

Observations on White-browed Guan *Penelope jacucaca* in north-east Brazil

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Jacus-verdadeiros *Penelope jacucaca* foram estudados na reserva particular RPPN Mãe-da-lua no interior semi-árido do Estado do Ceará no nordeste do Brasil. Durante vários meses da estação seca de 2007, 2008 e 2010, numerosos jacus visitaram regularmente um olho d'água e um comedor adjacente na reserva. Em outros estações e / ou anos, os jacus quase não freqüentavam o olho d'água e o comedor, e parece que uma grande parte da população permaneceu em lugares distantes, dentro ou fora da RPPN. Estes achados confirmam que *P. jacucaca* faz migrações locais, e são relevantes para a conservação desta espécie, em particular para o planejamento e manejo de reservas. Outras pesquisas seriam necessárias para mostrar os motivos e o alcance dos deslocamentos. Observei os jacus durante muitas sessões no campo, frequentemente usando um esconderijo ('blind') que as aves aproximavam a uma distância de poucos metros. Nesta publicação, apresento informações sobre: vocalizações; comportamento no comedor; aparência dos jovens; hábitos de empoleirar, e frequentes mudanças dos locais para passar a noite. No início da estação chuvosa, aves 'rufando as asas' foram gravadas em duas ocasiões. Jacus-verdadeiros foram também registrados em outras localidades do Ceará, fora de unidades de conservação, em mata úmida (Maranguape) e em uma fazenda na caatinga (Pentecoste). O registro da fazenda sugere que pelo menos no norte do Ceará, a vegetação secundária madura nas regiões agricultores da caatinga pode ser suficiente para a espécie sobreviver e reproduzir.

White-browed Guan *Penelope jacucaca* is endemic to north-east Brazil, from Maranhão and Ceará to Minas Gerais^{11,14,17–19}. It was formerly common in parts of the north-east¹³, but is now considered Vulnerable². The sparse literature concerning its behaviour and vocalisations is summarised below. Information concerning the species' morphology and taxonomy appears elsewhere^{5,8}.

O. Reiser participated in an Austrian expedition to north-east Brazil in 1903 and encountered White-browed Guans in Piauí and Bahia¹³. According to his observations, guans usually occurred in small groups (e.g. 3–7 individuals), sometimes feeding in crowns of trees, and were most easily found near water and in dry riverbeds, where the birds dustbathed. When humans approached, the birds often did not fly, but hid. During the breeding season the mating call of females could be heard at long distance.

In 1923–26, H. Sneathlidge traveled through Piauí, Maranhão and Ceará^{7,16}. He found *P. jacucaca* in humid primary forest, in dry forest, dry palm forest and temporarily flooded forests¹⁷. He also remarked that it and other cracids in the region undertake local migrations to areas with temporary food resources. For example, when a certain ripe fruit ('araça') was available in the dry forest of northern Piauí, then '...one can be certain to encounter there, at dawn and dusk, large flocks of the shy *Penelope jacucaca*... During this period, they can also frequently be flushed in the forest... Later, one hardly encounters them any more.'¹⁷

(all translations mine). Sneathlidge considered *P. jacucaca* a territorial bird that temporarily departs its territory for other areas with better food availability¹⁷. Despite the paucity of information concerning the species, his findings (published in German) appear to have been ignored by subsequent authors. That *P. jacucaca* undertakes short-range movements in search of food has not been mentioned in other publications, although it has important implications for conservation (see Results and Discussion).

Olmos¹² found a 'good population' of guans in Serra da Capivara National Park, Piauí, and was first to confirm that *P. jacucaca* wing-whirrs, like other guans⁵. He wrote: 'This species...is easily detected by the characteristic sound it makes with the wings during the rainy season, apparently as a courtship display.' Preferred habitats are taller dry forest, but also second-growth *caatinga* near human dwellings. The fruits of the juazeiro tree *Ziziphus joazeiro* form part of its diet.

