



## A new species of *Formicivora* antwren from the Chapada Diamantina, eastern Brazil (Aves: Passeriformes: Thamnophilidae)

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### Abstract

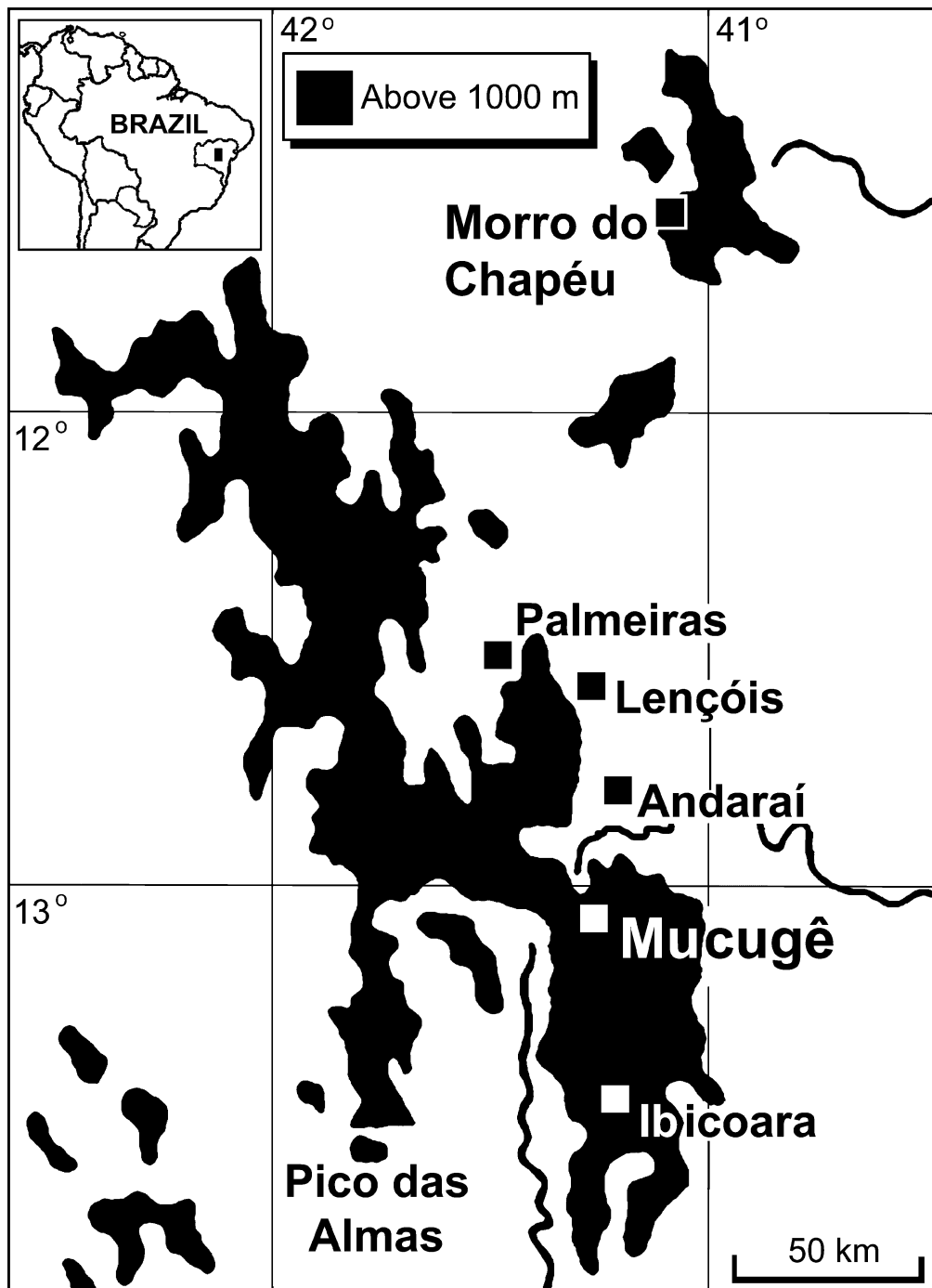
*Formicivora grantsau* **sp. nov.** (Sincorá Antwren) is described from a series of specimens from the valley of the Rio Cumbuca (12°58'29"S, 41°21'29"W, elevation 860 m), 3.5 km northeast of Mucugê, Bahia, Brazil, and adjacent areas. It is more closely related to *F. acutirostris*, *F. grisea*, and *F. rufa* than to other species of the genus, differing from them by a combination of plumage and vocal characters. The new species is known only from the *campo rupestre* vegetation of the Serra do Sincorá between 850 m and 1100 m in the Chapada Diamantina, which is part of the Espinhaço Range, a distinctive area of endemism for birds and other groups of organisms in South America. In places it occurs sympatrically with *F. rufa*, but the two occupy different habitats.

**Key words:** Campo rupestre, Chapada Diamantina, Espinhaço Range, *Formicivora*, new species, taxonomy, Thamnophilidae

### Introduction

*Formicivora* Swainson (*sensu* Gonzaga 2001; type, *Turdus griseus* Boddaert) currently comprises seven species of small and long-tailed antwrens with strong sexual dichromatism that inhabit a variety of non-forest habitats and forest edges in Central and tropical South America: *F. erythronotos* Hartlaub, *F. littoralis* Gonzaga & Pacheco, *F. melanogaster* Pelzeln, *F. serrana* (Hellmayr), *F. acutirostris* (Bornschein, Reinert & Teixeira), *F. grisea* (Boddaert), and *F. rufa* (Wied). Further taxonomic work on this group is needed and may result in the recognition of species status of several named subspecies, especially in the *F. grisea* complex, which includes distinctive forms such as *F. g. fumosa* (Cory) and *F. g. orenocensis* Hellmayr (Cory & Hellmayr 1924; Gonzaga 2001; Zimmer & Isler 2003).

On 2 January 1997, while making observations near Lençóis, on the northeastern border of the Serra do Sincorá, which lies at the northern portion of the Espinhaço Range in the Chapada Diamantina region (Fig 1), DRCB and AMPC observed and tape recorded some scolding calls of an antwren whose streaked underparts resembled a female of *F. rufa*, but whose voice sounded unlike any of the calls that DRCB knew for this species. Buzzetti played his recording to LPG, who could not identify the calls either, despite the extensive experience he had acquired during a study of the genus started years before (Gonzaga 2001). Two years later, at the same habitat in rocky outcrops with scrubby vegetation ("campos rupestres"), and close to the site where he and DRCB had found the bird, AMPC collected and sent to LPG two adult males of supposedly the same species. These resembled *F. rufa*, but were darker and less rufescent above and lacked the characteristic yellowish hue which is present on the flanks of both males and females of that species. It was the first unequivocal evidence for LPG that an undescribed taxon might be involved.



**FIGURE 1.** Chapada Diamantina region in the Espinhaço Range, eastern Brazil, showing land above 1000 m and localities mentioned in the text (adapted from Davis *et al.* 1997).

Finally, LPG was able to visit the Chapada Diamantina and, together with AMPC, undertook a survey of the region in search of this bird. In the course of this trip, 12–29 November 2002, they were able to make extensive documentation of the vocal repertoire and collect specimens not only of the unknown species at several new sites along the Serra do Sincorá but also of *F. rufa* at the adjacent savannas (“gerais de Mucugê”), as the two live almost side by side but with a sharp ecological separation. Analysis of all available evidence, including skin specimens, voice recordings, and preferred habitat, allowed us to identify a number of unequivocal diagnostic characters and conclude that we should recognize the antwren living in the rocky outcrops of the Serra do Sincorá as a new species, which is described herein.

Although a number of observers and collectors have visited this region, the new species was overlooked by some (R.Parrini and J.C.Minns pers. com. to LPG 2002) or possibly misidentified as *F. rufa* by others. Apart from the more distinctive *F. melanogaster* from the adjacent drier areas covered by *caatinga* vegetation, *F. rufa* is the only species of the genus recorded so far from the Chapada Diamantina region (Naumburg 1939, Parrini *et al.* 1999). However, B. Whitney tape-recorded both song and calls of a *F. rufa*-type bird at Morro do Pai Inácio (northwest of Lençóis) on 28 and 29 November 1994, and recognized that this bird had remarkably different vocalizations from those known of that species (B.Whitney *in litt.* 2007). Also A. Whittaker and K. Zimmer, while leading a birding tour below Morro do Pai Inácio on 29 January 1997, observed and tape-recorded a pair of adults of *Formicivora* feeding fledged juveniles that they thought probably represented an undescribed species based on observed morphological and vocal differences from *F. rufa* (A.Whittaker *in litt.* to LPG 2005).

In the course of our analysis of the material assembled, it came to our knowledge that one adult male of this species had been collected by Rolf Grantsau at Igatu, on the eastern border of the Serra do Sincorá, as long ago as 1965, during his searches (see Grantsau 1967) for the endemic Hooded Visorbearer *Augastes lumachella* (Lesson). Grantsau (pers. com. to LPG 2003) could not identify the bird, but refrained from describing it as a new taxon in the absence of any additional specimens or biological information.

