



A cryptic new species of hummingbird of the *Campylopterus largipennis* complex (Aves: Trochilidae)

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Abstract

A new species of *Campylopterus* sabrewing is described from eastern Brazilian tropical dry forests occurring below 900 m asl. Its holotype (MZUSP 99024) is an adult female from Sítio Duboca (16°43'19"S, 43°58'20"W, elevation 840 m), municipality of Montes Claros, state of Minas Gerais. A taxonomic revision based on more than 1,000 museum specimens revealed that the new taxon, together with *C. largipennis*, *C. diamantinensis* and *C. obscurus* (with *C. aequatorialis* considered as a subjective junior synonym) should be ranked as species. We provide a key to permit easy identification of the four species. The new species is very similar to the parapatric *C. diamantinensis* of high altitude “campos rupestres” above 1,000 m asl, differing from it by its smaller size and longer light tail tips, as well as by sternum measurements. Given the several threats faced by the habitat to which the new species is endemic, we propose to consider it as Vulnerable under the IUCN criteria.

Key words: cryptic biodiversity, Neotropical, Trochilidae, tropical dry forests

Introduction

The genus *Campylopterus* consists of 13 hummingbird species from Central and South America, where most inhabit the understorey of forests, edges and clearings (Schuchmann 1999). *Campylopterus largipennis* (Boddaert, 1783) is the most widespread species in the genus, occurring from lowland Amazonian rainforests to “campos rupestres”, a kind of high-altitude rocky grassland found in southeastern Brazilian mountaintops (Ruschi 1982; Grantsau 1988; Sick 1997).

Taxa ascribed to the *C. largipennis* complex have been considered by different authors as full species or subspecies (Salvin & Hartert 1892; Boucard 1893–1895; Brabourne & Chubb 1912; Cory 1918; Simon 1921; Berlioz 1931; Peters 1945; Zimmer 1950). The current taxonomic treatment, after the wide acceptance of the Biological Species Concept in ornithology, is as a single polytypic species embracing four subspecies (Ruschi 1982; Grantsau 1988; Schuchmann 1999; Dickinson & Renssen 2013): 1) *C. l. largipennis* (Boddaert, 1783), found north of the Amazon River and east of the middle and lower Negro River; 2) *C. l. obscurus* Gould, 1848, found south of the Amazon River, from the Madeira River eastward (Peters 1945; Zimmer 1950; Ruschi 1964, 1982); 3) *C. l. aequatorialis* Gould, 1861, found east of the Andes from Colombia to Bolivia and Brazil west of the Madeira River; and 4) *C. l. diamantinensis* Ruschi, 1963, restricted to the Espinhaço Range in southeastern Brazil. The three Amazonian taxa inhabit humid forests, but are unusual inside unbroken forests, favoring forest edges, margins of streams and other forest openings, generally below 400 m, locally reaching 1,200 m or even more (Ruschi 1982; Schuchmann 1999; Hilty 2002; Schulenberg *et al.* 2007). *Campylopterus l. diamantinensis* inhabits “campos rupestres” from 1,100 to 2,000 m (Ruschi 1982; Vasconcelos & Melo Júnior 2001).

Taxonomy of the *C. largipennis* complex remained undisputed during the last half century. Nevertheless,

published molecular, biogeographical, ecological, and morphological data combined with our unpublished field observations suggested to us that the polytypic *C. largipennis* might consist of more than one species, as follows:

First, Milá *et al.* (2012) evaluated mtDNA genetic variation for 41 Amazonian forest understory species and found numerous cases of deep intraspecific divergence, including within *C. largipennis*, which suggested that new species-level designations will arise upon closer taxonomic examination and comprehensive sampling.

Second, the montane *C. l. diamantinensis* is isolated from the predominantly lowland Amazonian subspecies by more than 800 km (Ruschi 1982; Grantsau 1988; Sick 1997) of dry open intervening habitats, the “dry diagonal” formed by the Caatinga, Cerrado, Pantanal, and Chaco (Werneck *et al.* 2013). This large disjunction is broken by some anomalous records, usually overlooked in the literature. For instance, the alleged presence of *C. l. largipennis* in the central region of the Cerrado was first reported by Ruschi (1951) after examining a specimen collected in “Galheiros, Goiás”, currently Divinópolis de Goiás (13°17’S, 46°24’W, 630 m). This specimen’s identification was confirmed by Ruschi (1981, 1982) after the description of *C. l. diamantinensis* in 1963. A possible solution for this biogeographical inconsistency was presented by Silva (1989, 1990, 1995), who collected specimens of *Campylopterus* in Iaciara, state of Goiás (14°09’S, 46°40’W, 570 m), and in Coribe, state of Bahia (13°45’S, 44°28’W, 650 m), identifying them as *C. l. diamantinensis* (which is morphologically similar to the nominotypical subspecies); this extended the range of *C. l. diamantinensis* far from the “campos rupestres” of the Espinhaço Range. Silva (1990) stated that these specimens were collected in the interior of dry forests growing on limestone-derived soils, a habitat quite different from that known for this subspecies (Ruschi 1963, 1982; Grantsau 1988). Additional records of *C. largipennis*, but without subspecific identification, were also obtained in the dry forests of northern state of Minas Gerais (Mattos *et al.* 1991; Kirwan *et al.* 2001; Vasconcelos & D’Angelo Neto 2007) and in southern state of Piauí (Santos 2004) [these records refer to the new species described here, as discussed below].

Third, preferred habitat of the populations of *C. largipennis* found in eastern Brazil (“campos rupestres” and dry forests) contrasts sharply with the humid habitats of the three Amazonian subspecies (Ruschi 1982; Hilty & Brown 1986; Stotz *et al.* 1996; Schuchmann 1999). Furthermore, the occurrence of *C. l. diamantinensis* in both dry forests and high-altitude “campos rupestres” would be unusual, because these vegetation types present very distinct climates, phytophysiognomies and floristic composition (Giulietti *et al.* 1997; Pennington *et al.* 2006) and no bird species are known to occur exclusively in both of these two distinct habitat types (Vasconcelos & Rodrigues 2010). Thus, if *C. l. diamantinensis* shows such wide habitat amplitude, one would expect to find it in intervening areas covered by other vegetation types, such as Cerrado, Caatinga or Atlantic Forest, which is not the case. Furthermore, there is an elevation gap of almost 500 m between the highest published record of *Campylopterus* for the dry forests (ca. 650 m in Coribe, Silva 1989, 1990, 1995) and the lowest for the “campos rupestres” (ca. 1,100 m in Grão Mogol, Minas Gerais, Ruschi 1963; Vasconcelos & D’Angelo Neto 2007).

Fourth, records of *C. largipennis* from eastern Brazil are from two distinct endemic bird areas, the “central Brazilian hills and tablelands” (i.e., the Espinhaço Range) and the “deciduous forests of Minas Gerais and Goiás” (Stattersfield *et al.* 1998).

Based on the evidence presented above, and on the fact that specimens from the “campos rupestres” are much larger than specimens from the dry forests (Vasconcelos 2001), we conducted a taxonomic revision of the *C. largipennis* complex using phenotypic character suites traditionally used in avian taxonomy (i.e. morphometrics and plumage features) to address the following questions: 1) is the population of *C. largipennis* occurring below 1,000 m in dry forests of eastern Brazil diagnosable from the population of *C. l. diamantinensis* found in the “campos rupestres” above 1,000 m; 2) if so, which phenotypic features provide diagnostic characters for the taxa in the *C. largipennis* complex; and 3) are the four currently named populations of *C. largipennis* and the possibly distinct population from dry forests of eastern Brazil recognizable as distinct taxa? Before proceeding, we present a thorough taxonomic and nomenclatural revision of the *C. largipennis* complex.

Taxonomic and nomenclatural history. *Trochilus largipennis* Boddaert, 1783, was the Linnean name proposed for the hummingbird painted by François Nicolas Martinet that appeared in figure 2 of plate 672 from “Planches enluminées”. The first plate appeared in 1765 in France, under the supervision of Edmée Louis Daubenton, without any title or text, except the vernacular names of the birds, and 1,008 of those plates were published in the course of ~20 years (Anker 1938). A specimen housed in the Muséum National d’Histoire Naturelle (MNHN 2012.78) is labelled as the holotype of this name, even though it is not listed in the catalogue of types of hummingbirds housed in the MNHN (Jouanin 1951). We question the authenticity of this specimen, which

we believe, is in suspiciously good condition for a skin 250 years old, as techniques then available for preparing specimens and maintaining a collection were unsatisfactory; furthermore, its method of preparation appears quite modern (Farber 1977). This specimen, if bearing authentic data, is supposed to have been formerly deposited in the personal collection of the Comte de Buffon and to have been used as the basis for Martinet's illustration. It was collected in "Cayenne", which is the type locality of *Trochilus largipennis*. The genus *Campylopterus* Swainson, 1827, was erected specifically for this taxon, which was not in a satisfactory systematic position (Swainson 1827). Diagnostic features of *C. l. largipennis* are its broadly white light tail tips (hereafter LTTs), in contrast to the bluish-black base of the rectrices (Ruschi 1982; Grantsau 1988; Schuchmann 1999).

Four other names are considered junior synonyms of *C. largipennis*: 1) *Trochilus cinereus* Gmelin, 1788, the Latin name proposed for the "Ash Bellied Humming-bird" of Latham (1782), which was based on a specimen from an unknown locality deposited in the collection of Sir Joseph Banks. We were unable to discover the fate or whereabouts of this specimen, but it has probably disappeared due to unsatisfactory methods of preservation and curation adopted by Banks (Lysaght 1971). The "Ash Bellied Humming-bird" of Latham (1782) was described from a female specimen, as suggested by its curved bill and non-enlarged shafts of wing feathers (see below). The detailed description of its tail pattern presented by Latham (1782) leaves no doubt about *T. cinereus* being a junior synonym of *T. largipennis*: "the two middle tail feathers are green; the next on each side black; the three outer ones steel black at the base, and the end half white, deepest on the outer feather"; 2) *Trochilus campylopterus* Gmelin, 1788, the Latin name proposed for the "Oiseau-mouche Larges Tuyaux" of Buffon (1779), which was based on the same figure painted by Martinet; 3) *Trochilus latipennis* Latham, 1790, the name proposed to designate his "Broad-shafted Humming-bird" (Latham 1782), also based on Martinet's illustration, which represents a male. Therefore, *T. campylopterus* and *T. latipennis* are objective synonyms of *Trochilus largipennis* Boddaert, 1783; 4) *Campylopterus largipennis maronicus* Simon, 1921, which was based on a small series collected in the Maroni River, a natural boundary between Suriname and French Guyana. This subspecies was described as differing from the nominotypical subspecies by its darker green and slightly bluish central rectrices and tail coverts, as well as by its longer bill. Bill length (exposed culmen) in the type series of *C. l. maronicus* is 25.5 mm for a male, and from 25.0 to 27.5 mm for females (Simon 1921). Females also show slightly shorter LTTs (Simon 1921). Simon (1921) did not designate a holotype or a type series, but at least three specimens (one male and two females) were examined by him, as implied in the original publication by the range of measurements presented. Although Simon (1921) did not indicate where these were housed, they were unquestionably in his private collection, which was inherited by Jacques Berlioz, his personal friend and director of the laboratory of zoology (birds and mammals) of the Museum National d'Histoire Naturelle, Paris (Delacour 1976; Greenway 1976). Berlioz's private collection of hummingbirds was one of the largest in the world, given that he acquired some other important collections, such as that of E. Gounelle (Gounelle 1909) and that of A. L. Butler (Berlioz 1964), both relevant here (see below). After the death of Berlioz, his collection was held by Christian Jouanin, who replaced Berlioz as the head of the ornithology department of the Museum National d'Histoire Naturelle. The Berlioz collection was finally bought in 2011 by the Musée des Confluences, Lyon, France, where it is currently housed.