I discovered the species in Mãe-da-lua reserve in 2007, close to a spring, where I have a blind (Fig. 1). In 2007–08, I occasionally observed birds from the blind, and photographed and sound-recorded them. However, my field notes from this time are rather incomplete. Several birdwatchers visited during this period, and their images from the reserve appear on various websites (www.wikiaves.com.br, www.arthurgrosset.com, www.worldwildlifeimages.com, www.ibc.lynxeds.com). In 2010, I collected behavioural and vocalisation



Figure 1. Blind (B) at Gameleiras in hills of Mãe-da-lua reserve, Ceará, 21 February 2010; part of the feeding area (F) is visible in the foreground, but the spring is located behind the blind and cannot be seen in the photograph (Hermann Redies)

data for the species in the reserve, presented here, sometimes complemented by observations from other years.

Main study site and Methods

Mãe-da-lua private reserve (03°48'41"S 39°28'25"W), Itapajé municipality, Ceará, in the semi-arid *caatinga* of north-east Brazil, encompasses 769 ha, c.50% lowland secondary arboreal *caatinga* at various stages of regrowth, mostly 15–30 years old. The other 50% covers low hills (max. altitude 700 m), with similar *caatinga* lower down, and secondary dry and subhumid forest above c.500 m. More information can be found at www.mae-da-lua.org. The wet season normally starts around January and lasts until May–July. The dry season, nearly or entirely without rainfall, occupies the rest of the year^{1,9}.

There are several water sources in the reserve, including a permanent spring (Gameleiras) in a valley in the mountains, where I have a blind (Fig. 1). Nearby, I cleared an irregularly shaped area of 150 m² of vegetation, as a feeding site (Fig. 1, foreground). At intervals, usually of 2–3 days, in August–December 2007 and 2008, and June–October 2010, I scattered a few kg of coarse-ground corn on the ground, to attract guans. Since the reserve was created in 2006, I have regularly visited Gameleiras and, to my knowledge, hunters have mostly avoided this area. Observations from

the blind were conducted irregularly, often in early mornings, from c.04h30 (before dawn) until c.07h00 or later. Occasionally, I remained a few hundred metres distant, to observe the guans approach.

Equipment and software.—Sound-recordings were made using a Marantz PMD671 or PMD661 digital recorder and Sennheiser ME-67 or ME-66 directional microphones. Photographs were made using a Canon 20D camera and 200-mm or 300-mm lenses; despite the poor light, flash was not used, except occasionally in 2007. Most computer work was done on a Linux platform (OpenSuse 11.4), with Wavesurfer 1.8.5 and Praat 5.2 for sound-editing, and Gimp 2.6 for image processing.

Supplementary material.—All sound-recordings mentioned herein, and additional photographs, can be accessed via www.mae-da-lua.org/supplement_wbg.html. In the text, references in the form 'jpg Pnn' or 'mp3 Rnn' can be found on this webpage.

Results and Discussion

Occurrence of *P. jacucaca* in Mãe-da-lua reserve

In July or August 2007, 2008 and 2010 (i.e. 1–2 months after the last rains), guans began visiting the spring and feeding site at Gameleiras. During the following months, guans were present there nearly daily, usually early in the morning, sometimes also late in the afternoon. In 2007 up to



Figure 2. White-browed Guans *Penelope jacucaca*, Gameleiras, Mae-da-lua reserve, showing c.20 of the 34 guans present, 18 August 2010 (Hermann Redies)

16 birds were present and in 2008 up to 14. In 2009, following above-average rains, very few guans visited the waterhole. In 2010, I counted a max. 38 birds (Fig. 2). In 2011, following another season of relatively heavy rains, the situation was as in 2009, with almost no guans present.