## Material and methods

Abbreviations for institutions are: AMNH, American Museum of Natural History, New York; ASEC, Arquivo Sonoro Prof. Elias P. Coelho, Departamento de Zoologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro; LSUMZ, Louisiana State University Museum of Natural Science, Baton Rouge, Louisiana; MLNS, Macaulay Library of Natural Sounds, Cornell University, Ithaca, New York; MNA, Museu Nacional, Rio de Janeiro (anatomical collection), MNRJ, Museu Nacional, Rio de Janeiro; MPEG, Museu Paraense Emílio Goeldi, Belém, Pará; MZUSP, Museu de Zoologia, Universidade de São Paulo; RG, Coleção Rolf Grantsau, São Bernardo do Campo, São Paulo, and UFRJ, Ornithological collection of the Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro. Geographical coordinates were obtained at collecting sites with a Garmin 12 GPS (map datum WGS 84); elevations were measured with a Thommen barometric altimeter. Capitalized color names with numbers refer to Smithe (1975, 1981).

Vocalizations were recorded by LPG at the type locality using a Sony TCD-D8 DAT recorder with a Sennheiser ME-64 microphone coupled to a 24" fiberglass parabolic reflector. Only these high-quality recordings of the new species were used for measurements and spectrographic analysis. Vocalizations of other species of *Formicivora* were also recorded by LPG at the type locality (*F. rufa*) and several other localities with same equipment or an Uher 4000 Report-L open-reel tape recorder with an Uher M-514 dynamic microphone (coupled to same parabolic reflector) at a tape speed of 19 cm/s. Original recordings and digital copies are deposited at ASEC. Additional recordings of vocalizations of other species of *Formicivora* were obtained from other sources (see Acknowledgments). Copies of all these recordings are stored at ASEC.

Tape recordings were made at 48 kHz, 16 bits or digitized at 44.1 kHz, 16 bits, and the sound analyses were made with an iMac G3/600 and with a PC (AMD Sempron 2200/1500) microcomputers with Canary (v. 1.2.4) and Raven (v. 1.2.1 for Windows®) softwares from Cornell Laboratory of Ornithology (Bioacoustics Research Program). Time measurements were made in the waveform, if necessary after the sound has been lowpass and highpass filtered to remove most of the background noise. Frequency measurements were made in audiospectrograms; given values refer to the fundamental harmonic, which is usually also the dominant one. Description of acoustic properties of calls follows terms and definitions provided by Beeman (1998) and Gerhardt (1998). The "max frequency" measurement corresponds to the frequency at which the maximum power occurs within a given time interval (Charif *et al.* 2004).

Comparative material and tape recordings examined are listed in Appendices 1 and 2. Only those recordings used for measurements or spectrographic analysis were included in Appendix 2; several others have been heard only.

***Formicivora grantsaui* sp. nov.**

(Fig. 2)

**Holotype.** MNRJ 44149: adult male (skull 100% ossified; right testis 4.2 mm, left 3.6 mm) from the valley of the Rio Cumbuca (12°58'29"S, 41°21'29"W, elevation 860 m), 3.5 km northeast of the town of Mucugê, in the municipality of Mucugê, state of Bahia, Brazil; mist-netted 22 November 2002 by LPG and AMPC, prepared as a skin by LPG; carcass (including post-rostral skull) preserved in alcohol; molting feathers on body and head, plumage slightly worn. Calls tape-recorded by LPG (ASEC 10614-10616). Flattened wing length 50 mm; tail length 59 mm; bill from anterior edge of nostril 8.5 mm; exposed culmen 12.5 mm; tarsus 19.5 mm; weight 9.0 g (light fat).

**Paratypes.** MNRJ 44150: adult female (skull ossified, well-developed egg in oviduct 16.1 mm x 11.5 mm) paired with holotype, same date and site, molting feathers on wing, tail, head and body, prepared as a skin; voice recordings ASEC 10614-10615. MPEG 60419: adult female (skull ossified, ovary 5.7 mm, oviduct moderately developed) collected 14 November 2002, same site as holotype, molting feathers on tail, head and body, prepared as a skin. MPEG 60420: adult male (skull ossified, right testis 3.3 mm, left 4.1 mm), paired with MPEG 60419, same date and site, molting feathers on head and body, prepared as a skin. MZUSP 76676: adult male (skull ossified, right testis 2.8 mm, left testis 3.0 mm), collected 28 November 2002, same site as holotype, molting feathers on head and body, prepared as a skin; voice recording ASEC 10515. MZUSP 76677: adult female (skull ossified, ovary 3.9 mm, oviduct not developed) paired with MZUSP 76676, same date and site, molting feathers on wing and breast, prepared as a skin.

**Additional specimens (non-type material).** MNA 2690 and MNA 2691 (spirit specimens): adult males, Serra do Ribeirão (12°33'30"S, 41°25'13"W, elevation 950 m), municipality of Lençóis, 17 and 19 February 1999; RG 2924 (skin): adult male, Igatu, municipality of Andaraí, 18 May 1965; UFRJ 0798 (flat skin): adult male, Igatu, municipality of Andaraí, 16 November 2002; voice recordings ASEC 10541-10542.

**Diagnosis.** *Morphology and coloration.* Females of the new species differ from those of *F. littoralis*, *F. melanogaster* and *F. serrana* by lacking a facial black mask and by having the sides of the head, throat, and breast whitish with black streaks (vs. no streaks). From *F. acutirostris* and *F. erythronotos* the new species differs by possessing 12 rectrices (vs. 10 in the former and 10 or 12 in the latter) with large (vs. absent or narrower) white tips and by the adult males having the sides of the head, throat, and breast black separated from upperparts by a white eyestripe continuing and broadening down the sides of the neck and breast (vs. no stripe). Both females and adult males of the new species differ from those of *F. rufa* (Figs. 3–5) by having the flanks brown (vs. yellowish ochraceous), the upperparts darker and, more strikingly, by having the underwing-coverts grey and white (vs. entirely white, Figs. 6–7). From most recognized taxa in the *F. grisea* complex the new species differs by the streaked (vs. plain) pattern of females, being similar in this respect to *F. g. orenocensis*, from which it differs by having the flanks brown (vs. white) and by having the outer rectrices edged white (vs. extensively white). *F. grantsaui* differs further from *F. grisea* by possessing a longer tail (tail length > 105% wing length, vs. < 100% wing length), similar to both *F. acutirostris* and *F. rufa*.

*Voice.* Distinguished from all other taxa in the genus by having a two-part alarm call formed by more than two (rarely only two) notes. This call type has been hypothesized to be derived within *Formicivora* (Gonzaga 2001), contributing to define a clade that includes *F. acutirostris*, *F. rufa*, and the *F. grisea* complex (Figs. 9–12). A very short and distinctively modulated territorial (duet) call also differentiates *F. grantsaui* from all other species in the genus. A homologous call has been recorded from *F. grisea* and *F. rufa*, showing a different sound structure in each of these species (Figs. 15–18), but it is apparently absent from the repertoire of the

other species in this clade, *F. acutirostris*, possibly as a secondary loss (Gonzaga 2001). Another striking diagnostic vocal character state between the new species and *F. rufa* is the pace of the loudsong, which is much slower in *F. grantsauui* (c. 2 notes/s vs. c. 14 notes/s; Figs. 19–20); as in *F. acutirostris*, these notes do not form phrases with a stereotyped duration such as those of the loudsong of *F. rufa*. Furthermore, the new species differs from *F. rufa* and other species of the genus by its distress call, which is a series of a few weak whistles (vs. a sharp trill). A similar distress call has been recorded also in *F. grisea* (Figs. 21–23).