Campylopterus obscurus Gould, 1848, was described from a specimen collected in "Rio Amazonas" (Gould 1848), and this holotype is deposited in the Natural History Museum, Tring, UK (Warren 1966). Hellmayr (1910) suggested Pará (= Belém) as the type-locality. The main diagnostic feature of *C. obscurus* is its short and greyish LTTs, contrasting with the bluish black base of the rectrices (Ruschi 1982; Grantsau 1988; Schuchmann 1999).

Campylopterus obscurus has been treated as a subspecies of *C. largipennis* by the majority of authors since Berlioz (1931), even though Todd (1942) wrote that he would "unhesitatingly keep this form specifically distinct from *C. largipennis*". Berlioz (1931) considered the treatment of both taxa as distinct species somewhat exaggerated and erroneous ("quelque peu exagérée et erronée"), considering the morphological differences between them simply too small. Berlioz (1931) also pointed that two specimens from southern Maranhão showed intermediate features with one alleged specimen of *C. l. largipennis* collected by Gounelle in Minas Gerais (note that *C. l. diamantinensis* was undescribed at that time).

Campylopterus aequatorialis Gould, 1861, was described from "the neighbourhood of Quito", Ecuador (Gould 1861a), which is almost certainly incorrect given the high altitude of this area (above 2,800 m). For this reason, Chapman (1926) suggested the region of Napo River, in eastern Ecuador, as the type locality. The holotype is also deposited in the Natural History Museum (NHMUK; Warren 1966). *Campylopterus aequatorialis* was firstly included as a subspecies of *C. obscurus* (Hellmayr 1906), and subsequently both taxa were treated as subspecies of

C. largipennis (Berlioz 1931), as suggested by Laubmann (1930). Diagnostic features are LTTs of intermediate length (Ruschi 1982; Grantsau 1988; Schuchmann 1999) and pale grey (Todd 1942; Bond & Meyer de Schauensee 1943), not white as mentioned by some authors (e.g. Gould 1861b; Cory 1918), contrasting with the bluish-black base of the rectrices. Todd (1942) also stated that *C. l. aequatorialis* tends to be greener, less bronzy, above than *C. l. obscurus*.

Campylopterus largipennis diamantinensis Ruschi, 1963, was described from Córrego das Pedras, municipality of Diamantina, state of Minas Gerais, Brazil (Ruschi 1963). The holotype is housed in the American Museum of Natural History, New York, USA (Greenway 1978). Ruschi (1963, 1982) described this subspecies as similar to the nominotypical subspecies, but larger, with central and subcentral rectrices with lighter green metallic bronzy color, outer rectrices having dorsally a green metallic bronzy band extending from the base to the transversal white band at the outer vane; the blackish band is almost imperceptible on the outer rectrices.

The occurrence of a member of the *C. largipennis* complex in eastern Brazil was first reported by Gounelle (1909), who collected a single specimen in the Serra do Caraça, Minas Gerais, but referred it to the nominotypical subspecies. Gounelle's record was long considered doubtful or incorrect (Peters 1945). Berlioz (1964) did not find this specimen in the Butler Collection (which housed at that time the specimens collected by Gounelle), but recognized that one specimen without locality of origin in Butler's collection was a "somewhat aberrant specimen (...) differing from all others by its paler color, more golden green upperparts, as well as by its almost whitish underparts" [translated from French]. Therefore, he was unable to solve this "mystery" which, unbeknownst to him, had been solved one year earlier, with the description of *C. l. diamantinensis* (Ruschi 1963).

Material and methods

We examined 1,012 specimens of the *C. largipennis* complex (see Appendix 1) housed in 22 Brazilian and overseas institutions (see acknowledgments for institutional acronyms). We examined the so-called holotype of *Trochilus largipennis* Boddaert, 1783 (MNHN 2012.78) and the holotypes of *Campylopterus obscurus* Gould, 1848 (BMNH 1888.7.25.75), *Campylopterus aequatorialis* Gould, 1861 (BMNH 1872.5.28.53) and *Campylopterus largipennis diamantinensis* Ruschi, 1963 (AMNH 801435). We also examined topotypes of *Campylopterus largipennis maronicus* Simon, 1921 (AMNH 479302, 479303; MNHN 3572, 3573).

We took the following measurements (Baldwin *et al.* 1931) with digital calipers (0.1 mm accuracy) from each specimen: length of wing chord; tail; total culmen; and the longest length of the LTT of the four outer rectrices (hereafter LTT-1 to LTT-4, numbered from outside to inside). Because Simon (1921) considered length of exposed culmen of *C. l. maronicus* as a diagnostic character of this taxon, we also measured this on some males and females of *C. l. largipennis* for comparison. Weight data were obtained from specimen labels.

We prepared partial skeletons of some specimens collected in the eastern Brazilian "campos rupestres" and dry forests, which were deposited in the MCNA. Because the traditional process of skin preparation damages several parts of the skeleton, we were only able to compare the sternum of these specimens. We took the following measurements of the sternum (following Robins & Schnell 1971): sternum length; keel length; sternum width; and keel depth.

For some morphometric analyses it was necessary to identify *a priori* all specimens tentatively as one of the subspecies of this complex, which was based primarily on plumage coloration. Nevertheless, because the diagnosis of *C. l. obscurus* and *C. l. aequatorialis* is problematic, we considered all specimens collected east of the Madeira River as *C. l. obscurus*, and all specimens to the west as *C. l. aequatorialis*. Therefore, we assumed that these subspecies are allopatric, or, at most, parapatric, excluding the possibility of sympatry.

Specimens from eastern Brazil were divided into two groups: 1) specimens collected above 1,000 m in the "campos rupestres" (*C. l. diamantinensis*) and 2) specimens collected below 1,000 m in dry forests. This elevation was used as a cut-off point because it represents the approximate altitude above which "campos rupestres" are usually found (Giulietti *et al.* 1997). Dry forests do not occur above this elevation in the study region. This division was supported by previous analysis of morphological characters, especially body size and length of LTTs.

Geographic coordinates of the records, when not gathered in the field or available on the specimen labels, were obtained from ornithological gazetteers (Paynter 1982; Stephens & Traylor 1983, 1985; Paynter & Traylor 1991; Paynter 1992; Vanzolini 1992; Paynter 1993, 1997), from online satellite images available from Google Earth (<http://earth.google.com/>) and from an online gazetteer (<http://www.fallingrain.com/world/>). Color descriptions follow Munsell (2000), except for the iridescent colors, which have no parallel in that catalogue.

Taxonomic propositions presented here are based on the General Lineage Concept of Species (GLCS; de Queiroz 1998, 2005). Therefore, we accept that taxonomy is pluralistic, that species have different but potentially informative properties, and that intrinsic reproductive isolation is not a mandatory property of a species (de Queiroz 1998, 2007; Sangster 2014). We also comment on the application of the Phylogenetic Species Concept (PSC, Cracraft 1983) and the Biological Species Concept (BSC; Mayr 1969; Johnson *et al.* 1999).

Data analyses. Differences between mean measurements of males and females of each taxon were tested by Student's t-test (Zar 2010). We investigated the existence of significant differences among the mean measurements of each taxon using one-way ANOVA and *post hoc* Tukey's test (Zar 2010). We also conducted a Principal Component Analysis (PCA), a technique that summarizes patterns of correlations among observed variables and reduces a large number of variables to a smaller number of components (Tabachnick & Fidell 2007). Variables used in the PCA were the lengths of total culmen, wing, tail, LTT-1, LTT-2, LTT-3 and LTT-4. Given the small sample size available for specimens from eastern Brazil, we estimated missing values (*e.g.*, wing molting, loss of one tail feather) by means of a linear regression before conducting the PCA (Zar 2010).

To test the diagnosability of the subspecies currently recognized we conducted a discriminant analysis using the same variables used in the PCA (Tabachnick & Fidell 2007). The diagnosability of the taxa included in the *C. largipennis* complex was also investigated by the method proposed by Patten & Unitt (2002) for PC1 and PC2 scores at a diagnosability level of 95%.

We conducted two independent analyses to better understand the complex pattern of morphological variation observed in *C. l. obscurus* and *C. l. aequatorialis* (see below). First, we investigated the hypothesis that these two taxa might represent the endpoints of an east-west cline in the length of LTTs. This was done by assessing the Spearman's correlation coefficient (Zar 2010) between the longitude of the collection site (in decimal degrees west of Greenwich) and the length of all four LTTs. A strong correlation between longitude and length of LTTs, with eastern birds presenting the shortest LTTs and western birds presenting the longest LTTs, would support this hypothesis. Second, we conducted a box plot comparison among the groups of specimens found in each one of the major Amazonian areas of endemism (Silva *et al.* 2005; Ribas *et al.* 2012). This analysis aimed to investigate if there is any important difference in the length of LTTs among Amazonian areas of endemism, that is, if the morphological variation observed cannot be described by a simple smooth clinal pattern.

Because specimens of *Campylopterus* collected in high altitude "campos rupestres" are significantly heavier and have larger body measurements than specimens collected in lower elevation dry forests (Vasconcelos 2001), we investigated if this variation could be ascribed to the effect of elevation alone. This hypothesis was based in Bergmann's Rule, which predicts that larger homeotherms are found in colder climates (*i.e.* at higher latitudes or elevations) than closely related smaller ones (see Meiri 2011 for a recent debate on this topic). We did not consider the effect of latitude, because the northernmost and southernmost specimens available are from localities separated by only 5° of latitude. The analysis of this topic has an additional complication, because hummingbirds living at higher elevations have considerably longer wings than those living at lower elevations (Feinsinger *et al.* 1979), as hovering flight is one of the most energetically challenging forms of locomotion and is influenced by both atmospheric oxygen availability and air density (Altshuler & Dudley 2002; Altshuler *et al.* 2004). Therefore, if variation in body size observed in eastern Brazilian hummingbirds (which span an elevational range of ~1,500 m) could be due to the effect of elevation alone, we would expect to find a similar pattern of variation for *C. l. largipennis* (elevational range of ~1300 m) and for *C. l. aequatorialis* (elevational range of ~1600 m). To test this hypothesis, we assessed the Spearman's correlation coefficient (Zar 2010) between the elevation of the collection site and PC1 scores (recalculated for the two populations found in eastern Brazil as well as for *C. l. obscurus* and *C. l. aequatorialis* using only body length measurements: total culmen, wing and tail), which is perhaps the best index of body size (Zink & Remsen 1986). Given that preliminary analyses revealed the existence of slight morphological differences between specimens from the major Amazonian areas of endemism, correlation for *C. l. aequatorialis* was tested separately for its two populations that reach highlands (Napo and Inambari). All analyses were performed with the aid of the software STATISTICA 8.0 (StatSoft 2007). Significance level adopted was 5%.