Local movements.—Snethlage stated that *P. jacucaca* undertakes local movements to areas with better food availability¹⁷. Temporary concentrations of guans at Gameleiras during the dry season of some years confirms this. Short-range movements are also reported for Sickle-winged Guan *Chamaepetes goudotii* and Black-fronted Piping Guan *Pipile jacutinga*^{6,10,15}. Because of the availability of food and water at Gameleiras, one might expect that in those years in which guans were present, they would remain until the onset of the rains (January), but this was not so. Instead, in 2007 and 2008, most birds appeared to have left by the year-end, several weeks prior to the rains. (In 2010, I discontinued early-morning observations in late October, when guans were still present.)

When guans did not visit Gameleiras, they were far more difficult to locate. In the reserve, I occasionally saw two or more individuals, which fled as soon as they realised my presence. At times, vocalisations indicated the presence of guans in the dense vegetation. During the early wet season, wing-whirring was heard rarely (see below). I



Figure 3. Adult White-browed Guan *Penelope jacucaca*, Gameleiras, Mãe-da-lua reserve, in alert position, with its head elevated and the bird attentive, 10 July 2010 (Hermann Redies)



Figure 4. Juvenile White-browed Guan *Penelope jacucaca*, in company of adult, Gameleiras, Mãe-da-lua reserve, 18 August 2010 (Hermann Redies)

had no reliable means to determine how many birds remained year-round, or in which areas they were present. Presumably, the guans that left Gameleiras in late 2007 and 2008, moved to another location within or outside the reserve, for the remainder of the dry season. It is probable that in the wet season, pairs are spread out across the reserve and its environs.

The issue of local movements is relevant because the species' conservation is potentially undermined if the birds periodically leave the protected area^{6,12}. Guans are not strong fliers³, and it is therefore unlikely that they migrate far, but even movements of just a few km would reach unprotected areas worked by hunters. Further research is needed to clarify how far guans move, what precisely attracts them to a given area, and those characteristics a reserve should possess to adequately protect the birds year-round.

Morphology

Size of guans seen at Gameleiras varied considerably, from half grown to full grown, but except two juveniles (see below) all had adult-like plumage (Fig. 3), matching descriptions and illustrations in the literature^{3,5}.

Juveniles.—On 18 August 2010, two juveniles (probably siblings) were seen (Fig. 4, cf. jpg P04–06). The peri-orbital skin of one was yellowish, slightly

darker in the other. Foreneck yellowish without the characteristic red dewlap, and whitish stripes on wings, breast, flanks etc., less pronounced. These were the youngest individuals I saw, probably <2 months old. They must have hatched around June, suggesting that some birds breed either very late in the wet season, or more than once p.a.

Iris colour.—Sick¹⁵ noted that males possess red irides and females brown, but Blake³ stated that they are brown in both sexes. Delacour & Amadon⁵ did not mention sex-related differences for *P. jacucaca*, but described such differences for *P. pileata* and *P. ochrogaster*, which are closely related to *P. jacucaca*. Vaurie²⁰ suggested for the genus *Penelope* in general that '...a sexual difference probably exists, because brown, rather than red, was usually mentioned in the case of females. The iris probably becomes red in males during the breeding season.' I did not pay direct attention to iris colour during my field work, but I photographed numerous individuals, presumably of both sexes, and verified that some had a pale brown or red-brown iris (jpg P02) and others a dark brown iris (jpg P01), compatible with the assumption of sexual differences in iris colour (males reddish-brown or pale brown, females dark brown), but I have no other evidence to support this, and fluctuations in ambient light might have contributed to the apparent variation (cf. jpg P03).

The issue of sex-related differences in iris colour in *P. jacucaca* remains to be resolved.

General behaviour

I spent 16 morning sessions in the blind (Fig. 1) at Gameleiras between 25 June and 27 October 2010, normally 04h30–07h00 / 08h00. During June–July, guans did not regularly visit the feeding area. On 25 June, several were heard but not seen. On 10 July, several birds that roosted at Gameleiras the previous night were at the feeding site (Fig. 3). On 18 July, none was noted. On 23 July, guans were again heard, but not seen. In August–October, 10–38 individuals were seen during each of 12 sessions. In this section, I describe their behaviour, as observed at close range from the blind. My view was often restricted by the vegetation, by poor light at dawn and by shade, and by the small windows in the blind. To follow the events, I relied partially on the sounds produced by the birds.