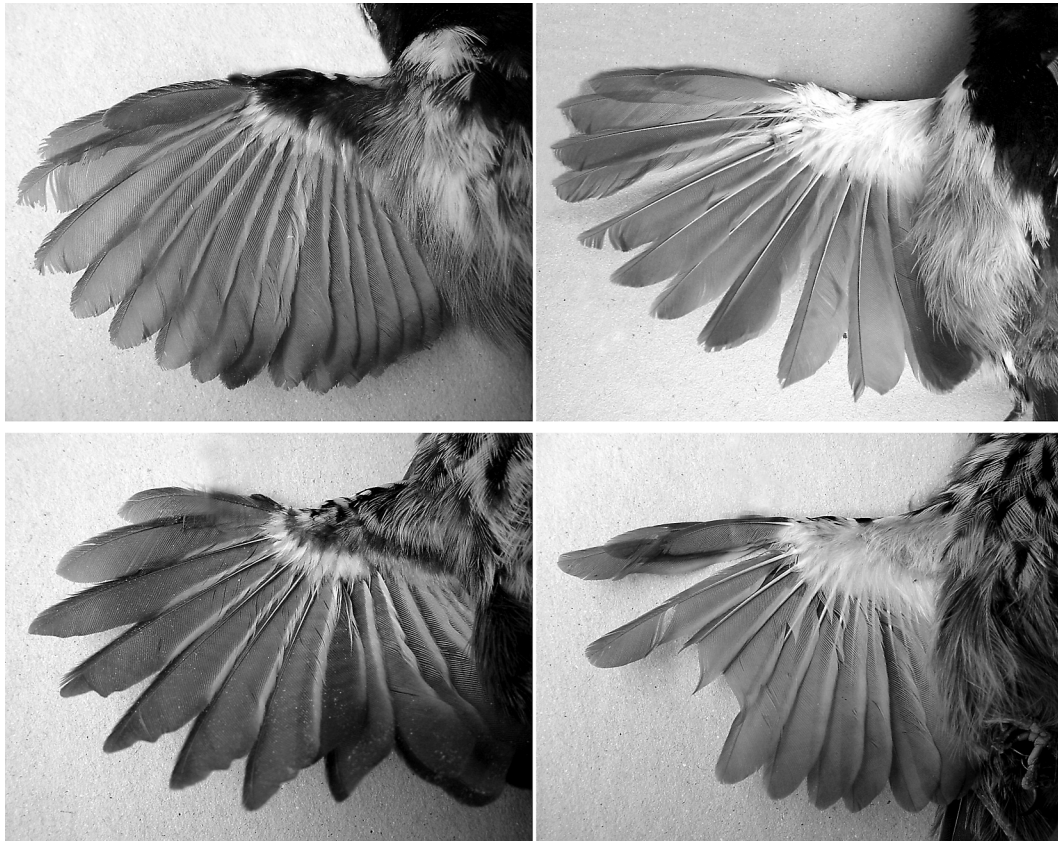


**FIGURE 2.** *Formicivora grantsauui* sp. nov. in its habitat near the type locality (Mucugê, Bahia). Above: adult male. Below: female-plumaged bird (Photos by Sidnei Sampaio).





**FIGURES 3–5.** From left to right in each figure: holotype of *Formicivora grantsaui* sp. nov. (MNRJ 44149); male *F. rufa* collected at the same locality (MNRJ 44151); female paratype of *F. grantsaui* sp. nov. (MNRJ 44150); and female *F. rufa* collected at the same locality (MNRJ 44153); 3, ventral view; 4, lateral view; 5, dorsal view.



**FIGURE 6.** Comparison of underwing-coverts in specimens of *Formicivora* from Mucugê, Bahia. Left: grey and white in *F. grantsaui* sp. nov. (above: male MZUSP 76676; below: female MNRJ 44150). Right: entirely white in *F. rufa* (above: male MNRJ 44154; below: female MNRJ 44153).



**FIGURE 7.** Syntype of *Myiothera rufa* Wied (AMNH 5353), collected in the interior of Bahia, showing white underwing-coverts.

**Description.** Adult males: crown, back and rump Verona Brown (223B), frontal feathers greyish. Crown feathers darker along rachides, giving it a slightly streaked appearance. No interscapular patch. Sides of head (including lores) and underparts from chin to belly black, bordered by a white stripe going down from above the lores to the sides of the belly through the sides of neck and breast. Posterior portion of belly and crissum grey. Flanks Sayal Brown (223C). Wing feathers Vandyke Brown (121), inner webs with whitish edges. Upper wing-coverts black with white terminal spots. Underwing-coverts dark grey in the basal two-thirds,



white in the distal third. Tail feathers with white tips that are narrower (c. 2 mm in fresh plumage) in the central feathers and increasingly broader (up to c. 5 mm) towards the outer feathers; white on the tips of the two outer pairs of tail feathers extending along the edge of the outer webs (Fig. 8). Upper surface of tail feathers Vandyke Brown (121), becoming darker towards the tip. Under surface of the tail feathers (especially the outer ones) two-toned, grey with a broad black subterminal band (Fig. 8). Females: differ from males by having upperparts slightly paler than males, Raw Umber (23) instead of Verona Brown (223B), and sides of the head and underparts white with black streaks (c. 2 mm wide on chest). Tail composed of 12 rectrices, strongly graduated (outer rectrices 38%–47% shorter than central ones).



**FIGURE 8.** Underside of the tail of the holotype of *Formicivora grantsaui* sp. nov. (MNRJ 44149), showing the pattern of white marks and two-toned (grey and black) coloration of the outer feathers.

**Coloration of soft parts in life.** irides brown; bill black (basal half of mandible grey in females), palate and tongue orange; tarsi and toes plumbeous-grey, soles yellowish.

**Morphometry.** See Table 1.

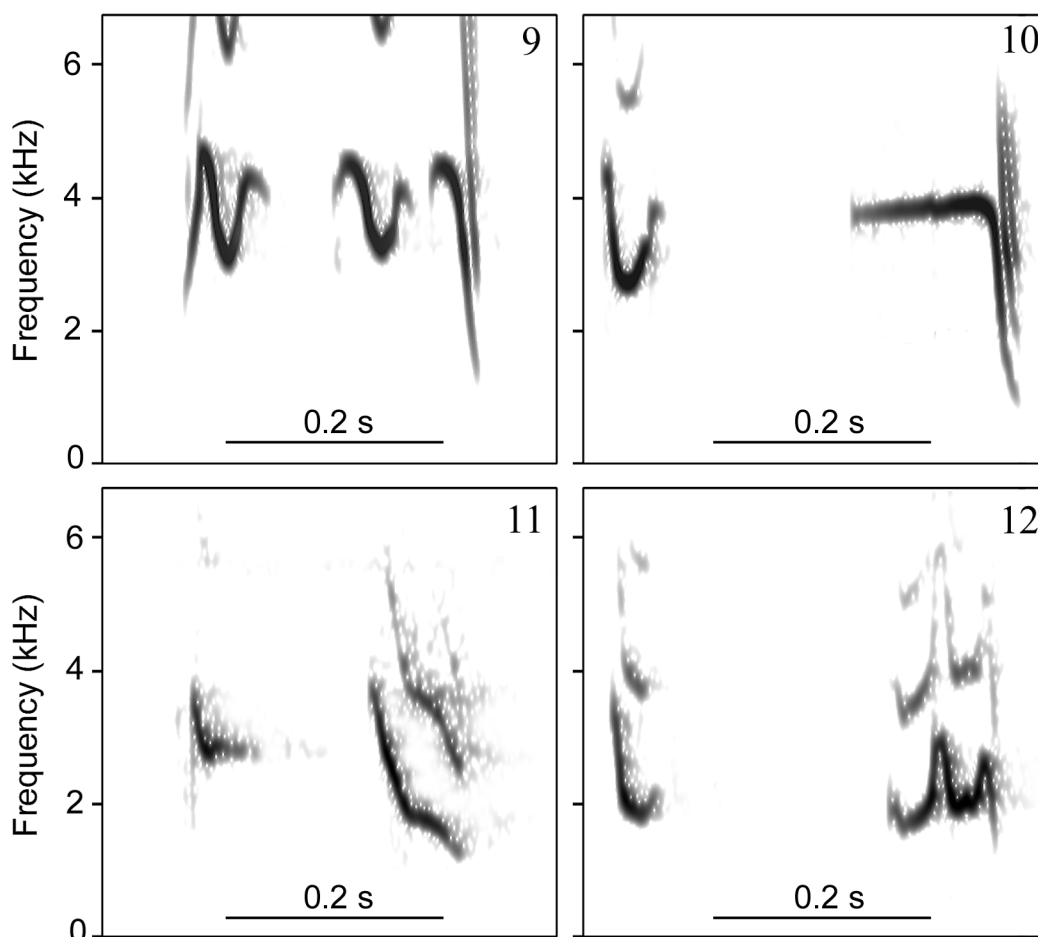
**TABLE 1.** Morphometric data of specimens of *Formicivora grantsaui*.

