *P. u. koepckeae* samples based on 25 detections of singing individuals; *P. u. unicornis* samples based on 72 detections of singing individuals during studies in Carrasco National Park, Bolivia, and descriptions in Cox *et al.* (1997), MacCormick & MacLeod (2000), and MacLeod & Duguid (2000).

Pauxi form	Final loud note	Phrase duration	Pause duration	No. of phrases	No. of notes	Tail movement during alarm calls
koepckeae	no	3 s	2 s	1	4	horizontal fanning
unicornis	yes	8–10 s	5–7 s	4	8	vertical pumping

tions) singing briefly in early August 2006 a total of three times and found one tail feather at 1150 m a.s.l.. In November 2006, curassows were heard singing 10 times and seen once at Quimpichari, and a tail feather was found at ~ 1100 m a.s.l.. In addition, J. Mendoza observed an individual curassow at 1360 m a.s.l. at 14:41 h on 5 November 2006 and was able to record 9 min of video showing morphological characteristics and behavior (Fig. 2). In March 2008, four individuals were seen, and singing individuals were heard on four occasions at altitudes of 1100–1200 m a.s.l.. In total these observations represent 24 detections of *P. u. koepckeae* at Quimpichari at different times of year, representing a resident population inhabiting the cloud forest zone with an overall altitudinal range of 1100–1435 m a.s.l. during the breeding season.

Population abundance. Line transects at Quimpichari covered a total of 2.4 km. Based on prior experience measuring detectability of curassow vocalizations (RM unpubl. data), we estimated that *P. u. koepckeae* could be heard vocalizing up to a distance of 100 m. By combining records from the same location and altitude, we calculated four different male *P. u. koepckeae* vocalizing along transects. Based on information from captive cracids (O. Joiner pers. com.) and field experience with curassow singing behavior in Bolivia (MacLeod & Duguid 2000, MacLeod *et al.* 2005, 2006), we know that only males of the genus *Pauxi* vocalize, so we concluded that the songs we heard represented a minimum of four breeding territories at the Quimpichari site. Because the survey area covered by transects was estimated at 0.48 km^2, we calculated a density of 8.3 vocalizing (male) individuals/ km^2.

DISCUSSION

More than 20 local knowledge and field surveys searching in suitable habitat for curassows between the known ranges of *P. u. koepckeae* in Peru and *P. u. unicornis* in central Bolivia have failed to find any evidence of the presence of the genus (Herzog & Kessler 1998, Hennessey *et al.* 2003, Hennessey 2004, Gastañaga & Hennessey 2005, MacLeod *et al.* 2005; additional unpubl. surveys by RM, BH, S. Herzog, & R. Soria). This suggests that what was once thought would be a single population found contiguously along the Peruvian/Bolivian Andean mountain cloud forest chain is actually two isolated populations found at the peripheries of the potential distribution, with a gap of over 1000 km between them (Fig. 1). The 1000 km separation, intervening low lying habitat and human populations mean that the populations have been reproductively isolated for a considerable length of time and there is no likelihood that the two populations could come into contact in the future.

Morphological differences. Morphology differs between the two taxa (Table 1). Although