Results

Males of all taxa analyzed tend to be larger and heavier than females, but considerable overlap in measurements can be observed between sexes (Table 1). Wings of males are longer than those of females for all taxa, and tails of

males of *C. l. obscurus*, *C. l. aequatorialis* and *C. l. diamantinensis* are also longer than those of females. On the other hand, bills of females are longer than those of males for all taxa analyzed (Table 1), also differing in shape, being slightly decurved in females and almost straight in males (Figure 1).

TABLE 1. Morphometric analysis of body length measurements (mm) and weight (g) of the *Campylopterus largipennis* complex, showing statistical comparisons among taxa and sexes. LTT (Light Tail Tip) = largest length of the light tips of the four outer rectrices.

Variable	Sex	<i>C. l. largipennis</i>				<i>C. l. obscurus</i>				<i>C. l. aequatorialis</i>			
		Mean	SD	Min–Max	n	Mean	SD	Min–Max	n	Mean	SD	Min–Max	n
Culmen	♂	30.2A*	1.33	27.2–33.8	120	30.2A*	0.98	27.7–32.4	120	30.3A*	1.27	27.2–33.2	135
	♀	31.3A	1.40	28.1–33.9	79	31.4A	1.16	28.8–34.3	88	31.7A	1.14	29.0–34.0	98
Wing	♂	73.8B*	2.05	68.1–78.2	119	73.1B*	1.93	68.2–77.4	118	75.3A*	1.87	70.6–79.3	134
	♀	71.4A	1.77	68.0–75.4	78	70.7A	1.63	66.8–76.0	89	71.5A	1.79	67.3–75.7	97
Tail	♂	52.0BC	1.58	48.9–55.8	120	50.1C*	1.42	46.8–53.1	118	52.4AB*	1.67	48.5–56.8	136
	♀	52.0A	1.95	48.5–56.5	78	49.4B	1.70	45.6–53.0	87	50.8A	1.39	47.4–54.0	96
LTT-1	♂	20.6A*	1.21	18.1–24.0	118	9.4B*	1.54	5.3–13.3	118	11.0C*	1.44	8.0–14.9	132
	♀	19.3B	1.21	16.2–22.4	75	10.7C	1.17	7.5–13.6	85	11.7C	1.59	8.7–15.6	94
LTT-2	♂	18.7B*	1.35	15.5–22.0	120	7.3C*	1.44	3.0–10.7	119	8.3C*	1.13	5.7–11.1	135
	♀	17.8A	1.18	14.6–20.7	76	7.8B	1.37	5.6–11.2	87	9.2C	1.31	5.6–12.3	95
LTT-3	♂	11.7A*	2.01	6.7–16.5	120	2.7B	2.24	0.0–7.3	117	2.6B*	1.48	0.0–6.3	132
	♀	12.6A	1.65	9.2–16.6	77	3.1B	2.43	0.0–8.5	86	3.6B	1.95	0.0–8.8	96
LTT-4	♂	0.6AB*	0.95	0.0–4.5	114	0.6A	0.89	0.0–4.1	117	0.1B	0.26	0.0–2.0	133
	♀	1.2A	1.35	0.0–5.1	71	0.4A	0.84	0.0–4.2	88	0.1B	0.20	0.0–1.2	94
Weight	♂	8.5AB*	1.06	6.5–10.5	24	8.3B*	0.83	6.0–10.0	56	8.9A*	0.52	8.0–9.8	36
	♀	7.2AB	0.63	6.0–8.6	18	7.0B	0.62	5.5–8.0	39	7.4A	0.61	6.5–8.6	32

continued

Variable	Sex	<i>C. l. diamantinensis</i>				Dry forests			
		Mean	SD	Min–Max	n	Mean	SD	Min–Max	n
Culmen	♂	30.0AB*	0.94	28.2–31.5	22	28.7B*	0.78	27.3–29.5	10
	♀	31.3AB	1.22	28.9–33.1	11	29.7B	0.79	28.5–30.0	10
Wing	♂	75.2A*	1.55	71.9–78.0	22	69.4C*	2.66	65.2–72.7	9
	♀	71.0A	1.09	68.2–72.6	11	66.9B	0.63	66.0–67.6	9
Tail	♂	53.1A*	1.30	50.4–55.4	21	48.3D	1.08	46.5–49.8	10
	♀	51.5A	1.31	49.7–54.4	12	47.6C	1.61	45.6–50.0	10
LTT-1	♂	23.2D*	0.95	20.8–24.5	20	23.5D*	2.01	20.3–26.4	10
	♀	21.3AB	0.79	20.1–22.6	12	20.8A	1.21	18.9–22.6	10
LTT-2	♂	18.4B	1.18	16.4–21.4	21	21.4A*	1.33	19.3–22.9	10
	♀	18.1A	1.16	15.8–19.5	12	19.9D	1.04	18.2–21.4	10
LTT-3	♂	10.5A	1.46	8.4–13.8	20	12.1A	1.19	10.3–14.2	10
	♀	10.1A	0.78	8.6–11.3	12	13.2A	1.23	11.4–14.9	9
LTT-4	♂	0.0B	0.04	0.0–0.2	21	0.0AB	0.00	0.0–0.0	10
	♀	0.1AB	0.17	0.0–0.6	12	0.0AB	0.07	0.0–0.2	9
Weight	♂	9.1A*	0.43	8.4–10.2	16	7.0C*	0.70	5.6–7.8	8
	♀	7.7A	0.65	7.0–8.6	6	5.9C	0.28	5.5–6.5	10

*Asterisks indicate that mean measurements of males differ from those of females of the same taxon by $p < 0.05$. Means followed by different capital letters in lines differ by $p < 0.05$.

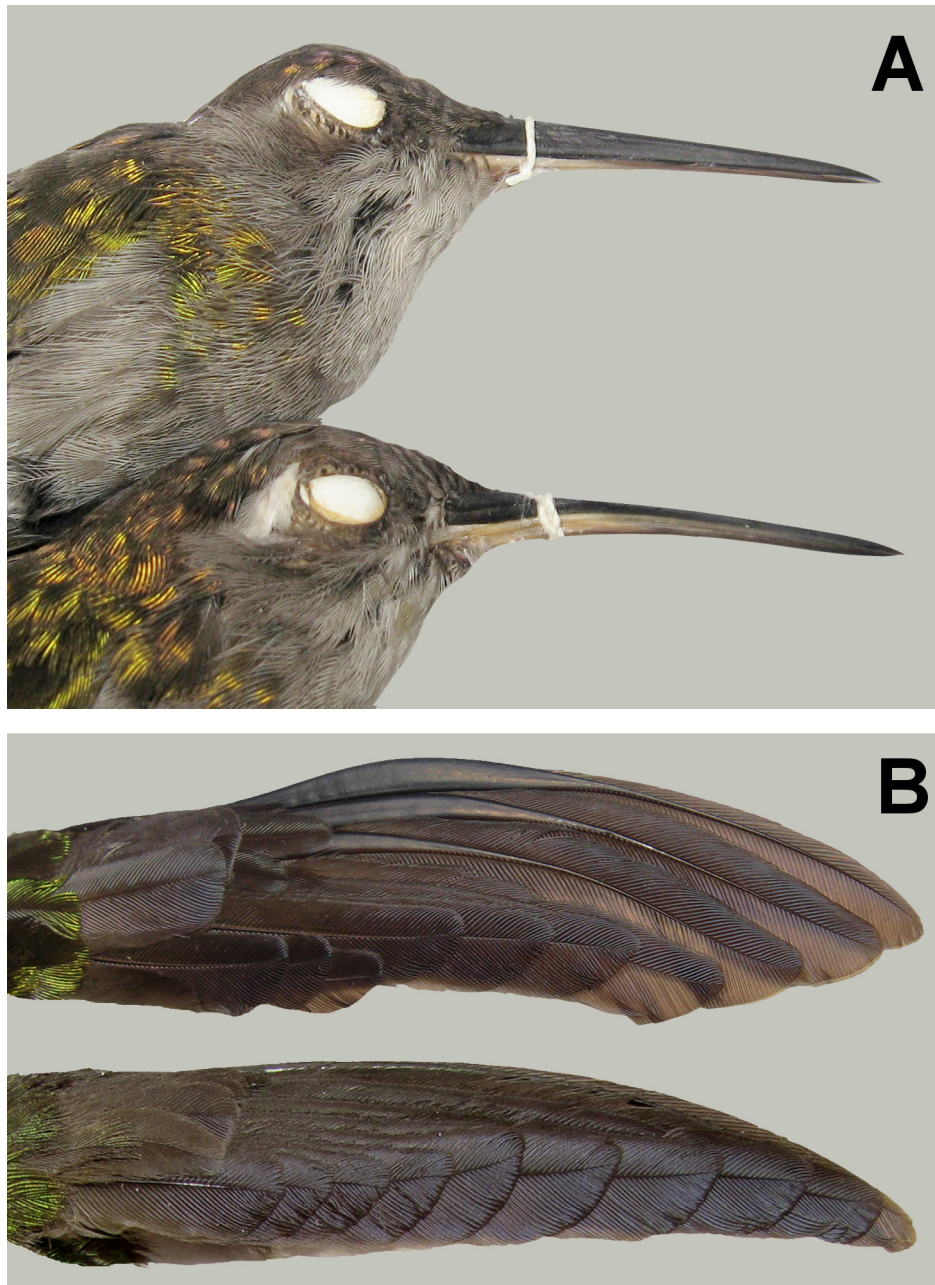


FIGURE 1. Sexual dimorphism in the shape and size of bill (A) and in wing shape (B) of taxa in the *Campylopterus largipennis* complex. In both pictures male is presented above female. (A) male (MZUSP 99025, paratype) and female (MZUSP 99024, holotype). (B) male (DZUFMG 5007) and female (DZUFMG 7170). Photographs by LEL.

All taxa showed significant differences between sexes in the length of LTTs of at least one tail feather (Table 1). There is no absolute pattern of variation in this character, but as a general rule, males with long and white LTTs (*C. l. largipennis*, *C. l. diamantinensis* and the dry forest specimens) have LTTs longer than females. The opposite is true, with females of those taxa with short and greyish LTTs (*C. l. obscurus* and *C. l. aequatorialis*) having LTTs longer than males.

Significant differences in the length of bill, wing, and tail between several taxa were observed (Table 1), but individual variation is large, with wide overlap, which generally precludes the diagnosis of taxa based on size alone (Table 2). However, specimens from the dry forests are noteworthy by their small size when compared with those of other taxa (Table 1), and females can be diagnosed from other taxa (except *C. l. obscurus*) by size alone (Table 2).