	Males						Females			
	MNA	MNA	MNRJ	MPEG	MZUSP	RG	UFRJ	MNRJ	MPEG	MZUSP
	2690	2691	44149	60420	76676	2924	0798	44150	60419	76677
Wing length <sup>a</sup>	51	52	50	52	50	53	52	51	50	49
Tail length <sup>a</sup>	60	56.5	59	61	54	58.5	60.5	59	57.5	57
Length difference between central and outer rectrices <sup>a</sup>	28	25	27	23	21	23	25	26	22	24
Bill length <sup>a</sup> (from nostril)	8.5	8.5	8.5	9	8.5	9	8.5	8.5	8.5	8.5
Culmen length <sup>a</sup>	13.5	13	12.5	13.5	12.5	13.5	13	12.5	12.5	12.5
Tarsus length <sup>a</sup>	19	19	19.5	19.5	19	20	21	20.5	20	19
Weight <sup>b</sup>	-	-	9.0	9.1	8.5	11.0	11.0	11.5	10.5	9.5

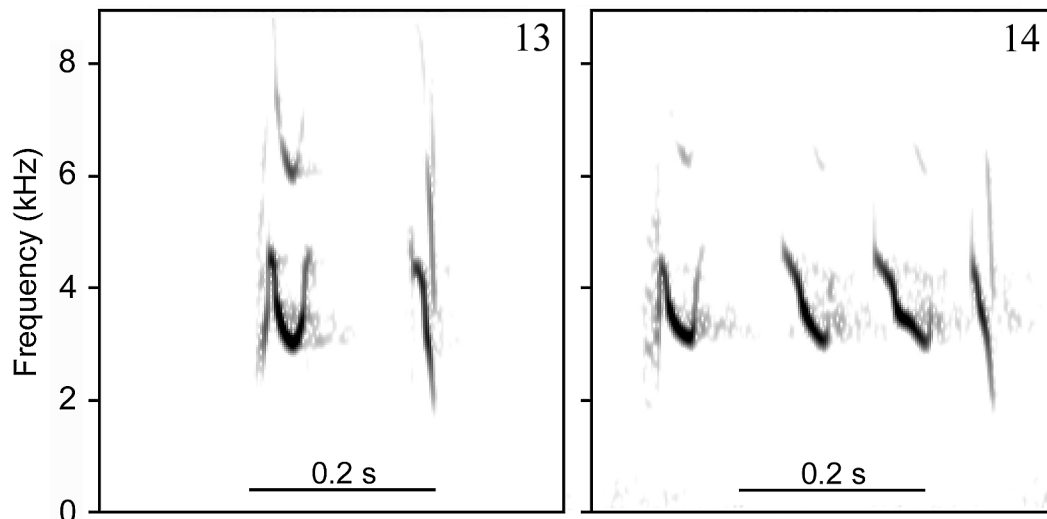
<sup>a</sup>mm; <sup>b</sup>grams.



**Vocalizations.** *Alarm or contact call.* This call (Fig. 9) is usually delivered when a bird is apparently alarmed or trying to re-establish contact to its mate. It is typically repeated at short intervals (range = 0.6–3.0 s, mean = 1.13 s, SD = 0.39,  $n = 147$  calls from at least 5 birds) forming a long series that may contain 47 or more consecutive calls at an average delivery rate of 0.75 calls/s (range = 0.61–0.95, SD = 0.11,  $n = 7$  series from at least 5 birds). The first part of this two-parted call is formed by a single note, and the second part most often (93%,  $n = 286$  calls from at least 7 birds) presents two notes, rarely one or three (Figs. 13–14). These infrequent variant calls are mixed in among a series of more typical (three-noted) calls given by an individual, not given in independent series by different individuals. Three-note calls have an average duration of 0.26 s (range = 0.2–0.3 s, SD = 0.02,  $n = 188$  calls from at least 6 birds) and an average “max frequency” of 3.4 kHz (range = 3.1–4.4 kHz, SD = 0.23,  $n = 194$  calls from at least 6 birds), being noticeably the sharpest voice of the repertoire. On one occasion, a female-plumaged bird that approached the observer in response to tape playback delivered a series of these calls in which the last note of each call was prolonged in a harsh sound that was like a short version of scolding calls (Fig. 24). This transitional series was followed without interruption by a series of purely harsh and longer scolding calls (see below), after which the bird stopped calling and departed.



**FIGURES 9–12.** The alarm call shared by: 9, *Formicivora grantsaui* sp. nov. (ASEC 10549); 10, *F. rufa* (ASEC 3186); 11, *F. acutirostris* (MBBR s/no.); and 12, *F. grisea* (ASEC 3011) presents a similar first note with a rapid descending frequency modulation followed by a second part, having up to three additional notes, whose structure is more variable among the several taxa. In *F. grantsaui* this final part most often has two very short notes (but see Figs. 13–14), while in the other species it always has only one note (window function Blackman, amplitude logarithmic, window size 533 samples, overlap 96.2%, DFT size 16384 points).



**FIGURES 13–14.** Infrequent variants of the alarm call of *Formicivora grantsaui* **sp. nov.**: 13, with only one note on the second part of the call (ASEC 10512); 14, with three notes on the second part of the call (ASEC 10517). Notice that the first part of the call shows no significant variation in the note structure (see Fig. 9) (window function Blackman, amplitude logarithmic, filter bandwidth 533 Hz, overlap 93.75%, FFT size 16384 points).

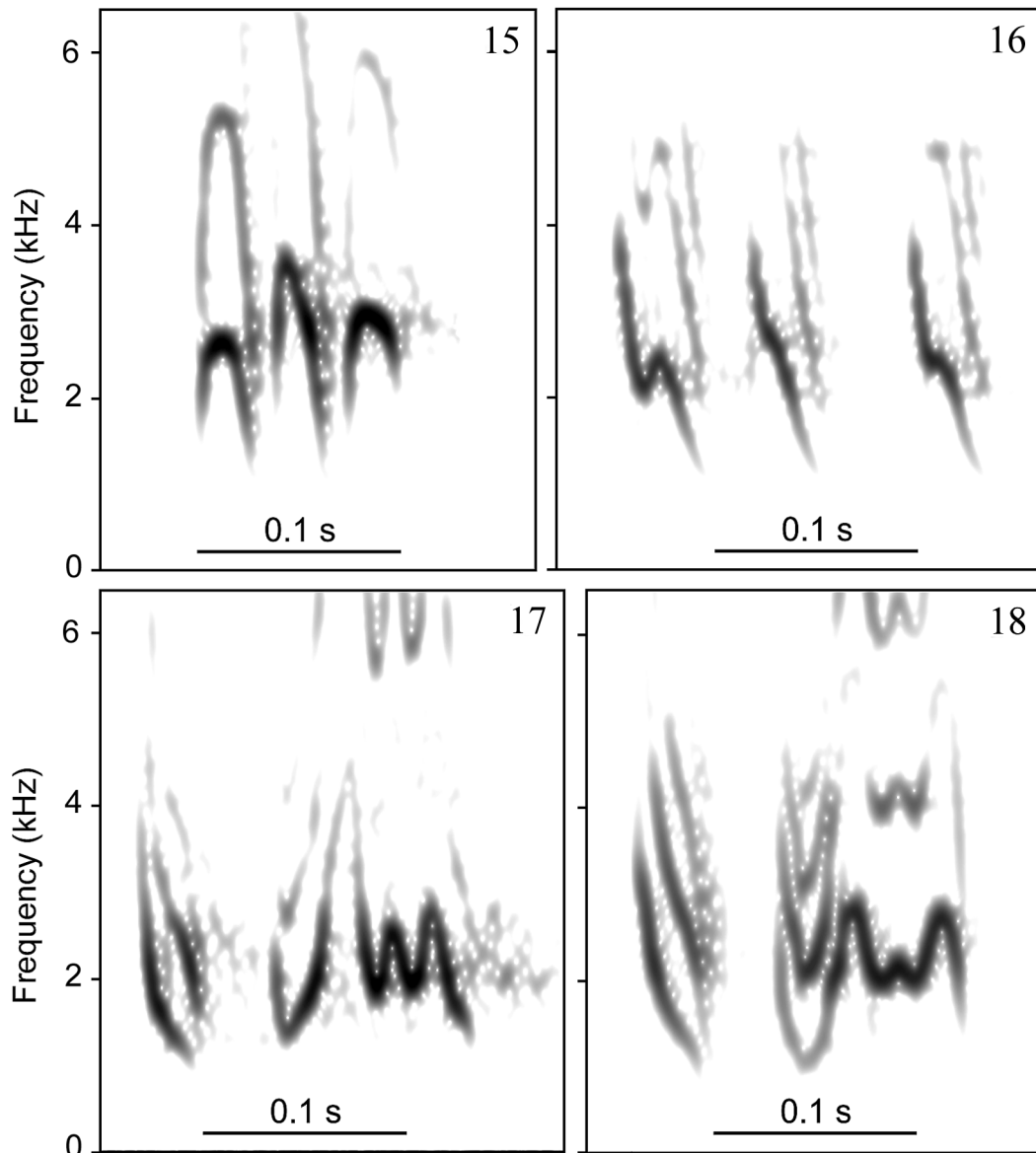
*Territorial duet call.* This pair duet (Fig. 15) is often delivered at the end of a song bout, but may also take place as an isolated series of calls. Up to 9 calls have been recorded in a sequence (range = 3–9,  $n = 8$ ). Each call is a very short syllable composed of two or three notes, most often (63%,  $n = 57$  calls from at least 8 birds) three notes, with an average duration of 0.1 s (range = 0.08–0.13 s, SD = 0.014,  $n = 63$  calls from at least 8 birds) and an average “max frequency” of 3.0 kHz (range = 2.6–3.9 kHz, SD = 0.26,  $n = 63$  calls from at least 8 birds). Sometimes, the call seems to be composed of only one note with three linked parts, each of these with a deep ascending/descending modulation in both frequency and amplitude. Whichever the case, the highest frequency always occurs in the middle (or second note) of the call.