Response to the blind.—Guans often approached to 2–3 m and were surprisingly indifferent to noise or movements within the blind (Fig. 1). Usually, a reasonably discrete observer did not appear to disturb the birds, which are otherwise described as shy¹⁷, and which immediately flee on realising human presence (pers. obs.).

Arrival at feeding area.—The birds arrived to feed at dawn, after leaving their roosts. They usually perched >2 m above ground in nearby vegetation for the first few minutes, often >10 m from the feeding site. Gradually they moved closer, cautiously checking before jumping to the ground, which they did one by one or in small groups. While perched many vocalisations were heard: *ga-ga* and *ga-o* calls, and series of *ga-ga-ga...* or *ga-o-o-o...* (Fig. 5) were commonest. Whistles (Fig. 6) were also heard, and, typically, one or more particularly loud *sh-sh...ga-ga...* calls (Fig. 7) were given. Some sounds are audible over several hundred metres, and could indicate the position of the calling bird not only to other guans, but to predators. As Reiser¹³ wrote, ‘The expert hunter notes a group of these guans already from far away, ...by a particular cawing (Gekrakel)’.

Behaviour on ground.—If undisturbed, the guans initially fed for 20–40 minutes. Largest numbers were regularly present just after dawn, until c.06h00. Usually, a variable number remained at least one hour longer, often feeding for a second time, augmented by late-arriving visitors. During feeding, many whistles of several different types were heard (Fig. 6).

Diurnal roosting.—After feeding some birds departed, while others moved to nearby trees to rest. I repeatedly observed a group of c.10 move to a large tree opposite my blind. They jumped, climbed and flew from branch to branch, before selecting a suitable position. Some soon returned to the

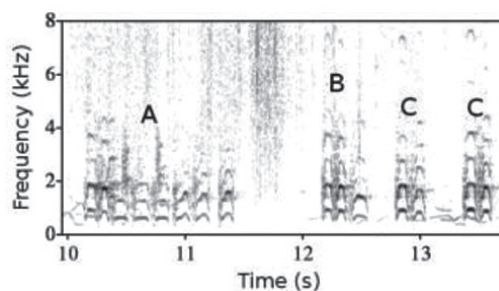


Figure 5. Sonogram of *ga-ga* calls and variants, given by birds in vegetation around feeding site, 10 September 2010 (download: mp3 R30). The sonogram illustrates the variability of these sounds: initially, there is a series of eight notes *ga-ga-o-o-o-o-o-o* (A), then a *ga-ga-o* sequence (B), followed by two pairs of *ga-ga* notes (C). In the few minutes between arrival in the trees and jumping to the ground, the guans produce hundreds of these and similar sounds. In background, some whistles (cf. Fig. 6).

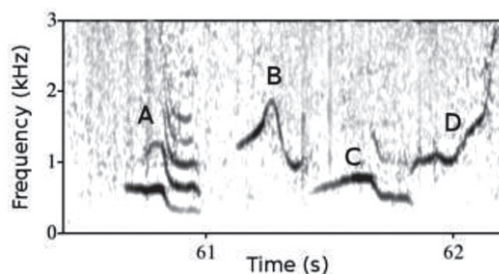


Figure 6. Examples of frequency modulated whistles, from birds at feeding site, 5 September 2010 (download: mp3 R50). A: frequently heard sound, with strong harmonics. B: another commonly heard, quite variable note, with a relatively high frequency range. C: similar to A, but fewer harmonics; D: less common upslurred whistle. Several other types of whistles were recorded, but are not depicted here. Sonogram manually edited, to reduce noise.

ground to drink at the spring and / or to feed again. Roosting birds on the tree often uttered whistles similar to those heard while feeding (Fig. 6).