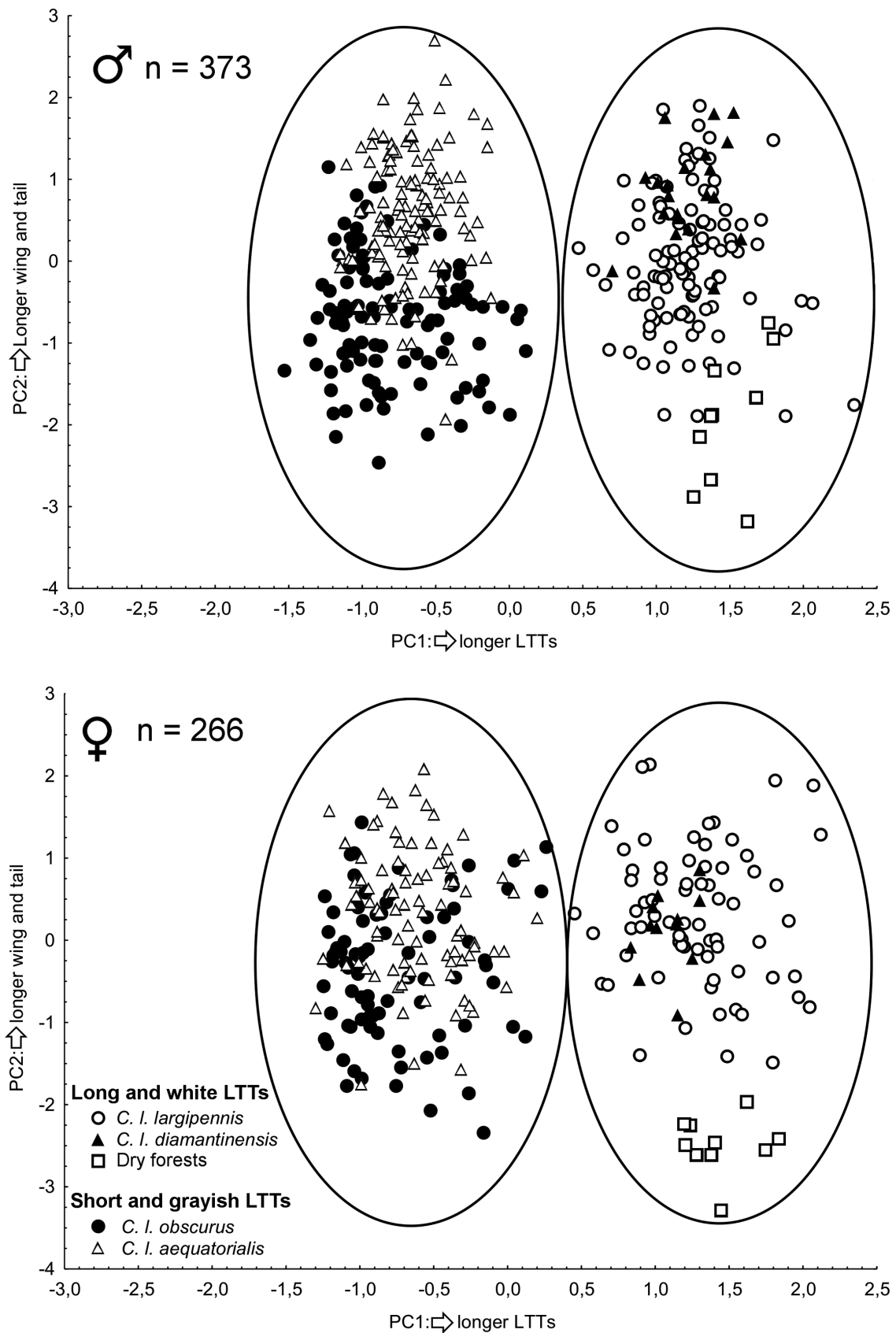


FIGURE 2. Scatterplots of the first versus the second principal component scores of a Principal Component Analysis (Varimax rotated) of morphometric variables measured from specimens of the *Campylopterus largipennis* complex. There is a clear-cut separation of the complex into two distinct groups (solid ellipses). The first group is formed by specimens showing short and grayish LTTs (left). The second group is formed by specimens showing long and white LTTs (right).

TABLE 2. Diagnosability of subspecies of the *Campylopterus largipennis* complex based on the pairwise diagnosability index (Patten & Unitt 2002) calculated from PC1 (summarizes relationship between LTTs measurements) and PC2 (summarizes relationship between body measurements) scores at a diagnosability level of 95%. Results of the test are presented in both directions. Diagnosable (*i.e.* positive) values are highlighted in bold.

Taxon	<i>largipennis</i>	<i>obscurus</i>	<i>aequatorialis</i>	<i>diamantinensis</i>	Dry forests
PC1—males					
<i>largipennis</i>	-	D_{lo} = 0.65	D_{la} = 0.87	D _{ld} = -1.04	D _{lc} = -0.79
<i>obscurus</i>	D_{ol} = 0.70	-	D _{oa} = -1.02	D_{od} = 0.86	D_{oc} = 1.11
<i>aequatorialis</i>	D_{al} = 0.82	D _{ao} = -1.12	-	D_{ad} = 0.97	D_{ac} = 1.23
<i>diamantinensis</i>	D _{dl} = -1.08	D_{do} = 0.77	D_{da} = 0.99	-	D _{dc} = -0.67
Dry forests	D _{cl} = -0.80	D_{co} = 1.05	D_{ca} = 1.27	D _{cd} = -0.64	-
PC1—females					
<i>largipennis</i>	-	D_{lo} = 0.46	D_{la} = 0.51	D _{ld} = -0.87	D _{lc} = -1.43
<i>obscurus</i>	D_{ol} = 0.47	-	D _{oa} = -1.27	D_{od} = 0.76	D_{oc} = 0.89
<i>aequatorialis</i>	D_{al} = 0.46	D _{ao} = -1.33	-	D_{ad} = 0.74	D_{ac} = 0.88
<i>diamantinensis</i>	D _{dl} = -0.99	D_{do} = 0.62	D_{da} = 0.66	-	D _{dc} = -0.57
Dry forests	D _{cl} = -1.47	D_{co} = 0.83	D_{ca} = 0.88	D _{cd} = -0.50	-
PC2—males					
<i>largipennis</i>	-	D _{lo} = -2.50	D _{la} = -2.60	D _{ld} = -1.99	D _{lc} = -27.11
<i>obscurus</i>	D _{ol} = -2.54	-	D _{oa} = -1.83	D _{od} = -1.22	D _{oc} = -27.69
<i>aequatorialis</i>	D _{al} = -2.63	D _{ao} = -1.82	-	D _{ad} = -2.52	D _{ac} = -1.04
<i>diamantinensis</i>	D _{dl} = -2.10	D _{do} = -1.29	D _{da} = -2.60	-	D _{dc} = -0.51
Dry forests	D _{cl} = -18.00	D _{co} = -18.54	D _{ca} = -0.79	D _{cd} = -0.18	-
PC 2—females					
<i>largipennis</i>	-	D _{lo} = -2.81	D _{la} = -3.37	D _{ld} = -2.59	D_{lc} = 0.35
<i>obscurus</i>	D _{ol} = -2.85	-	D _{oa} = -2.64	D _{od} = -2.25	D _{oc} = -0.26
<i>aequatorialis</i>	D _{al} = -3.44	D _{ao} = -2.67	-	D _{ad} = -2.45	D_{ac} = 0.49
<i>diamantinensis</i>	D _{dl} = -2.78	D _{do} = -2.40	D _{da} = -2.57	-	D_{dc} = 0.76
Dry forests	D_{cl} = 0.05	D _{co} = -0.53	D_{ca} = 0.26	D_{cd} = 0.65	-

Length of LTTs was the morphometric character that showed more variation among subspecies, making feasible the diagnosis of most of them (Table 2). Longer LTTs (especially of LTT-2 and LTT-3) are generally shown by specimens from the dry forests, followed by *C. l. diamantinensis*, *C. l. largipennis*, *C. l. aequatorialis* and *C. l. obscurus* (Table 1). Length of LTT-4 is equal to zero for 63% of the specimens analyzed, being longer than 1 mm for only 16.7% of such specimens.

The PCA showed a clear-cut separation of the *C. largipennis* complex in two groups (Figure 2). The first group includes *C. l. largipennis*, *C. l. diamantinensis* and specimens from the dry forests. This group is distinguished by its white and long LTTs (sum of the length of LTT-1 to LTT-3 is ≥ 42 mm). The other group includes *C. l. obscurus* and *C. l. aequatorialis*, and is distinguished by its short and greyish LTTs (sum of the length of LTT-1 to LTT-3 is ≤ 34 mm). The contribution ratios of the first principal component (PC1) were 43.0% for males and 46.6% for females. The second principal component (PC2) contributed with 23.3% and 21.4%, respectively. PC1 represents a relationship between LTTs measurements (LTT-1, LTT-2 and LTT-3), whereas PC2 represents a relationship between body measurements (wing and tail lengths).

In the first group, *C. l. largipennis* and *C. l. diamantinensis* show wide overlap of their individual scores (Figure 2), and it is impossible to diagnose them based only on morphometric characters (Tables 1 and 2).

Nevertheless, these two taxa can be diagnosed by color of their rectrices (see below). Specimens from the dry forests, especially females (Figure 2), form a cohesive sub-group, which is defined by smaller body size and proportionally longer LTTs (Tables 1 and 2). *Campylopterus l. obscurus* and *C. l. aequatorialis* showed wide overlap between their individual scores (Figure 2), and their diagnosis proved to be impossible using morphometric characters (Tables 1 and 2).

The discriminant analysis correctly classified 87.1% of the males and 85.7% of the females (Table 3). If we exclude members of the group with short and greyish LTTs, the discriminant analysis correctly classified 95.7% of the males and 96.8% of the females. Therefore, the difficulty of diagnosing specimens of *C. l. obscurus* from specimens of *C. l. aequatorialis* based solely on morphometry was again evident.

TABLE 3. Classification matrix of the taxa included in the *Campylopterus largipennis* complex after a discriminant analysis. Rows represent observed classifications and columns predicted classifications.

Taxa	Percent correct	Dry forests	<i>obscurus</i>	<i>aequatorialis</i>	<i>largipennis</i>	<i>diamantinensis</i>
Males						
Dry forests	100%	10	0	0	0	0
<i>obscurus</i>	80.9%	0	89	21	0	0
<i>aequatorialis</i>	83.1%	0	21	103	0	0
<i>largipennis</i>	98.1%	0	0	0	106	2
<i>diamantinensis</i>	80.9%	1	0	0	3	17
Total	87.1%	11	110	124	109	10
Females						
Dry forests	100%	10	0	0	0	0
<i>obscurus</i>	76.8%	0	63	19	0	0
<i>aequatorialis</i>	82.4%	0	16	75	0	0
<i>largipennis</i>	97.7%	0	0	0	69	2
<i>diamantinensis</i>	91.7%	0	0	0	1	11
Total	85.7%	10	79	94	70	13

A PCA conducted exclusively with specimens from eastern Brazil (Figure 3), including both males and females, revealed two distinctive groups, one formed by birds collected in high-altitude “campos rupestres” (*C. l. diamantinensis*) and the other formed by birds collected in low-altitude dry forests. The contribution ratio of the first principal component (PC1) was 40.1%, and the second principal component (PC2) contributed 22.9%. Dry forest specimens generally present smaller body size and longer LTT-2 and LTT-3. Females of both taxa generally present shorter LTT-1 than males of the same taxon (Figure 3, Table 1).

A discriminant analysis including both sexes of birds found in the “campos rupestres” and dry forests of eastern Brazil correctly classified 98.1% of the specimens. Only one female of the dry forest group was incorrectly classified as a male of the same group.

In southern Amazonia, longitude of the collection site and the length of LTT-1, LTT-2 and LTT-3 are significantly correlated for both sexes of *C. l. obscurus* and *C. l. aequatorialis* (Table 4). This means that, as a general rule, birds from eastern Amazonia have shorter LTTs than birds from the western part of the range. Nevertheless, the correlation is weak (Table 4), with much individual variation. A box plot analysis (Figure 4) does not support the idea of a smooth east to west cline in the length of LTTs. Instead, the pattern of morphological variation is complex in both sexes. Although LTT-1 is the longest in birds from the extreme western portion of the range (Napo and Inambari areas of endemism), this is not true for LTT-2, which is the longest in the central-western portion of the range (Rondônia and Tapajós areas of endemism). On the other hand, LTT-3 and LTT-4 are shorter in the two extremes of the range, reaching their highest values in the middle of the range (Tapajós and Rondônia areas of endemism).