*Loudsong (sensu Willis 1967).* As in the other species of the genus (Gonzaga 2001), the loudsong of *F. grantsaui* (Fig. 19) is a steady repetition, with occasional hesitations (i.e. occasional lengthened intervals between notes), of very short notes (< 0.1 s) with a sharp descending frequency modulation. In *F. grantsaui*, the notes have an average duration of 0.07 s (range = 0.06–0.08 s, SD = 0.006,  $n = 507$  notes from at least 8 birds), an average “max frequency” of 3.1 kHz (range = 2.6–3.6 kHz, SD = 0.15,  $n = 507$  notes from at least 8 birds) and are uttered in a deliberate way, at an average pace of 2.1 notes per second (range = 1.5–2.7, SD = 0.35,  $n = 31$  series from at least 8 birds). Bandwidth of each note is about 3.0 kHz, with an average highest frequency of 4.4 kHz (range = 3.8–5.2 kHz, SD = 0.26) and an average lowest frequency of 1.4 kHz (range = 1.1–1.8 kHz, SD = 0.12,  $n = 507$  notes from at least 8 birds). In all but one of 8 individuals recorded, the notes show a rapid inflection at the middle. A recording made by B. M. Whitney at Morro do Pai Inácio that appeared in a CD publication (Isler & Whitney 2002) as one of the two included examples of the loudsong of *F. rufa* is, in fact, a sample of the loudsong of *F. grantsaui*.

*Distress call.* This call (Fig. 21) was recorded from birds handled after capture in mist-nets. It consists of a very soft whistle with a rapid attack and a descending/ascending frequency modulation, around an average “max frequency” of 2.58 kHz (range = 2.3–3.1 kHz, SD = 0.20,  $n = 103$  notes from 2 birds) and an average duration of 0.27 s (range = 0.2–0.4 s, SD = 0.04,  $n = 103$  notes from 2 birds). It is usually delivered in groups of 2–5 calls, rarely more ( $n = 37$  call groups from 2 birds), at irregular intervals that apparently depend on the level of discomfort of the bird.

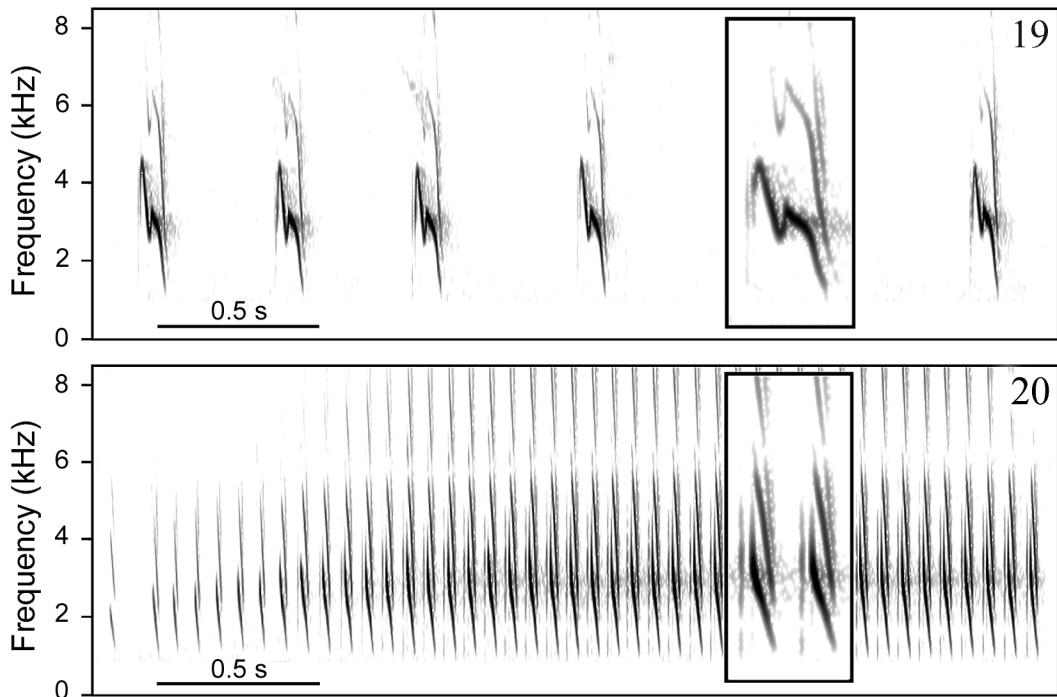
*Scolding call.* This call (Fig. 25) was recorded from both adult males and female-plumaged birds as they approached the observer in response to playback. As with the alarm call, it may be delivered in a long series

with up to 16 or more consecutive calls, at an average delivery rate of 0.7 calls/s (range = 0.3–1.1, SD = 0.3,  $n = 8$  series from at least 3 birds). Each call has an average duration of 0.56 s (range = 0.4–0.9 s, SD = 0.08,  $n = 99$  calls from at least 3 birds) and an average “max frequency” of 4.6 kHz (range = 3.4–6.0 kHz, SD = 0.61,  $n = 99$  calls from at least 3 birds). The interval between consecutive calls is quite variable (range = 0.2–5.1 s, mean = 1.2 s, SD = 1.04,  $n = 90$  calls from at least 3 birds). The harsh sound of this voice results from a periodic modulation in both amplitude and frequency of the carrier, which is represented in the narrow-band audiogram as a series of sidebands, each looking like a zigzag horizontal line, and in the broad-band spectrogram as a series of broad-band frequency vertical lines. A similar call was recorded from *F. grisea* near Santo Amaro, Bahia, Brazil (Fig. 26), but it seems not to be commonly delivered by any other species of the genus, at least not as frequently as it seems to be by *F. grantsau*.

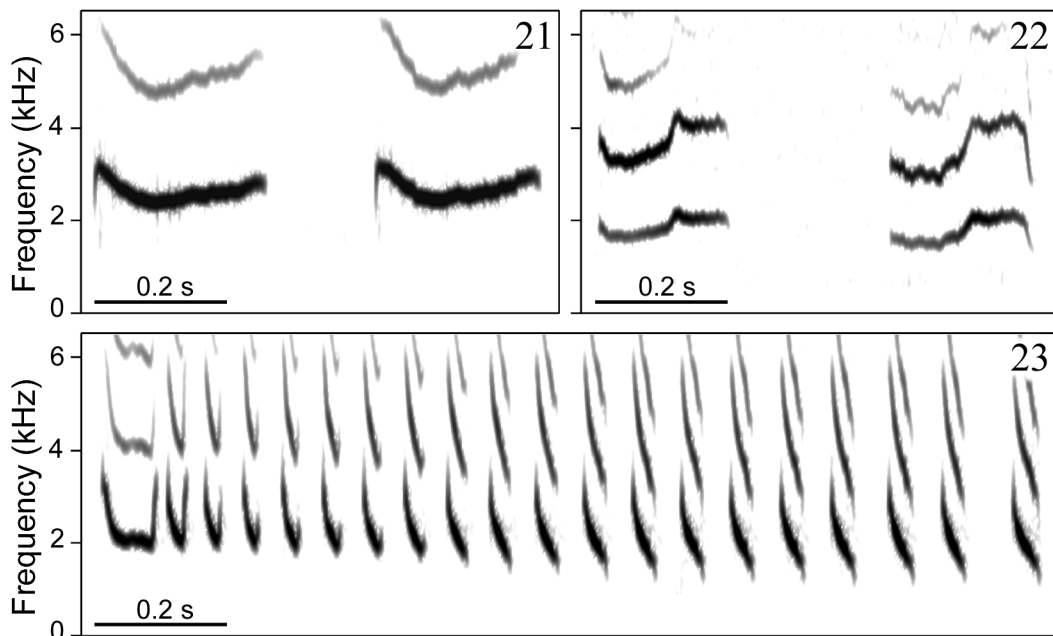


**FIGURES 15–18.** Territorial (duet) call of: 15, *Formicivora grantsau* **sp. nov.** (ASEC 10545); 16, *F. rufa* (ASEC 2818); 17–18, variants of *F. grisea* (ASEC 2990 and 3012 respectively). Notice the shorter call with distinctive ascending/descending frequency modulation of notes in *F. grantsau* (window function Blackman, amplitude logarithmic, window size 533 samples, overlap 96.2%, DFT size 32768 points).