Social behaviour and aggression.—Guans arrived to feed in groups, but on the ground they mostly foraged together. However, one or two groups often kept separate from the rest. Occasionally, a guan aggressively pecked at another, and one or more loud, sharp notes (mp3 R60) were then given, probably by the victim of the aggression. I also observed birds jumping high into the air and several times one bird with an erect crest chased another around the feeding site, similar to the video recording by J. del Hoyo at Rio de Janeiro zoo (ibc.lynxeds.com).

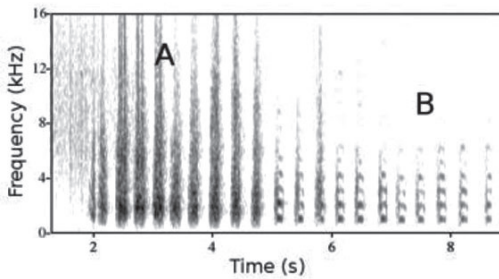


Figure 7. Sonogram of recording from bird shortly after arriving around feeding site, 10 September 2010 (download: mp3 R40). Initial series of raucous *sh* notes (A) grades into evenly spaced *ga* notes (B).

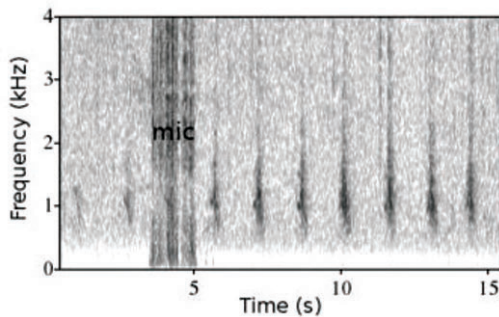


Figure 8. Series of raucous calls given by single guan during pause en route to Gameleiras, 14 September 2010 (download: mp3 R110). The vocalisation is markedly different from the *sh-sh...* calls in Figs. 7: notes have narrower frequency range (mostly 0.5–2.0 kHz), and pauses between notes much longer; 'mic' = microphone handling noise.

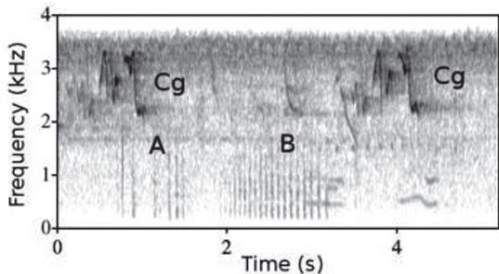


Figure 9. Wing-whirr of White-browed Guan *Penelope jacucaca*, 19 January 2011, with a few initial wingbeats (A) followed by a break and then, at two-second mark, a longer series of wingbeats (B). In background, Rufous-browed Peppershrike *Cyclarhis gujanensis* (Cg) (download: mp3 R160).

Response to danger.—Feeding sessions were often interrupted by loud alarm-calls and sudden flights from the ground to the surrounding trees (mp3 R70, R80). In most cases, the birds returned to feed after 1–2 minutes, presumably because the

alarm was 'false' or the danger passed. A common cause of alarm was the arrival of Brown Capuchins *Cebus apella* or warning calls of White-naped Jays *Cyanocorax cyanopogon*. Details of alarm and escape behaviour will be presented elsewhere.

Approach to Gameleiras

In September–October 2010, I spent five dawn sessions outside the blind, overlooking the surroundings of Gameleiras. The directions from which guans approached Gameleiras varied, presumably due to changes in their roost sites. Furthermore, the birds generally arrived from several directions, suggesting separate roosts. Guans were seen alone, in pairs or in groups. 'Lone' birds often (nearly always?) were part of a pair or group whose members moved independently of each other, and reassembled at intermediate stops or at the destination. For vocalisations given on the move, see Figs. 5, 7–8 and mp3 R120.