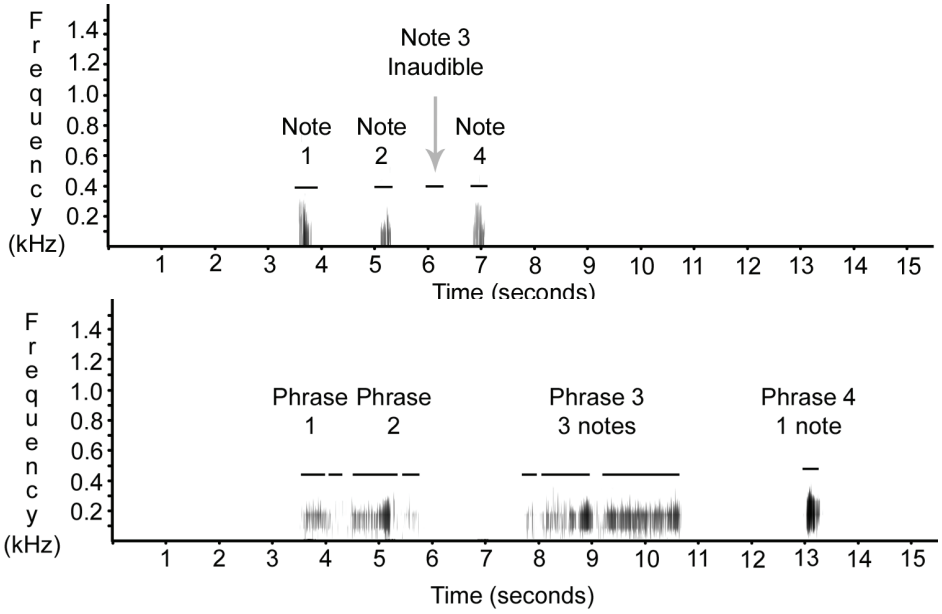

FIG. 3. Sonograms of a) *P. u. koepckeae* and b) *P. u. unicornis*. The song of *P. koepckeae* has a phrase of four notes (indicated by the black horizontal lines) with the first note somewhat louder than the following 3 notes. In the sonogram the third note was so quiet that it could not be separated from the background noise of the recording although it was audible to the observers in the field. The song of *P. u. unicornis* has eight notes (indicated by the black horizontal lines), forming the four phrases (Cox *et al.* 1997) shown in the sonogram. The song of *P. u. unicornis* is three times longer, with a final distinctive, much louder and far-carrying note, which is completely absent from the song of *P. u. koepckeae.*

there are few specimens available for comparison, those that are available have especially striking differences in casque form, with a flattened shield-like ellipsoid in *P. u. koepckeae* and an erect cone-shaped horn in *P. u. unicornis* (Fig. 2). In the field the casque shape of *P. u. koepckeae* (N = 14 observations reported here and in Graham 2009) also consistently differs from that of *P. u. unicornis* (N > 30 observations, photographs and videos; Cox *et al.* 1997, Herzog & Kessler 1998, Macleod & Duguid 2000; pers. com. of R. Soria-Auza, A. Muñoz, & V. García-Soliz).

Vocal differences. Vocalizations differ between the two taxa. The song of *P. u. koepckeae* is a low booming vocalization that lacks the final emphatic far carrying note that is the most distinctive feature of the song of *P. u. unicornis* (Cox *et al.* 1997). The booming sequence of *P. u. koepckeae* is a series of four notes followed by a pause of approximately 2 s, repeated every 4–5 s. In contrast the *P. u. unicornis* booming sequence comprises four phrases totaling eight notes that lasts 8–10 s and is repeated every 15 s, and also has the very distinctive and very loud final sharp BMM! note (Cox *et al.* 1997) that *P. u. koepckeae* lacks. The song of the only other curassow found in the Sira Mountains, *Mitu tuberosa*, has a similar number of notes and length of song to *P. u. unicornis* (Cox *et al.* 1997), and its song is more much similar to *P. u. unicornis* than *P. u. koepckeae* is to *P. u. unicornis.*

Although there has been little detailed analysis published on the vocalizations of *P. Pauxi,* the song is described by Hilty (2003) and a brief sonogram has been published by Delacour & Amadon (1973). Based on these sources the song of *P. pauxi* consists of 7–8 low-pitched booming notes lasting approximately 7 s and separated by a pause into at least two phrases. Like the song of *P. u. koepckeae* the song of *P. pauxi* lacks the distinctive final note of the song of *P. unicornis*, but otherwise the song of *P. pauxi* seems more similar in length, phrasing, and number of notes to P. *u. unicornis* than to *P. u. koepckeae.*

The 'Ksop!' alarm call was very similar to that made by *P. u. unicornis* (Cox *et al.* 1997). However, while the call was accompanied by a horizontal fanning of the tail feathers concordant with each call in *P. u. koepckeae*, *P. u. unicornis* accompanies each alarm call by pumping the tail up and down concordant with each call (RM unpubl. data, video recording by A. Muñoz). The alarm call of *P. pauxi* is described as a high reedy whistle 'fweet' (Hilty 2003) and there is no information recorded on any accompanying tail movements.

In regards to the series of low, sharp bark-like calls emitted by *P. u. koepckeae* before flushing, we are unaware of any published record of this type of call in closely related curassow species.