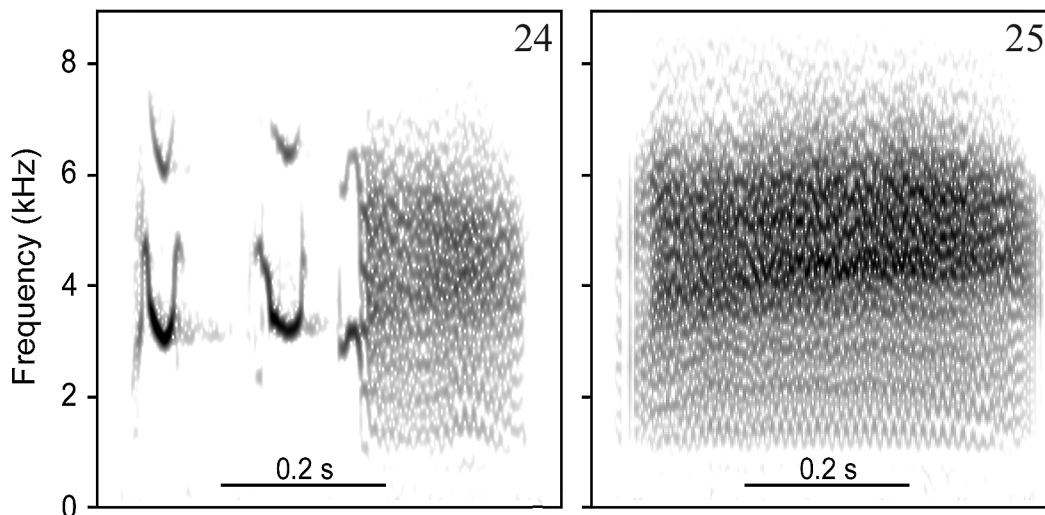




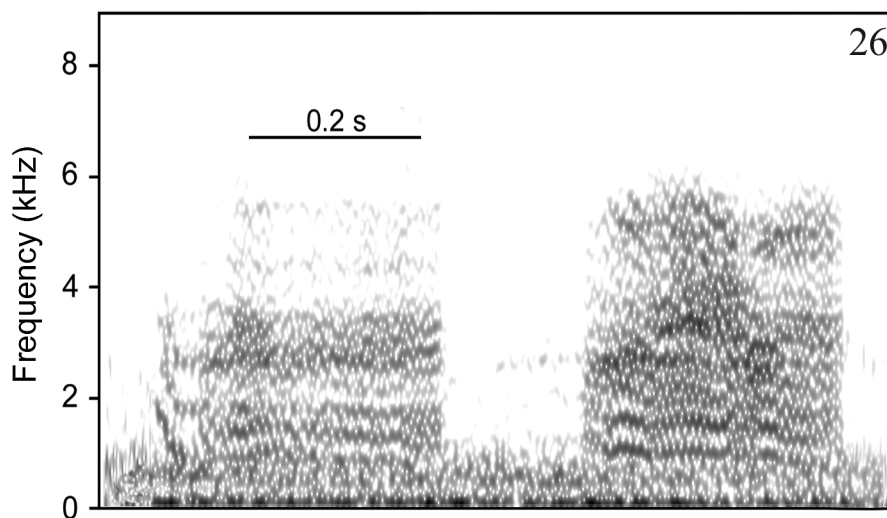
**FIGURES 19–20.** Loudsong of: 19, *Formicivora grantsaui* sp. nov., showing six notes from a much longer series (ASEC 10549); 20, *F. rufa* recorded at the same locality, showing a complete song phrase (ASEC 10539). Notice the pace about 7 times faster in *F. rufa*. Inset in each figure is an enlargement on the time scale (same scale for all) to show more comparative detail (window function Blackman, amplitude logarithmic, window size 533 samples, overlap 96.2%, DFT size 4096 points).



**FIGURES 21–23.** Distress call of: 21, *Formicivora grantsaui* sp. nov., two consecutive whistles (ASEC 10615, from the holotype); 22, *F. grisea*, two consecutive whistles (JMCS 07/39); 23, *F. rufa*, a complete trill (ASEC 3184). All recordings made from mist-netted birds. (window function Blackman, amplitude logarithmic, window size 533 samples, overlap 96.2%, DFT size 16384 points).



**FIGURES 24–25.** Calls of *Formicivora grantsaui* sp.nov. (ASEC 10512): 24, a transition call between a series of alarm calls (see Fig. 9) and scolding calls; 25, a typical scolding call. Notice that the last note of the call in Fig. 24 is prolonged in a harsh sound, like a short version of the scolding call (window function Blackman, amplitude logarithmic, filter bandwidth 533 Hz, overlap 93.75%, FFT size 16384 points).



**FIGURE 26.** Two consecutive scolding calls of *Formicivora grisea* from coastal Bahia, Brazil (MLNS 35741) (see Figs. 24–25) (window function Blackman, amplitude logarithmic, window size 533 samples, overlap 96.2%, DFT size 32768 points).

**Geographic range.** The new species is known thus far only from the Serra do Sincorá, on the eastern escarpments of the Chapada Diamantina, Central Bahia, eastern Brazil (for a general description and bird list of this region, see Giuliatti *et al.* 1997 and Parrini *et al.* 1999). In this range, *F. grantsaui* has been documented by specimens or voice recordings from several sites between 850 m and 1100 m at four localities, although it certainly occurs more extensively within the area bounded by these records (Fig. 1): Morro do Pai Inácio, in the municipality of Palmeiras; the valley of the Rio Ribeirão, in the municipality of Lençóis; Vale do Paty and near Igatu, both in the municipality of Andaraí; and the valley of the Rio Cumbuca and other sites around the town of Mucugê.

Currently, only *F. melanogaster* has been recorded further north of Morro do Pai Inácio, in the Morro do Chapéu region (Naumburg 1939, Parrini *et al.* 1999), and south of Mucugê, near the town of Ibicoara (Parrini *et al.* 1999), and only *F. rufa* was documented further west (specimen from Rio de Contas: MNRJ 39000 and

voice recordings by R. Parrini from the nearby Pico das Almas). Our survey of the Chapada Diamantina in November 2002 also included a brief search for the new species north of Lençóis (using tape playback) but, as did previous workers, we found only *F. melanogaster* there, near Morro do Chapéu.



**FIGURE 27.** *Campo rupestre* vegetation on rocky outcrops of the Serra do Sincorá, Chapada Diamantina, habitat of *Formicivora grantsaui* **sp. nov.** (Photos by Charles Ozanick).



**Habitat and ecological segregation.** The new species inhabits primarily the *campo rupestre* vegetation occurring on the rocky outcrops above 800 m of elevation on the slopes of stream valleys or high plateaus and at exposed ridges (Fig. 27). This landscape is composed of ancient Precambrian sandstones and conglomerates, eroded and dissected by water; soils are thin and nutrient-poor, with acid sands mixed with black peat (Harley & Giuliatti 2004). A century and more ago, the Chapada Diamantina was an important area in Brazil for diamond and gold extraction. Most of the area was converted to a National Park in 1985 and the economy is slowly shifting to ecotourism (Funch 1999). Although vegetation may be recovering from past disturbance from mining activities and direct exploitation (Harley & Giuliatti 2004), fire is a major permanent threat (Funch 1999).

Characteristic plants of the *campo rupestre* near the type-locality (Mucugê) are the stemless palm *Syagrus harleyi* (Palmae), the “canelas-de-ema” *Vellozia* spp. (Velloziaceae), the “imbé” *Philodendron saxicolum* (Araceae), the “mocó” *Clusia burllemarxii* (Guttiferae), *Lychnophora* spp. (Compositae), *Calliandra* spp. (Leg. Mimosoidea), *Verrucularia glaucophylla* (Malpighiaceae), *Marcetia taxifolia* and many other members of its family (Melastomataceae), the bottle cactus *Stephanocereus luetzelburgii* (Cactaceae), the grasses *Eragrostis petrensis* and *Panicum* sp. (Gramineae), everlastings (Eriocaulaceae), terrestrial orchids (Orchidaceae) and bromeliads (Bromeliaceae), myrtles (Myrtaceae), the “flecha” *Lagenocarpus rigidus* (Cyperaceae), and the “feijão-seco” *Humiria balsamifera* var. *parvifolia* (Humiriaceae) (Harley & Giuliatti 2004).

Other birds occurring with *F. grantsaui* in this habitat are: *Phaethornis pretrei* (Lesson & Delattre), *Chlorostilbon aureoventris* (d’Orbigny & Lafresnaye), *Augastes lumachella*, *Thamnophilus torquatus* Swainson, *Polystictus superciliaris* (Wied), *Elaenia cristata* Pelzeln, *Schistochlamys ruficapillus* (Vieillot), *Gnorimopsar chopi* (Vieillot), *Saltator atricollis* Vieillot, *Sicalis citrina* Pelzeln, *Zonotrichia capensis* (Müller), and *Embernagra longicauda* Strickland.

In November 2002, we found that *F. rufa* may be locally sympatric with *F. grantsaui*. Around Mucugê, pairs of *F. rufa* were common at the *cerrados* (locally known as “campos gerais”, Harley & Giuliatti 2004, p. 106) in flatter areas with lateritic soils mixed with sand west of the Serra do Sincorá, along the dirt road to the town of Palmeiras (Fig. 28), and some apparently isolated males were recorded in the valley of the Rio Mucugê, just south of the town, an obviously very disturbed area. One of these males was singing within hearing distance of at least one female-plumaged *F. grantsaui*, which we found slightly higher up on a rocky slope. An apparently permanent ecological segregation exists between *F. rufa* and *F. grisea* when they occur in sympatry (Sick 1955, Silva *et al.* 1997, Gonzaga 2001), and it would be expected to exist also in the Chapada Diamantina between *F. rufa* and *F. grantsaui*.