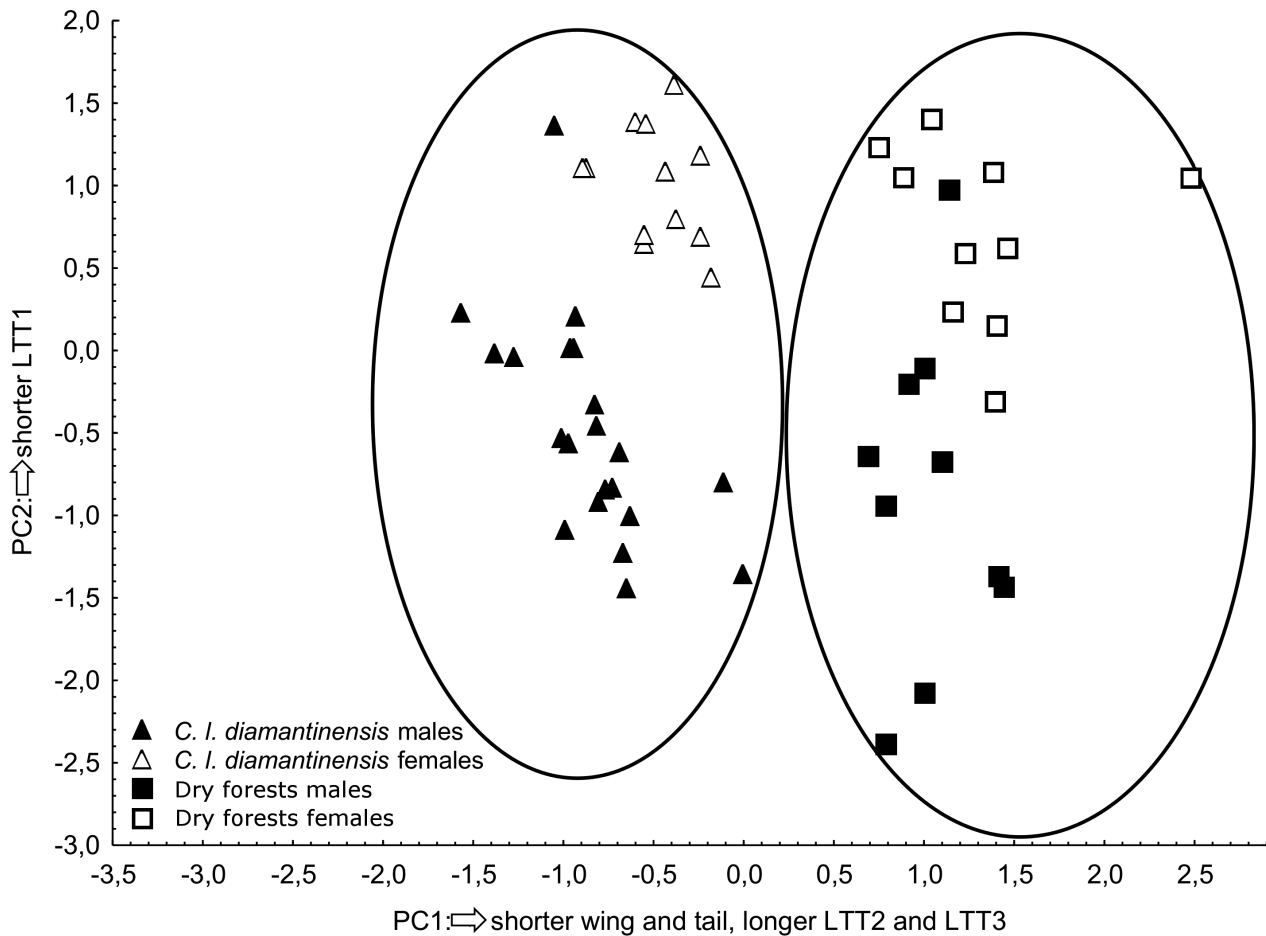


FIGURE 3. Scatterplots of the first versus the second principal component scores of a Principal Component Analysis (unrotated) of morphometric variables measured from specimens of the *Campylopterus largipennis* complex collected in eastern Brazil. Montane birds (*C. l. diamantinensis*, $n = 33$) are depicted by triangles and dry forest birds ($n = 20$) are depicted by squares. Solid symbols indicate males, and open symbols indicate females.

TABLE 4. Spearman's rank correlation between the longitude of the collection site (in decimal degrees west of Greenwich) and the length (mm) of the light tip of the four outer rectrices (LTT-1 to LTT-4) in specimens of *Campylopterus largipennis obscurus* and *C. l. aequatorialis* examined in this study. Significant values at $p < 0.05$ are highlighted in bold.

Character	♂	♀
LTT-1	n = 244, R = -0.50, P < 0.001	n = 176, R = -0.30, P < 0.001
LTT-2	n = 248, R = -0.42, P < 0.001	n = 179, R = -0.50, P < 0.001
LTT-3	n = 243, R = -0.13, P = 0.04	n = 179, R = -0.25, P < 0.001
LTT-4	n = 244, R = 0.16, P = 0.01	n = 179, R = 0.13, P = 0.09
sum of all LTTs	n = 236, R = -0.35, P < 0.001	n = 172, R = -0.37, P < 0.001

We found no correlation between the elevation of the collection site and PC1 values for any taxon investigated (Table 5, Figure 5). We also found no appreciable differences in shape of the sternum between specimens collected in dry forests and from “campos rupestres”. Nevertheless, in spite of the small sample size, dry forest birds had considerably smaller sterna than *C. l. diamantinensis* for all four measurements taken, with no or negligible overlap (Table 6).

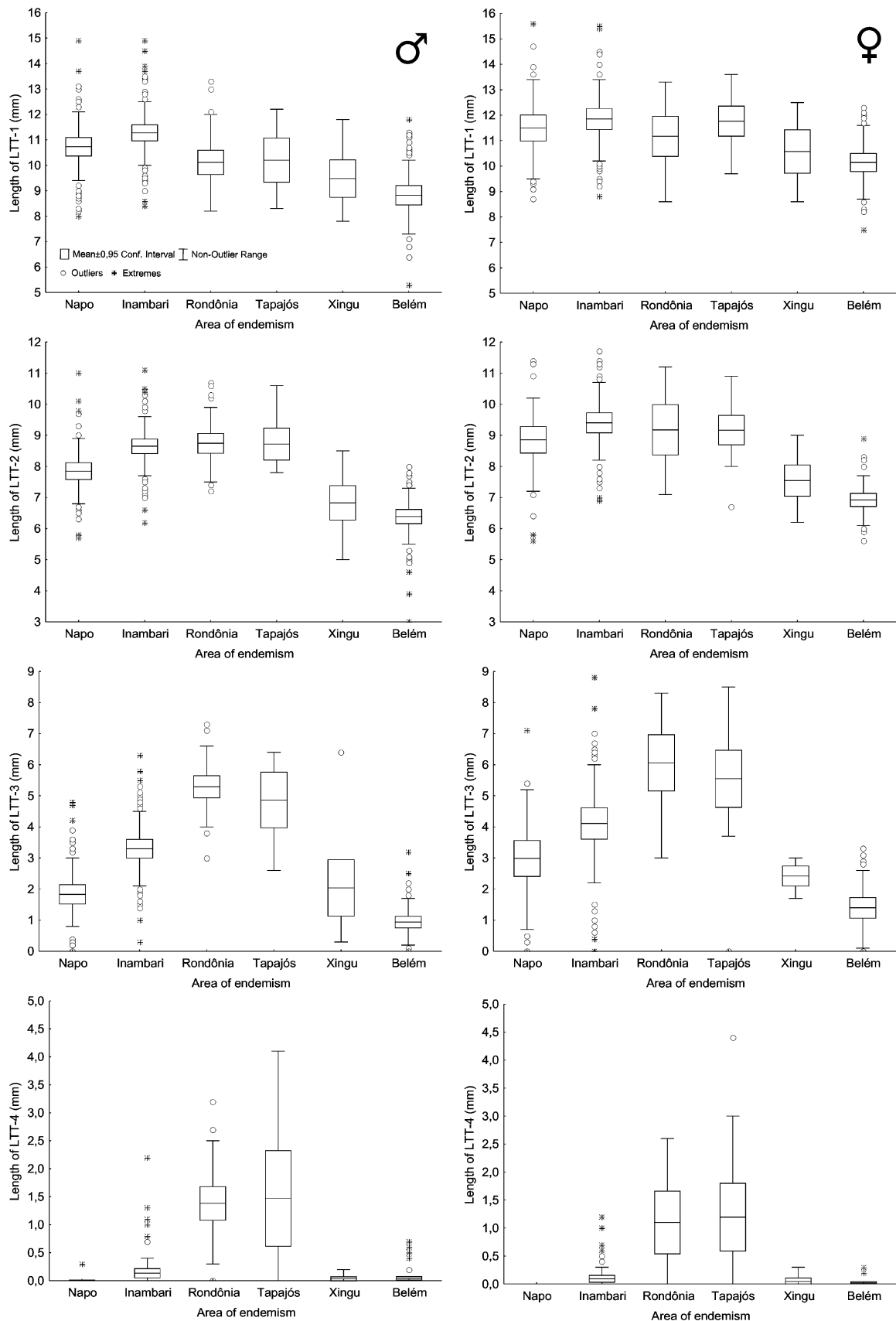


FIGURE 4. Box plot comparisons of the length of the light tip of the four outer rectrices (LTT-1 to LTT-4) among specimens of *Campylopterus largipennis aequatorialis* and *C. l. obscurus* found in each of the major Amazonian areas of endemism. Sample sizes are: Napo (61♂, 38♀), Inambari (71♂, 56♀), Rondônia (35♂, 13♀), Tapajós (11♂, 18♀), Xingu (14♂, 11♀), and Belém (58♂, 43♀).

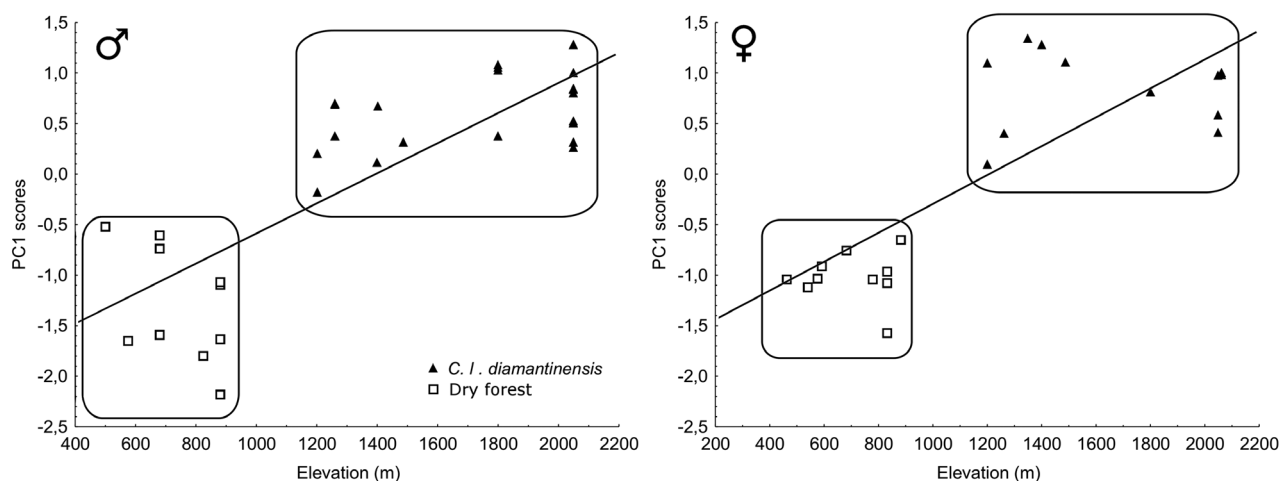


FIGURE 5. Correlation between elevation of the collection site and PC1 values for *Campylopterus largipennis diamantinensis* (specimens collected in high altitude “campos rupestres”) and specimens collected in dry forest at lower elevations.