Roosting

P. jacucaca roosts in trees, at least a few metres above ground. On several occasions in Mãe-da-lua reserve and at Maranguape (see below), I observed that smaller groups form loose nocturnal roosts. For example, in the late afternoon of 20 July 2010, I observed two groups at Gameleiras, settling themselves in two different trees, c.30 m apart. Vocalisations recorded at the time (mp3 R130, mp3 R140) were reminiscent of those at dawn, when arriving to feed. Communal roosts of cracids were mentioned by Delacour & Amadon⁵ who cautiously stated that 'some ... [species] may tend to roost socially'. While guans may use the same roost for days or weeks, sites are not permanent. Rather, they change at irregular intervals, perhaps due to disturbance (pers. obs.). This agrees with my observation that directions from which guans approached the feeding site at dawn changed frequently.

Wing-whirring

According to Delacour & Amadon⁵, all *Penelope* species make wing-whirring displays in the breeding season, and Olmos¹² briefly mentioned such behaviour for *P. jacucaca*. I heard wing-whirrs in the reserve in January 2011 at the onset of the wet season, firstly on c.15 January, at dawn, when I heard guan vocalisations, followed by a series of unusually loud wingbeats, as the birds flew off. The second record was on 19 January 2011, a few hundred metres from the previous location. One wing-whirr was sound-recorded at 05h39 (mp3 R150) and another at 05h41 (Fig. 9). I could not reliably determine how far the birds were away (200 m?), but the sounds were rather faint

To my knowledge, these are the first sound-recordings of wing-whirring by *P. jacucaca*.

Comparison of Fig. 9 with a sonogram of wing-whirring by Crested Guan *P. purpurascens* recorded by P. Schwartz⁵ suggests that the sound is similar in both species.

I cannot confirm the remark that *P. jacucaca* is 'easily detected' by wing-whirring in the wet season¹². In my experience, wing-whirring is difficult to hear and easily missed. Delacour & Amadon⁵ suggested that wing-whirring may substitute primary song in some guans. More field work is needed to validate this, and to clarify the significance of wing-whirring in *P. jacucaca*.

New records

Fazenda Canaã, municipality of Pentecoste, Ceará.—On numerous occasions in 2003–06, I saw guans at Fazenda Canaã (03°43'00"S 39°11'00"W), but could not determine the species (*P. jacucaca* or Rusty-margined Guan *P. superciliaris*). On 3 February 2009, I finally observed two at close range, in riverine gallery vegetation, and identified them as *P. jacucaca*, based on their morphology and vocalisations. Local people were aware of the species' presence and I saw a trap (to be baited with corn) in the neighbourhood. Vegetation at Fazenda Canaã, and surrounding rural areas in a radius of 20+ km, comprises secondary arboreal *caatinga*, farmland and secondary gallery forest. Some of the vegetation is relatively mature regrowth, >20–30 years old, but there is no pristine *caatinga* or gallery forest (pers. obs.). The presence of guans here indicates that, at least in northern Ceará, secondary vegetation can support the species, confirming that *P. jacucaca* can adapt to a range of habitats^{12,13,17}. However, there are several different types of *caatinga* in north-east Brazil¹ and not all *caatinga* regrowth may be equally suitable.

Municipality of Maranguape, Ceará.—In a privately owned fragment of preserved humid forest (precise coordinates unknown; Maranguape 03°53'24"S 38°41'09"W), 15–20 guans were seen in the late afternoon of 21 December 2009. They arrived in distinct groups, and roosted in at least two places c.50 m apart. On other days, groups of 3+ individuals were seen nearby in early morning. In conversations with residents, I learned that local hunters were scared by superstitions associated with this area, and therefore avoided it, to the obvious benefit of the guans.

Conservation

At present, the most serious threat to the species' survival is probably hunting^{4,12} (pers. obs.). It is important for conservationists to realise that in north-east Brazil comprehensive government assistance is offered to poor rural populations and hunting no longer qualifies as 'subsistence hunting', but instead has become a popular pastime, mainly for fun and often bordering on vandalism (pers.

obs.). The prospects for White-browed Guan would be much brighter if government environmental agencies were more active in enforcing legislation that forbids hunting.