**Nomenclature.** Once it was demonstrated that the birds found in the campos rupestres of the Serra do Sincorá are not the same taxon as what is currently known as *Formicivora rufa* (e.g. Zimmer & Isler 2003), from which they are clearly diagnosable by plumage coloration, vocalizations and preferred habitat, it became important to determine the identity of the syntypes of *Myiothera rufa* Wied, 1831, which were collected at unspecified localities in the interior of Bahia (“aus den inneren Gegenden der Provinz Bahiá”: Wied 1831, p. 1098; see also Allen 1889, LeCroy & Sloss 2000). These specimens were examined at our request by M. LeCroy and subsequently also by AMPC and S. Kenney, to rule out the possibility that this name could be applied to the taxon we are describing here.

Any decision based on the general coloration of the types of *M. rufa* could be flawed, given the possibility that their colors have faded owing to the long exposure to light that Maximilian specimens have suffered (cf. Allen 1889) and given that the streaking of underparts is subject to much variation in *F. rufa*, as discussed by Pinto (1940, 1947). For these reasons, the most useful diagnostic character is the coloration of the underwing-coverts, which are grey and white in both sexes of one species, and white in both sexes of the other. Based on this premise, the syntypes were checked with an special attention paid to this feature. Both specimens, which are quite rufescent, have the underwing-coverts white (Fig. 7), which makes them distinct from the birds we described here, and is in full agreement with the original description of *M. rufa*, in which it is stated that the

anterior part of the wing, as well as the underwing-coverts, are white (“vorderer Flügelbug weiss, eben so die inneren Flügeldeckfedern”: Wied 1831, p. 1097). M. LeCroy (*in litt.* to LPG 2003), informed us that “unfortunately, the wings of both specimens have been glued on with huge globs of glue that make it difficult to see the underwings (...). However, I have done my best to pull the feathers loose from the worst of the glue and I see no indication of any dark feathers in the underwing-coverts. They appear all white, even though stuck together.” One of the few authors to have reported the presence of white underwing-coverts in *F. rufa* was Zimmer (1932), in his detailed description of *F. r. urubambae* from Peru. It is not clear, however, if he also considered this character when examining the types of *M. rufa*. Most of modern descriptions of *F. rufa* in the ornithological literature do not mention this feature.



**FIGURE 28.** *Cerrado* vegetation (“campos gerais”) on lateritic soils west of the Serra do Sincorá, Chapada Diamantina, habitat of *Formicivora rufa* (Photo by Charles Ozanick).

The conclusion that Wied's syntypes belong to the species currently recognized as *F. rufa* is also supported by the fact that all the localities visited by Wied in the interior of Bahia, where he might have collected the syntypes of *M. rufa*, lie more than 100 km to the south of the Chapada Diamantina, between the upper courses of Rio Pardo and Rio Gavião, close to the border between Bahia and Minas Gerais (cf. Bokermann 1957). Despite an apparently ill-informed claim that these specimens “never came from Bahia” (Hellmayr *in* Naumburg 1939), Naumburg (1939) concluded, “after a thorough study [of coloration patterns], that the types of *M. rufa* came from Minas Geraes border of Bahia”, in agreement with Zimmer (1932), who stated that “if these types are truly from Bahia they must be from some extreme southern locality”. Pinto (1940, 1947) concluded the same. There seems to be no reason to doubt that the syntypes of *M. rufa* were collected by Wied during his sojourn in the interior of Bahia, and that he never reached the known range of *F. grantsau* (see Bokermann 1957).

As evidently have our predecessors (e.g. Cory & Hellmayr 1924, Zimmer 1932, Pinto 1936, 1940, 1947, Naumburg 1939), we have assumed that Wied's types of *Myiothera rufa* are adult females. The possibility has been raised, however, that they might be immatures and that “it is possible that the underwing-coverts would

be light, then become dark when adult" (B. Whitney *in litt.* 2007). Although this entirely hypothetical speculation cannot be categorically disproved in the absence of known immature specimens of *F. grantsaui*, it is highly unlikely 1) that such an anomalous molt sequence would actually exist; 2) that both of the syntypes of *M. rufa* would be immature birds; 3) that immature birds from the *campos rupestres* of the Serra do Sincorá would prove to have entirely white underwing-coverts and still be similar in every other aspect to the syntypes of *M. rufa*; and 4) that what we have named *F. grantsaui* occurs (or occurred) outside the Chapada Diamantina in the localities visited by Wied in the interior of Bahia or, conversely, that he somehow obtained specimens from the *campos rupestres* of the Serra do Sincorá by other means. Therefore we prefer the most parsimonious hypothesis, which is that Wied's syntypes represent the taxon that has traditionally been associated with the name *Formicivora rufa*.

**Systematics and biogeography.** The Espinhaço Range has been regarded as an unparalleled area of endemism in eastern South America for vascular plants (Giulietti *et al.* 1997), and also holds a number of endemic birds (Bibby *et al.* 1992) and other terrestrial vertebrates (e.g. lizards, Rodrigues 1988). From a biogeographic point of view, the endemic avifauna of the Espinhaço Range seems to be composed of several distinct elements, as its taxa have their putative closest relatives in the Amazonian lowlands, the Guianan plateaus, or the Andean highlands. However, phylogenetic hypotheses based on parsimony analysis of morphological, molecular and ecological data that could provide a basis for biogeographic hypotheses of vicariance do not exist for most genera of Neotropical birds and plants, and the Espinhaço endemic taxa are no exceptions, which prevents any further advance in the understanding of possible past connections between those areas and the Espinhaço Range. Similarly, it is not possible to propose any hypothesis of evolutionary history for *F. grantsaui*, as its position in the group that encompasses its closest relatives (*F. acutirostris*, *F. grisea*, and *F. rufa*) is not known, pending a phylogenetic analysis that should ideally include samples of the entire *F. grisea* species complex and several populations of *F. rufa*.

Endemic bird taxa whose proposed sister relatives occur in the north of the continent are four hummingbirds: *Campylopterus largipennis diamantinensis* Ruschi, *Colibri delphinae greenewalti* Ruschi, and *Augastes* spp. It is notable that speciation has taken place along the Espinhaço Range itself within the genus *Augastes*, its two allospecies replacing one another in the more or less disjunct northern and southern portions of this geological complex (*A. lumachella* and *A. scutatus* Temminck, respectively). The presumed closest relative of these species is *Schistes geoffroyi* Bourcier, from the Andes (Sick 1993, Schuchmann 1999). Relationships of the canastero *Asthenes lizae* Vielliard are not certainly known but possible close relatives occur in the southern part of continent and in the Andes (Sick 1993, Remsen 2003). It is worth pointing that *A. lumachella*, *C. d. greenewalti* and *F. grantsaui* are restricted to the northern portion of the Espinhaço Range, the other three endemic taxa being restricted to its southern portion.

*Polystictus superciliaris* and *Embernagra longicauda* share the main part of their geographical and ecological distributions along all the Espinhaço Range, where they are typical of the *campo rupestre* (Parrini *et al.* 1999). However, neither species can longer be considered endemic to this mountain complex because they also have been recorded from other mountain ranges (Vasconcelos *et al.* 2003).

**Etymology.** We are pleased to name this new species after Rolf Grantsau, who first noticed its distinctiveness, and in recognition of his contributions to the study of Brazilian birds. As common names for this species we propose Sincorá Antwren (English) and Papa-formigas-do-Sincorá (Portuguese), referring to the type locality region, the Serra do Sincorá in the Chapada Diamantina.