Singing season differences. The greatest song activity for *P. u. koepckeae* was during March, whereas peak song activity for *P. u. unicornis* is highest in October and November (Cox *et al.* 1997, RM unpubl. data). This difference in peak singing activity suggests that the breeding season of the two populations differs by at least four months with *P. u. unicornis* breeding timed to coincide with the start of the wet season, and the main breeding activity for *P. u. koepckeae* coinciding with the end of the wet season. The differences in song and timing of breeding would appear to demonstrate a complex change in reproductive behavior, reinforcing that the two taxa are behaviorally and reproductively isolated.

Habitat and altitudinal differences. P. u. koepckeae was found resident between 1100–1435 m a.s.l. in cloud forest (characterized by a high density of epiphytes covering every surface, and frequent presence moisture derived from clouds); a more recent record also found *P. u. koepckeae* in cloud forest and extended the altitudinal distribution to 1600 m a.s.l. (Graham 2009). This contrasts with the Bolivian endemic *P. u. unicornis* which occurs in humid forest on the edge of the tropical lowlands and in lower montane forest (characterized by a lower density of epiphytic surface cover, higher density of lianas, higher canopy, and moisture usually derived from precipitation), with all confirmed observations and specimens representing resident populations between 400–1100 m a.s.l. (RM unpubl. data). Although Maillard (2006) reports a partial *P. u. unicornis* specimen thought to have been killed by a dog at approximately 1400 m a.s.l., this was an immature individual and therefore does not provide evidence of a resident breeding population; moreover, the altitude is perhaps imprecise because the exact location was determined from a third-hand account of where the bird was killed.

The Sira Mountains are a range isolated from the Andes, characterized by habitat zones that are at lower altitudes than the Andes (Terborgh & Weske 1975). In the Sira Mountains the cloud to montane forest transition is found at 1050 m a.s.l. , which is several hundred meters lower than this transition at comparable locations in the main Andes (low of 1380 m, Terborgh & Weske 1975). Therefore the difference in habitats occupied by the two taxa is even greater than that suggested by a simple comparison of altitudinal ranges. As *P. u. unicornis* and *P. u. koepckeae* do not appear to show any overlap in habitat during

their breeding periods, they are likely to have separate ecological requirements.

Taxonomic status and etymology. On the basis of the evidence we suggest that these two allopatric taxa have populations that show ecological, reproductive and behavioral isolation. It seems highly probable that they are separate lineages, each on their own evolutionary trajectory. Our results suggest *koepckeae* and *unicornis* are two distinct species that have followed separate evolutionary paths for a significant length of time.

The specific epithet *koepckeae* was provided in honor of the late Maria Koepcke (1924–1971) in light of her extensive contributions to Peruvian ornithology (Weske & Terborgh 1971). Here we propose that the vernacular name Sira Curassow would be appropriate for the *P. koepckeae* population, highlighting the importance of the pristine region to which this form is endemic. Other species, such as the Sira Tanager (*Tangara phillipsii*), also have their vernacular name for this unique region which supports various rare endemics (Graves & Weske 1987).

The superspecies concept concerns a monophyletic group of allopatric species that are too distinct to be included in a single species (Haffer 1986, Mayr & Ashlock 1991). The cis-Andean *Pauxi* clade is a good example of first order superspecies (Haffer 1986). While historically *Pauxi* likely comprised clinal variation of a single form (e.g., megasubspecies; Amadon & Short 1976), the contemporary situation is much different with all three species extremely divergent. Ranges of *P. pauxi* and *P. unicornis* are approximately 1500 and 1000 km, respectively, distance from the range of centrally located *P. koepckeae.* Moreover, both *P. pauxi* and *P. unicornis* are quite different morphologically and vocally from *P. koepckeae*, and all three species represent distinct taxa, under the evolutionary species concept (Simpson 1961).

Population density. All detections of singing Sira Curassows occurred in the late morning and early afternoon on, or close to, ridge tops where most of the transects were located. We suspect that this was because birds were moving up the slopes during the day to sing in locations further away from the noisy, fast flowing rivers in the valley bottoms that would limit audibility of their song. As a result we think the calculated density reflects a breeding season concentration of birds rather than average density for the Sira Mountains. Such exploded lek social strategies have been observed for other curassows during the breeding season (cf. Strahl *et al.* 1997). We found *P. koepckeae* present in the breeding season in approximately 15% of the area covered by our surveys. Mee *et al.* (2002) did not find any individuals despite extensive investigation within its altitudinal range, and Weske & Terborgh (1971) only accounted for one pair in their study area. Therefore despite high densities in one area during the breeding season we suspect average density of the *P. koepckeae* population is likely to be < 1 individual/km^2.