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References

1. Andrade-Lima, D. (1981) The Caatinga dominium. *Rev. Bras. Bot.* 4: 149–163.
2. BirdLife International (2008) *Penelope jacucaca*. In: IUCN 2011. IUCN Red list of threatened species. Version 2011.1. www.iucnredlist.org (accessed 28 August 2011).
3. Blake, E. R. (1977) *Manual of Neotropical birds*, 1. Chicago: University of Chicago Press.
4. Brooks, D. M., Cancino, L. & Pereira, S. L. (eds.) (2006) *Conserving cracids: the most threatened family of birds in the Americas*. Misc. Publ. Houston Mus. Nat. Sci. 6.
5. Delacour, J. & Amadon, D. (2004) *Currassows and related birds*. Second edn. Barcelona: Lynx Edicions & New York: American Museum of Natural History.
6. Galetti, M., Martuscelli, P., Olmos, F. & Aleixo, A. (1997) Ecology and conservation of the Jacutinga *Pipile jacutinga* in the Atlantic Forest of Brazil. *Biol. Conserv.* 82: 31–39.
7. Hellmayr, C. E. (1929) A contribution to the ornithology of northeastern Brazil. *Publ. Field Mus. Nat. Hist. Zool. Ser.* 12(18): 235–501.
8. del Hoyo, J. & Motis, A. (2004) Update chapter. In: Delacour, J. & Amadon, D. *Currassows and related birds*. Second edn. Barcelona: Lynx Edicions & New York: American Museum of Natural History.
9. Iplance Fundação Instituto de Planejamento do Ceará (1997) *Atlas do Ceará*. Fortaleza: Ed. Iplance.
10. Johnson, T. B. & Hilty, S. (1976) Notes on the Sickie-winged Guan in Colombia. *Auk* 93: 194–195.
11. Kirwan, G. M., Mazar Barnett, J. & Minns, J. (2001) Significant ornithological observations from the Rio São Francisco Valley, Minas Gerais, Brazil, with notes on conservation and biogeography. *Ararajuba* 9: 145–161.
12. Olmos, F. (1993) Birds of Serra da Capivara National Park, in the "caatinga" of north-eastern Brazil. *Bird Conserv. Intern.* 3: 25–36.
13. Reiser, O. (1925) Ergebnisse der zoologischen Expedition der Akad. der Wissenschaften nach Nordostbrasilien im Jahre 1903. *Vögel. Denkschr. Mathem.-naturw. Kl. Kais. Ak. Wiss., Wien* 76: 107–252.
14. Roos, A. L. & Antas, P. T. Z. (2006) White-browed Guan (*Penelope jacucaca*). In: Brooks, D. M.,

- Cancino, L. & Pereira, S. L. (eds.) *Conserving cracids: the most threatened family of birds in the Americas*. Misc. Publ. Houston Mus. Nat. Sci. 6.
15. Sick, H. (1997) *Ornitologia brasileira*. Rio de Janeiro: Ed. Nova Fronteira.
16. Sneathlaga, H. (1927) Meine Reise durch Nordostbrasilien. I. Reisebericht. *J. Orn.* 75: 453–485.
17. Sneathlaga, H. (1928) Meine Reise durch Nordostbrasilien. II. Biologische Beobachtungen. *J. Orn.* 76: 503–581.
18. Sneathlaga, H. (1928) Meine Reise durch Nordostbrasilien. III. Bausteine zur Biologie der angetroffenen Arten. *J. Orn.* 76: 668–738.
19. Vasconcelos, M. F., D'Angelo Neto, S., Kirwan, G. M., Bornschein, M. R., Diniz, M. G. & Silva, J. F. (2006) Important ornithological records from Minas Gerais state, Brazil. *Bull. Brit. Orn. Club* 126: 212–236.
20. Vaurie, C. (1968) Taxonomy of the Cracidae (Aves). *Bull. Amer. Mus. Nat. Hist.* 138: 133–259.

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