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## Appendix 1. Comparative specimens examined

- Formicivora erythronotos*: **Brazil**: AMNH 5360, 156326, 490402, MNRJ 33300; **Rio de Janeiro**: Angra dos Reis: MZUSP 76678, 76679, UFRJ 317.
- Formicivora littoralis*: **Brazil**: **Rio de Janeiro**: Cabo Frio: MNRJ 26540, MPEG 46319, 46322, UFRJ 0797, 0811; Arraial do Cabo: MNRJ 36751 (Holotype), MPEG 46317, 46318, 46320, 46321, UFRJ 0669, 0812; Araruama: UFRJ 0352, 0353, 0354, 0355, 0356, 0357, 0358, 0359, 0360; Saquarema: UFRJ 0361.
- Formicivora melanogaster*: **Brazil**: **Ceará**: Baturité: MZUSP 41730, 41731, 41732, 41733; Mosquito: MZUSP 41734; **Paraíba**: Coremas: MZUSP 39897, 39898, 39899, 39900, 39901, 39902; **Pernambuco**: Agrestina: MZUSP 63492, 63493, 63496, 63525, 63584; **Alagoas**: Palmeira dos Índios: MZUSP 37417, 37418, 37419; **Bahia**: Barra: MZUSP 7468, 7469, 7470, 7641, 8544, 8545, 40978; Rio Preto: MZUSP 40979, 40980; Coribe: MPEG 45269, 45270, 45271, 45272, 45273, 45274, 45275, 45276, 45278; **Goiás**: Rio Verde: MZUSP 27832; 34024; **Mato Grosso do Sul**: Xavantina: MZUSP 32449; **Minas Gerais**: Itacarambi: MPEG 41153, 41154, 41155; **São Paulo**: Avanhandava: MZUSP 4446.
- Formicivora serrana*: **Brazil**: **Espírito Santo**: Baixo Guandu: MNRJ 16978, 16983, 16984, 16990; Santa Teresa: MNRJ 26266, 26316; Jatiboca: MNRJ 27247, 27249, 27278; **Minas Gerais**: Mariana: MNRJ 16980, 16985, 16988, 16989; Muriaé: MNRJ 16976, 16977, 16979, 16981, 16982, 16986, 16987; Volta Grande: MNRJ 23978, 23979, 23989; **Rio de Janeiro**: Trajano de Moraes: MNRJ 36750, MPEG 46315, 46316.
- Formicivora acutirostris*: **Brazil**: **Paraná**: Guaratuba: LSUMZ 161020, 161021, MNRJ 42978, 42979, 42980; Matinhos: MNRJ 39458 (Holotype), 39457 (Paratype).
- Formicivora grisea*: **Venezuela**: **Bolívar**: Ciudad Bolívar: AMNH 490800, 490801, 490802; Altagracia: AMNH

490792, 490795, 490796, 490797, 490798; Caicara: AMNH 821365, 821366, 821367; **Colombia: Magdalena:** Bonda: MZUSP 13179, 13180, 13185, 13284; **Tolima:** Honda: MZUSP 12442, 12465; **Cundinamarca:** Bogotá: MZUSP 5259, 5261; **Brazil: Amapá:** Macapá: MNRJ 17419; **Amazonas:** Inambu, Rio Negro: MNRJ 37895, 37896; **Pará:** Alter do Chão: MNRJ 37696, 37697; Cametá: MNRJ 17621; Marabá, Serra Norte: MNRJ 31156, 31158; Tucuruí: MNRJ 43690, 43691; **Maranhão:** São Bento: MNRJ 16994; Anil: MNRJ 16991, 16996, 16999, 17281, 17285, 17288, 17828; Turiagu: MNRJ 17287; **Rondônia:** Alvorada d'Oeste: MNRJ 43344; **Mato Grosso:** Cuiabá: MNRJ 38677; **Goiás:** Aruanã: MNRJ 16997, 17286; **Paraíba:** João Pessoa: MNRJ 43306, 43310, 43311; **Pernambuco:** Recife: MNRJ 24654, 24655, 24656; **Alagoas:** São Miguel dos Campos: MNRJ 32044, 32045; **Sergipe:** Brejo Grande: MNRJ 37594; **Bahia:** Cachoeira: MNRJ 16993, 16995, 16998, 17000, 17279, 17282; Camamu: MNRJ 38246; **Espírito Santo:** Regência: MNRJ 26490, 26491; Linhares: UFRJ 0304, 0305.

*Formicivora rufa:* **Brazil: Amapá:** Amapá: MPEG 30512, 28685, 28686, 28687, 28688; **Pará:** Alter do Chão: MPEG 37765, 37766; Posto Tiriós: MPEG 17688, 17694, 17696; Santarém: MPEG 20566, 20567, 20568, 20569, 20570, MNRJ 44161; Rio Acará: MPEG 1665; **Maranhão:** Alto Parnaíba: MPEG 43487, 43488, 43489, 43490, 43491, 43492; **Tocantins:** Ilha do Bananal: MNRJ 32996; **Rondônia:** Porto Velho: MNRJ 8465; **Mato Grosso:** Pindaíba: MPEG 20562; Chapada dos Guimarães: MPEG 38914, 39003; **Goiás:** Aragarças: MPEG 15168, 15174, 15181, 20558, 20559, 20561, 20564; Goiânia: MPEG 15169, 19625, 19639; **Mato Grosso do Sul:** Xavantina: MPEG 15182, 20565; **Bahia:** AMNH 5353, 5354 (Syntypes); Mucugê: MNRJ 44151, 44152, 44153, 44154; Rio de Contas: MNRJ 39000; **Minas Gerais:** Pirapora: MNRJ 17209; Uberlândia: MNRJ 44162, 44163; **Espírito Santo:** Linhares: MNRJ 26455, 26463, 27248, 27250, 27252, 27267, UFRJ 0303; Cachoeiro do Itapemirim: MNRJ 17210, 17213; **Rio de Janeiro:** Cardoso Moreira: MNRJ 20955; Carapebus: UFRJ 0298, 0299, 0300, 0301, 0302.

## Appendix 2. Tape recordings analyzed.

*Formicivora grantsauyi.* **Brazil: Bahia:** Mucugê: ASEC 10505, 10507, 10508, 10512, 10513, 10514, 10515, 10516, 10517, 10518, 10541, 10542, 10545, 10549, 10552, 10553, 10554, 10614, 10615, 10616, 10617, 10618, 10619, 10620, 10621, 10622, 10629, 10630, 10631.

*Formicivora erythronotos.* **Brazil: Rio de Janeiro:** Ariró: ASEC 1953; Mambucaba: ASEC 2882, 2884, 2914, 2915, 2917, 2929, 2930, 2932, 2933, 2934, 2938, 2939, 2940, 2952, 2953, 2973, 2974, 9481.

*Formicivora littoralis.* **Brazil: Rio de Janeiro:** Araruama, restinga da Massambaba: ASEC 3052, 3053, 3055, 3056, 3057, 3058, 3060, 3062, 3063, 3064, 3069, 3073, 3074, 3075, 3076, 3077, 3078; Saquarema, restinga de Jacarepiá: ASEC 3079, 3080.

*Formicivora melanogaster.* **Brazil: Piauí:** Valença do Piauí: ASEC 3083; **Ceará:** Crato: ASEC 11421; **Pernambuco:** Arcoverde: ASEC 2333, 3195; **Bahia:** Curaçá: ASEC 5790; Morro do Chapéu: ASEC 2987; Canudos ("Cocorobó"): MLNS 46825, 46831; Boa Nova: ASEC 551, 675, 1021, 1073, 1094, 1218, 1220, 1274, 1401, 1625, 1736, 2347, 5175, 5253, 5445, 5465, 6751, 6986, 7086, 7355, 7946, 7987, 8474.

*Formicivora serrana.* **Brazil: Minas Gerais:** Santa Bárbara, Parque Natural do Caraça: ASEC 1806, 3200, 3201, 3202, 3203, 3204, 3205, 3206, 3207, 3208, 3209, 3210, 3211, 3212, 3213, 3214, 3215, 3216, 3217, 5588, 6012, 8036, 9630; Brumal: ASEC 015, 016, 173, 1257, 3355, 5882, 7508; **Rio de Janeiro:** Trajano de Moraes: ASEC 3187.

*Formicivora acutirostris.* **Brazil: Paraná:** Matinhos: ASEC 7832; Baía de Guaratuba: ASEC 1139, 2568, 4091, MBBR s/no.; **Santa Catarina:** Garuva, Porto Palmital: ASEC 7836, 7837, 7838.

*Formicivora grisea.* **Lesser Antilles: Tobago:** Speyside: MLNS 07083; **Venezuela:** MLNS 47812; **Bolivar:** El Dorado: MLNS 45525, 45526, 45534; **Suriname:** Kraka: MLNS 02110, 02111; Zanderij: MLNS 11531; **Brazil: Amapá:** JMCS 06B, 07/39; **Maranhão:** Peritoró: ASEC 2984; **Pernambuco:** Igarassu: ASEC 2985, 2986; **Alagoas:** São Miguel dos Campos: ASEC 2988; Barra de São Miguel: ASEC 804; **Bahia:** Santo Amaro: MLNS 35741; Una: ASEC 2990; **Espírito Santo:** Linhares: ASEC 2991, 2992, 2993, 2994, 2995, 2996, 2997, 2998, 2999, 3000, 3001, 3002, 3003, 3006, 3008, 3009, 3010, 3011, 3012, 3016, 3018, 3019.

*Formicivora rufa.* **Bolivia: Santa Cruz:** Flor de Oro: MLNS 65515; **Brazil: Bahia:** Mucugê: ASEC 10528, 10529, 10530, 10537, 10539, 10587, 10588, 10589, 10590, 10625, 10627, 10628, 10638, 10639, 10641; **Espírito Santo:** Linhares: ASEC 3171, 3175, 3176, 3178, 3179, 3180, 3181, 3182, 3183, 3184, 3185, 3186; **Rio de Janeiro:** Carapebus: ASEC 2818, 2819, 5035, 7768, 9009, 9243.