TABLE 5. Spearman’s rank correlation between the elevation of the collection site (in meters above sea level) and PC1 values of specimens of *Campylopterus largipennis* examined in this study. No correlation was significant at $p < 0.05$.

Taxon and area of endemism	Elevational range (m)	♂	♀
<i>C. l. largipennis</i> —Guiana	0–1070	n = 97, R = 0.113, $P = 0.27$	n = 71, R = -0.094, $P = 0.44$
<i>C. l. aequatorialis</i> —Napo	80–1500	n = 49, R = 0.173, $P = 0.23$	n = 35, R = -0.010, $P = 0.95$
<i>C. l. aequatorialis</i> —Inambari	100–1300	n = 66, R = -0.017, $P = 0.89$	n = 54, R = 0.233, $P = 0.09$
<i>C. l. diamantinensis</i> —Espinhaço	1200–2050	n = 21, R = 0.419, $P = 0.06$	n = 12, R = 0.010, $P = 0.97$
Dry forests	500–880	n = 10, R = -0.424, $P = 0.22$	n = 10, R = 0.227, $P = 0.53$

TABLE 6. Morphometric analysis of selected skeleton measurements (mm) of members of the *Campylopterus largipennis* complex collected in eastern Brazil, showing statistical comparisons among taxa and sexes.

Variable	Sex	<i>C. l. diamantinensis</i>				Dry forests			
		Mean	SD	Min–Max	n	Mean	SD	Min–Max	n
Sternum length	♂	22.3	0.23	21.9–22.7	8	20.3	0.21	19.9–20.4	5
	♀	19.5	0.20	19.3–19.7	4	17.8	0.34	17.3–18.2	6
Keel length	♂	24.5	0.37	24.0–25.1	8	22.6	0.36	22.0–22.8	5
	♀	20.0	0.24	19.7–20.3	4	18.9	0.55	18.0–19.5	6
Sternum width	♂	7.3	0.14	7.1–7.5	8	6.9	0.18	6.6–7.0	5
	♀	6.5	0.15	6.3–6.6	5	6.0	0.19	5.8–6.3	7
Keel depth	♂	14.1	0.18	13.7–14.3	8	12.8	0.23	12.5–13.1	5
	♀	12.0	0.15	11.8–12.3	5	10.5	1.16	7.9–11.4	7

Given the small sample size, we did not perform any statistical test for skeleton data.

We found no consistent pattern of variation in the color of belly, back or central pair of rectrices of the three Amazonian subspecies. These three characters, alone or in combination, are not diagnostic of the currently recognized subspecies, especially because individual variation is large, with substantial overlap among subspecies. In general, freshly collected specimens of the Amazonian subspecies have the belly grey (2.5Y 6/1), with a slight change in hue as the material gets older (reaching 10YR 6/1 in specimens older than 60–80 years and even 10YR 6/2 in some specimens).

Although we did not examine the holotype of *C. l. maronicus*, four topotypes (MNHN 3572, 3573; AMNH

479302, 479303) showed no plumage feature that distinguishes them from topotypes of *C. l. largipennis* (the two specimens housed in AMNH are labelled as “Marowijne river”, another name for the Maroni River). We also did not find noteworthy differences in bill length between specimens collected in the Maroni River and those from other localities. Bill length of the four topotypes of *C. l. maronicus* perfectly agrees with values obtained for the nominotypical subspecies. We observed that 85% of the males (n = 38) and 50% of the females (n = 29) of the nominotypical subspecies had the bill longer than that given in the original description of *C. l. maronicus*, demonstrating that bills of this alleged subspecies are not particularly long.

Specimens from eastern Brazil have the upperparts and the central rectrices slightly more golden than Amazonian specimens (Figure 6). The belly of eastern Brazilian specimens is also slightly lighter, being light grey (2.5Y 7/1). Nevertheless, differences in these characters are subtle, and cannot be considered diagnostic given the individual variation observed in this complex.



FIGURE 6. Under right side of tail showing coloration pattern in taxa of the *Campylopterus largipennis* complex. Illustration composed of photographs of several museum specimens collected in the following areas of endemism: *C. l. obscurus* (Belém), *C. l. aequatorialis* (Napo), *C. l. largipennis* (Guiana), *C. l. diamantinensis* (Central Brazilian hills and tablelands) and “Dry forest” specimens (deciduous forests of Minas Gerais and Goiás). Photographs by LEL.

The color of the LTTs of *C. l. largipennis*, *C. l. diamantinensis* and the dry forest specimens is pure white, without any significant variation (Figure 6). On the other hand, *C. l. obscurus* and *C. l. aequatorialis* show much individual variation in this character, which apparently is not related to age or sex. Geographic variation in this character is also large and seems to follow a clinal pattern. In spite of individual variation, specimens of *C. l. aequatorialis* from Napo have predominantly whitish LTTs (10YR 8/1 or 2.5Y 8/1) (Figure 6). Specimens from Inambari (especially from central Bolivia) show LTTs predominantly light grey (10YR 7/1), with some specimens presenting them whitish (10YR 8/1), the same pattern observed in specimens of *C. l. obscurus* from the Rondônia and Tapajós areas of endemism. Specimens from the Xingu area of endemism have LTTs light grey (10YR 7/1) or whitish (10YR 8/1) approximately in equal proportion. Specimens of *C. l. obscurus* from the Belém area of endemism have LTTs predominantly light grey (10YR 7/1), with some grey (10YR 6/1). Therefore, the pattern of coloration of LTTs is not diagnostic between *C. l. obscurus* and *C. l. aequatorialis*, at least not as these subspecies are currently delimited.

Color of the basal portion of the rectrices proved to be a constant and diagnostic character of some subspecies.

The basal portion, especially the inner vane, of the three outer rectrices of *C. l. obscurus* and *C. l. aequatorialis*, is almost entirely bright bluish-black (Figure 6). The base of the outer vane of the three outer rectrices is generally washed green. In *C. l. largipennis*, the basal portion of the outer vane of the outer rectrices is generally dark olive grey (5Y 3/2). On the other hand, *C. l. diamantinensis* and the dry forest specimens have the three outer rectrices with a bright bronzy green base, followed by a dark olive grey (5Y 3/2) band, sometimes with sparse reflections of bright bluish black, especially in the inner vanes, preceding the white tail tips (Figure 6). Another diagnostic character of *C. l. diamantinensis* and the dry forest specimens is the color of the sub-central pair of rectrices, which are almost completely bright bronzy green, with only a small terminal stain dark olive grey (5Y 3/2) or bright bluish black. In some specimens, the sub-central pair of rectrices lacks the terminal stain. In *C. l. largipennis*, *C. l. obscurus*, and *C. l. aequatorialis*, the terminal portion and about half of the inner vane of the sub-central pair is bright bluish black or dark olive grey (5Y 3/2) (Figure 6).

Given the evidence presented in this paper, which includes a large sample of museum specimens, extensive field observations on habitat preferences, and discovery of areas of parapatry without evidence of interbreeding, we conclude that the hummingbirds collected in eastern Brazilian dry forests represent an undescribed species. The allocation of this new species in *Campylopterus* (which is paraphyletic according to McGuire *et al.* 2014) is justified by its high morphological similarity and probably close relationship with *C. largipennis*, and to the fact that *Trochilus largipennis* Boddaert, 1783, is the type species of the nominal genus *Campylopterus* Swainson (Gray 1841). We propose to name this new species:

***Campylopterus calcirupicola* sp. nov.**

Dry-forest Sabrewing (English)

Asa-de-sabre-da-mata-seca (Portuguese)

Holotype. MZUSP 99024: adult female (bill not corrugated) from Sítio Duboca (16°43'19"S, 43°58'20"W, elevation 840 m), municipality of Montes Claros, state of Minas Gerais, Brazil, collected on June 6, 2007, by L.E.L., M.F.V. and S. D'Angelo Neto, prepared as a study skin and partial skeleton by M.F.V. Skeleton (MCNA 1753) and tissue samples (B03899) were also preserved.

Paratypes. MZUSP 99025: adult male (skeleton MCNA 1755, tissue B03896). DZUFMG 5730: adult female (skeleton MCNA 1752, tissue B03898). MCNA 1754: young female (same number for skeleton, tissue B03897). All specimens collected in the same locality and date of holotype and prepared as study skins and partial skeletons by M.F.V. The remaining specimens examined (Appendix) are not part of the type series.

Diagnosis. *Campylopterus calcirupicola* (Figures 7 and 8) differs from *C. l. obscurus* and from *C. l. aequatorialis* by its smaller size; basal half of outer rectrices bright bronze green, instead of bright bluish black; LTTs long and white, instead of greyish. It differs from *C. l. largipennis* by its smaller size; bases of outer rectrices bright bronze green instead of bright bluish black; and LTTs proportionally longer (Figure 6). It differs from *C. l. diamantinensis* by its smaller size and LTTs proportionally longer. A practical rule of thumb for separating these two taxa is to divide the sum of the length of LTT-2 and LTT-3 by the length of wing. Values below 0.44 indicate *C. l. diamantinensis*, whereas values above this indicate *C. calcirupicola* (see below an identification key for the species in this complex). Another character that might help in the identification of *C. calcirupicola* is the shape of the rectrices, which are narrower and more pointed than in *C. l. diamantinensis*, but given that this character varies with age (see below), a thorough evaluation of it in light of larger samples is necessary.

Description of holotype. Bill long and slightly decurved; all of upperparts, upper and lower wing coverts bright bronze green, with the pileum darker with coppery reflections; post-ocular white spot; remiges bluish black (5PB 2.5/1) with a metallic shine; underparts uniform light grey (2.5Y 7/1) except abdomen whitish (2.5Y 8/1); undertail coverts light grey (2.5Y 7/1); tail rounded, with 10 rectrices, the central pair being bright bronze green, the same color shown in the sub-central pair, which has a small terminal spot dark olive grey, three pairs of lateral rectrices with the base bright bronze green, with a narrow dark olive grey (5Y 3/2) band, especially in the inner vanes, preceding the white tip of these rectrices, which corresponds to 49% of the length of outermost rectrices, 44% of the length of the second outermost rectrices and 27% of the length of the third outermost rectrices. Bare-part colors in life: iris dark brown; maxilla black; mandible greyish red with black tip; tarsus, toes and nails black.