Conservation status. The Sira Mountains are already known to be a endemic zone holding a variety of taxa restricted to this mountain range, including the well known near-threatened Sira Tanager (*Tangara philipsi*) (Terborgh & Weske 1975, BirdLife International 2008). This region is also part of the Peruvian East Andean Foothills Endemic Bird Area (EBA 053) (Stattersfield *et al.* 1998). *Pauxi unicornis* (including in the assessment the Peruvian *P. koepckeae* population) is currently considered Endangered (MacLeod *et al.* 2006, Birdlife International 2008). If treated separately both the *P. unicornis* and *P. koepckeae* populations will qualify at least as Endangered under criteria A1d, A2d and B1+B2b, 2c&2e, C2b. Given that the known range of *P. koepckeae* is very small (all four known sites are separated by less than 30 km and appear to represent a

single subpopulation) we believe it could qualify as Critically Endangered under criteria B1+B2a, 2b, 2c, or C1. We also suggest that *P. unicornis* could qualify as Critically Endangered under criteria A2d since we have observed (2005–2010) a substantial decrease in the protection offered by the Bolivian National Parks that encompass the entire range of this population. This decreased protection has lead to constant infringement of park boundaries due to increased logging, illegal hunting and the growing of coca (RM pers. observ.; pers. com. of S. Herzog, R. Soria Azua, & V. Garcia Soles)

The main threat to *P. koepckeae* is hunting by local communities. The curassow is legally protected in the Communal Reserve El Sira that comprises most of the Sira Mountains, but no formal education or protection infrastructure has been established, and therefore the reserve offers little real protection. MGC previously conducted preliminary environmental education programs with some of the local communities to help them embrace the fact that this curassow is endangered and endemic to their area and many people in the communities demonstrated willingness to support the conservation of the species (Gastañaga & Hennessey 2005, Gastañaga 2006). Unfortunately, hunting continues and there is urgent need for more conservation work. We suggest the top conservation priorities are identifying the full distribution of the species within Sira Mountains so that conservation efforts can be focused in the most important areas, developing a strong education campaign, and improving the capacity of the Communal Reserve so it can offer real protection to the species and its habitat.

ACKNOWLEDGMENTS

Thanks to N. Raurau, T. Boza, and J. Mendoza for all their help in the field and to local guides E. Aspajo and J. Granados, the Granados and Campari families, E. Martinez (the local park guard), and the communities of Golondrina, El Sira, and Quimpichari for their help. Thanks to S. K. Herzog, R. Soria-Auza, A. Muñoz, and V. H. García-Soliz for information about records of *P. unicornis* in Bolivia. Fieldwork for MGC and RM was supported by the Chicago Zoological Society (2003, 2008), Sweden Club 300 (2003, 2005, 2006), Charles Blake Grant Nuttall Ornithological Club (2005, 2008), Carnegie Trust for Scottish Universities (2006), Ornithomedia.com (2005), Glasgow Natural History Society (2008), and the BP Conservation Program/Conservation Leadership Program (2006). DMB thanks the following individuals (and their respective institutions) for permitting access to specimens and helping to procure data: N. Rice (Academy of Natural Sciences, Philadephia - ANSP); J. Cracraft, P. Hart and S. Huber (American Museum of Natural History - AMNH); T. Valqui (CORBIDI); D. Richardson, R. Lopez, and J. Martinez (Dallas World Aquarium - DWA); M. Hageman and M. Magee (Houston Museum of Natural Science - HMNS). BH thanks the BirdLife International Preventing Extinctions program for their support. We also wish to thank the Macaulay Library at Cornell Laboratory of Ornithology for donating the Raven sound analysis package to Armonia to help with this work. Also big thanks to INRENA and all who over many years have encouraged and supported the Pauxi Peru project and made the project possible. Kind thanks to J. Tello, L. F. Silveira, and A. Weller for their helpful comments on the ms., and to J. V. Remsen for providing helpful guidance when sought.

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