Measurements of holotype. Total length 139 mm; culmen 29.4 mm; wing 66.5 mm; tail 45.9 mm (LTTs of the three outer rectrices, from outside: 22.4, 20.3 and 12.5 mm); weight 6.1 g.



FIGURE 7. The newly described *Campylopterus calcirupicola* (Dry-forest Sabrewing) from eastern Brazilian tropical dry forests. From an original watercolor painting by Walter Gam.

Etymology. The name *calcirupicola* is Latin, composed by “calx”, calcis, limestone; “rupes”, steep rocks; and “cola”, dwelling (Egglı & Newton 2004). It refers to the habitat of this new hummingbird, which inhabits dry forests growing on limestone outcrops. This specific name matches that for the cactus *Cereus calcirupicola* F. Ritter, found in the type locality and in the same habitat (Ritter 1979) of the new hummingbird. The vernacular names we propose also refer to the habitat used by the new species.



FIGURE 8. Two views of a young male of *Campylopterus calcirupicola* captured on 18 July 2006 in the Fazenda Corredor (880 m asl), municipality of Bocaiúva, Minas Gerais, Brazil (DZUFMG 5005). Photographs by LEL.

Sexual dimorphism and variation among paratypes and non-type material. Sexes are alike, but males in definitive plumage have the shafts of the three outer primaries, which lack part of the outer vane, broad and flattened, and strongly bent distally; and bill slightly shorter and straighter than that of female (Figure 1). Young males, which can be separated from definitive plumage birds by the corrugated rather than smooth bill texture as in adults (Ortiz-Crespo 1972), do not have broad shafts of the outer primaries. Individual variation in plumage is small and apparently unrelated to sex, age or geographic distribution. Individual variation is shown in the intensity of the coppery reflections in the head and the color of upperparts, which appears more golden in some specimens and more bluish in others. In many specimens it is possible to observe a small invasion of bright bluish black in the area dominated by the dark olive grey in the tail feathers. Young birds have somewhat more pointed and narrower rectrices than adult birds, a feature already described for members of the *C. aequatorialis/obscurus* complex (Naumburg 1930). Table 1 presents descriptive measurements of this taxon, in comparison to other members of the complex.

Geographic distribution. *Campylopterus calcirupicola* has been recorded from Divinópolis de Goiás (northeastern state of Goiás) and Coribe (southwestern state of Bahia) to Bocaiúva (northern state of Minas Gerais) on both banks of the São Francisco River, as well as in the Paranã River valley, an important tributary of the Tocantins River, west of the Serra Geral (Figures 9 and 10). The altitudinal range of this new species is between 460–880 m asl. The range of *C. calcirupicola* probably extends to southeastern Tocantins (Dornas *et al.* 2014) and the southern part of the state of Piauí (Santos 2004), from where there are sight records of *C. largipennis*. We believe that the specimen of *C. largipennis* from “Posse, Goiás” cited by Silva (1990) as housed in the MNRJ refers to the specimen from “Galheiros” housed in the same institution and mentioned by Ruschi (1951), probably representing a toponymic mistake committed by Silva (1990).

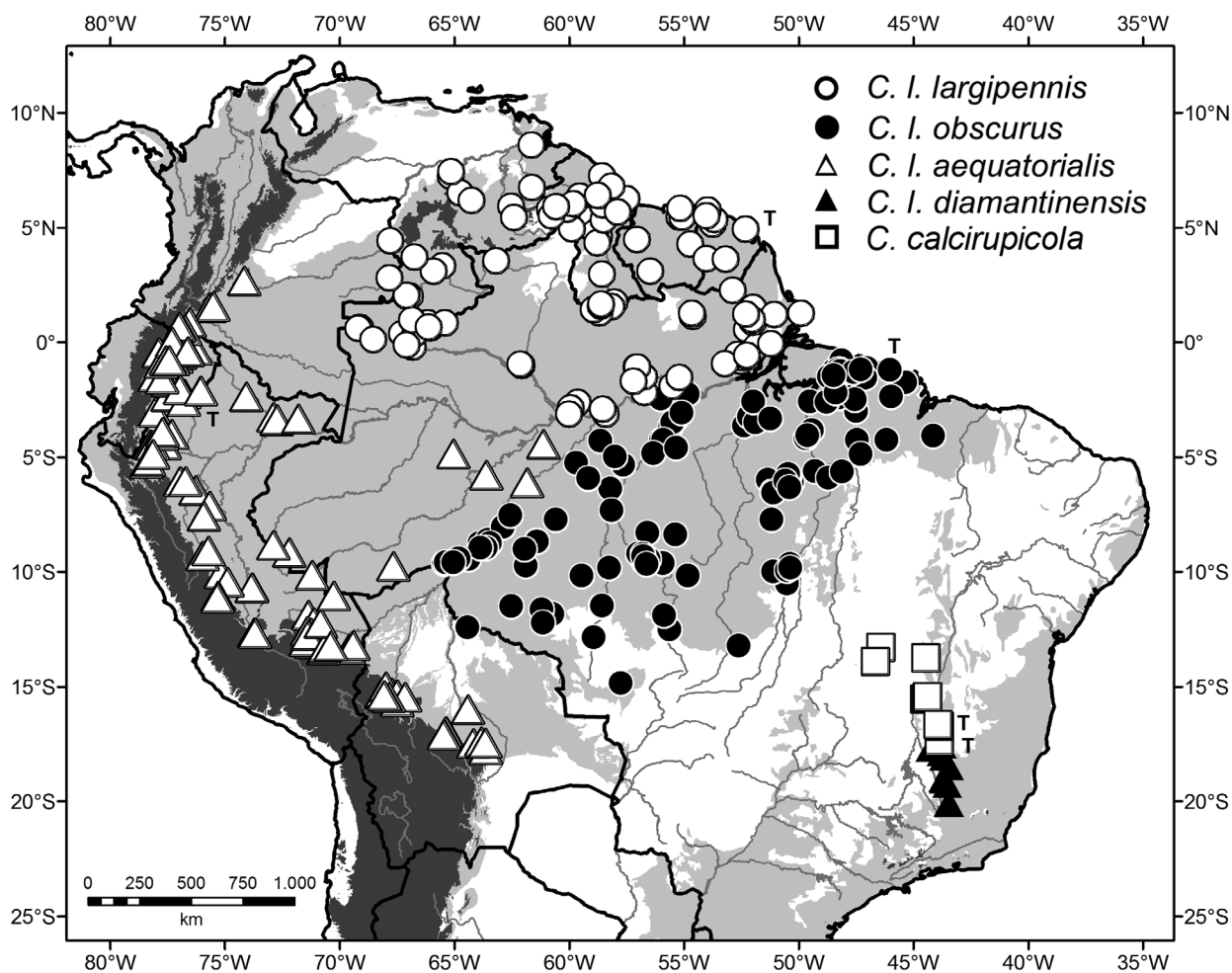


FIGURE 9. Geographic distribution of the examined specimens of the *Campylopterus largipennis* complex. Light grey areas are covered by forests (Olson *et al.* 2001). Dark grey areas indicate elevations above 1,500 m asl. Letters “T” indicate type localities.

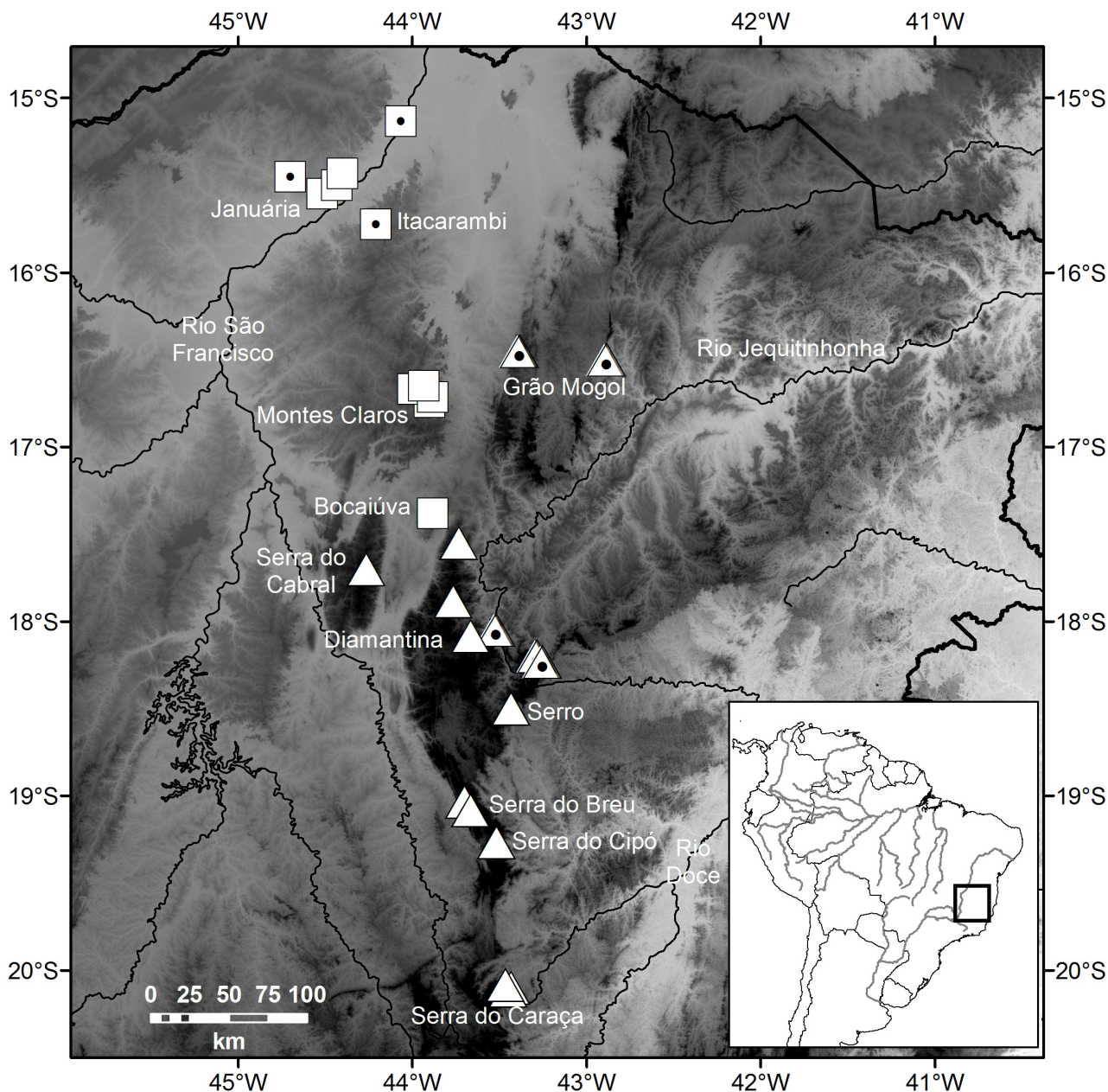


FIGURE 10. Detailed geographic distribution of *Campylopterus calcirupicola* (squares) and *C. diamantinensis* (triangles) in the state of Minas Gerais, eastern Brazil. In addition to the specimens examined, sight records are indicated by a dot inside the symbol. Higher altitudes are indicated by darker grey shading.

Habitat and behavior. *Campylopterus calcirupicola* is a resident of dry forests on limestone rocky outcrops or on limestone-derived soils (Figure 11). The diet of the species is poorly known, but it was recorded (M.F.V. and S. D'Angelo Neto, pers. obs.) visiting flowers of native and exotic species belonging to the following taxa: Acanthaceae (*Justicia* sp.); Bignoniaceae (*Spathodea campanulata*); Bromeliaceae (unidentified terrestrial species); Caricaceae (*Carica papaya*); Fabaceae (*Camptosema* sp., *Delonix regia*, *Inga laurina*); Lamiaceae (*Salvia* sp.) and Malvaceae (*Malvaviscus arboreus*). Only 50% of males ($n = 10$) have the shafts of the outer primaries broad, with a mean width of 2.5 mm ($n = 5$). Males with normal shafts can also be reproductively active, as demonstrated by the enlarged testes of some collected specimens. Its breeding biology is unknown, and its nest has not yet been described. Breeding season can be inferred from the gonads of collected specimens (deposited in DZUFMG and in MPEG). Males with enlarged testes (> 2.5 mm) were collected on 13 May, 19 July and 27 September. Females with a well-developed brood patch (DZUFMG) were collected on 24 June and 21 December, suggesting an extended breeding season.



FIGURE 11. The typical habitat of *Campylopterus calcirupicola*. Dry forest growing on limestone outcrop during the wet (left, late December) and dry (right, early October) seasons. Photographs taken in the municipality of Januária, Minas Gerais, Brazil, by LEL.

Geographic distribution of members of the *Campylopterus largipennis* complex. Members of the *C. largipennis* complex are widely distributed across the entire Amazon region and seem to come into contact in some isolated parts of their range (Figure 9). The range of *C. l. largipennis* is centered in the Guianan shield, north of the Amazon river, extending westward to both banks of the Uaupés River (e.g., AMNH 434093–434099; three unnumbered NRM specimens from “Taraquá, Rio Uaupés”), in the headwaters of the Negro River, which demonstrates that this river does not represent a geographical barrier for the taxon. This subspecies is found mainly below 600 m, but can be found locally to ~1300 m in isolated tepuis. No zone of sympatry is known between *C. l. largipennis* and *C. l. aequatorialis*, which was collected in “Río Duda, Mt Macarena” (AMNH 460155–460158), ~600 km to the northwest, the nearest locality from where we examined specimens of this taxon.

There is an alleged specimen collected by Natterer in August at Ypanema” (von Pelzeln 1868–1870), an old iron mill in the state of São Paulo, located at 23°26’S 47°36’W, c. 600 m asl (Vanzolini 1993). This record, although considered doubtful by Ihering (1898), was later accepted by the same author (Ihering & Ihering 1907). It is noteworthy that, to our knowledge, this record was not cited in the literature during the last one hundred years, even in compilations and checklists of the São Paulo avifauna (e.g. Willis & Oniki 2003; Silveira & Uezu 2011). We visited the Naturhistorisches Museum, Vienna, Austria, where this specimen was supposed to be housed, but failed to locate it there, and we did not find it in more than a dozen museums which could have received it in exchange (see Methods). Therefore, we suggest that the “Ypanema” record may have originated from a typographic error.

Campylopterus l. aequatorialis is a western Amazonian taxon with a strong foothill component, being frequently found in pre-Andean forests up to ~1600 m. *Campylopterus l. obscurus* is a southern Amazonian taxon,

restricted to lowlands. Both reach the headwaters of some of the tributaries of the Madeira, Tapajós, Xingu and Tocantins rivers, in transitional areas between the Amazonian forests and savannahs, where rivers are relatively narrow and apparently do not act as barriers for these taxa (Figure 9). The likely contact between these taxa was predictable, because this is not a true humid lowland forest species, being often found in riverine forests and borders. The seeming absence of members of this complex from much of lowland western and central Amazonia (Figure 9) deserves further investigation, because it may be due to poor sampling.

Populations from eastern Brazil are isolated from Amazonian taxa by almost 600 km (Figure 9) of predominantly non-forested habitats across central Brazil. *Campylopterus l. diamantinensis* and *C. calcirupicola* occur in parapatry, living in very distinctive habitats (compare Figures 11 and 12), with the nearest known records of both being only 25 km apart (Figure 10), without any evidence of hybridization between these populations.



FIGURE 12. The typical habitat of *Campylopterus diamantinensis*. Clockwise, from upper left: Serra do Breu (dry season), Parque Nacional das Sempre Vivas (wet season), and two pictures from Serra do Cipó (wet season). All photographs taken in Minas Gerais, Brazil, by Guilherme H.S. Freitas.

Discussion

On the invalidity of *C. l. maronicus*. As noted by previous authors (e.g. Berlioz 1931; Todd 1942), *C. l. maronicus* is not a diagnosable taxon. Simon (1921, p. 29), after listing the various “diagnostic” characters of this subspecies, mentioned, in a footnote, that only the longer bill was a constant feature, with specimens of *C. l. largipennis* from Suriname showing a tail pattern similar to that of *C. l. maronicus*. However, with a good series at hand, we verified the existence of specimens from many localities across the range of the nominotypical subspecies that have the bill length equal to or longer than that exhibited by *C. l. maronicus*. This has been noted by other authors, who considered this taxon unsustainable because the bill length is an inaccurate diagnostic character in this species,

showing large individual variation (Berlioz 1931; Todd 1942). Moreover, the Maroni River discharges into the ocean just 200 km from Cayenne, the admitted type locality of *C. l. largipennis*. Since both sites are in the coastal plain, where *C. largipennis* is a common and ubiquitous hummingbird (Thiollay 2002) in a matrix of continuous lowland rainforest (Tostain *et al.* 1992), the recognition of two distinct subspecies in French Guyana lacks biogeographical support.

Taxonomic limits and species concepts. The rationale for considering *C. calcirupicola* as an independent species is based on Helbig *et al.* (2002), who, although not explicitly adopting any species concept, based their guidelines for assigning species rank largely on the GLCS (Parkin *et al.* 2006). According to these guidelines, “diagnosable taxa that are strictly parapatric (...) and do not hybridize (...) [i.e. *diamantinensis* and *calcirupicola*] will be ranked as species, because it appears unlikely that such a situation can be maintained without intrinsic reproductive isolation”. This rationale also applies to the PSC.

Most followers of the BSC might argue that *C. calcirupicola* is best considered a subspecies of *C. diamantinensis*, or even that these two taxa should be lumped with *C. largipennis*. Nevertheless, the parapatric distribution without evidence of free gene flow between *C. calcirupicola* and *C. diamantinensis* is *prima facie* evidence for species rank also under the BSC (Remsen 2015). Furthermore, the burden of proof should be placed on those claiming “lumping” rather than on “splitting” taxa at the species level (Gill 2014).

Data presented here also demonstrate that the current taxonomic arrangement of the *C. largipennis* complex requires further changes. Specimens with the typical features of *C. l. obscurus* (short and greyish LTTs) occur at the extreme eastern portion of the range of this complex, while specimens with the typical features of *C. l. aequatorialis* (long and whitish LTTs) occur at the extreme western portion. Birds with intermediate features can be found in intervening areas, making it impossible to establish a clear-cut limit between *C. l. obscurus* and *C. l. aequatorialis* based on plumage characters and morphometric data. In spite of the apparent existence of an east to west linear cline in the color of LTTs, a smooth linear cline in the length of LTTs proved to be misleading, which is complicated by the large individual variation observed.

Difficulties in establishing the boundaries between *C. l. obscurus* and *C. l. aequatorialis* are widely documented in the literature. Just before describing *C. aequatorialis*, Gould (1861b) noted the existence of differences between specimens from Pará and Ecuador, but questioned whether to treat both as distinct taxa (note that the holotype of *C. obscurus* presents the shortest LTTs of all specimens measured by us, being an outlier). Subsequent authors considered *C. aequatorialis* a junior synonym of *C. obscurus* (Elliot 1878; Salvin & Hartert 1892). Nevertheless, Hellmayr (1906) recognized slight differences between these taxa, proposing again to treat them as subspecies. Later, Hellmayr and others raised doubts about the correct identification of some specimens: 1) Hellmayr (1910), after studying specimens from the Madeira River, was the first to point out specimens with intermediate features between *C. l. obscurus* and *C. l. aequatorialis*; 2) Simon (1921) pointed out that specimens from the Madeira River presented length of LTTs typical of *C. l. aequatorialis*, but the greyish color of these LTTs approached that of *C. l. obscurus*. Simon (1921) also reported two specimens of *C. l. obscurus* from Miritiba, Maranhão, which had longer LTTs, tending toward the condition in *C. l. aequatorialis*. These specimens were later examined by Hellmayr (1929), who stated that they “agree with others from Pará, but have the greyish tips to the lateral rectrices on average slightly more extended”, considering them as extremes of variation of *C. l. obscurus*; 3) Griscom and Greenway (1941) commented on the variation in plumage pattern of specimens from the Purus and Tapajós rivers, noting intermediate features between *C. l. aequatorialis* and *C. l. obscurus*; 4) Zimmer (1950), in a revision of the complex with copious material available, also considered those specimens from the Madeira River as having intermediate features between *C. l. aequatorialis* and *C. l. obscurus*. This author concluded that none of the proposed diagnostic characters, such as the color of the dorsal surface of the tail, or the length and hue of LTTs, would be sufficient to diagnose these taxa; 5) Niethammer (1953) also noted large individual variation in the color of LTTs in specimens from Bolivia, ranging from greyish white to sooty grey. Therefore, given that *C. l. aequatorialis* and *C. l. obscurus* cannot be distinguished from each other, at least not with the techniques employed here, we propose to consider *Campylopterus aequatorialis* Gould, 1861, as a junior subjective synonym of *Campylopterus obscurus* Gould, 1848. This taxonomic arrangement is provisional until the significant, but not yet fully understood, morphological variation observed in *C. l. obscurus* has been cleared up.

Uncertainties about the taxonomic limits between *C. l. obscurus* and *C. l. aequatorialis* has been repeatedly interpreted as evidence of introgression between them (Simon 1921; Hellmayr 1929; Berlioz 1931; Zimmer 1950). These uncertainties were improperly used to support lumping all taxa of the *C. largipennis* complex in a single,

polytypic species. However, there is no evidence of hybridization between members of the group with long and white LTTs (*C. l. largipennis*, *C. l. diamantinensis* and *C. calcirupicola*) and the group with short and greyish LTTs (*C. l. obscurus* and *C. l. aequatorialis*) (see McCarthy 2006). Although members of these two groups are not known to come into contact anywhere, a search for *Campylopterus* specimens in the database of Project Biomap (<http://www.biomap.net>), which has gathered and digitized data on Colombian bird specimens from 86 collections across the world, revealed two records that suggest that *C. l. largipennis* and *C. l. aequatorialis* possibly come into contact somewhere in eastern Colombia, in the departments of Guaviare or Vaupés. The occurrence of *C. l. largipennis* in the right bank of the Negro River was confirmed by a specimen collected in “Comunidad Teresita, Río Papuri, Vaupés” and deposited in the Instituto de Ciencias Naturales de la Universidad Nacional, Bogotá (ICN 35106). This same collection also houses one specimen of *C. l. aequatorialis* (ICN 35096) collected in “La Pedrera, Vda. San Pablo, costado norte del río Caquetá, Amazonas”. Although these two records are separated by ~200 km, the intervening area is covered by continuous forests, harboring no large river or landmark barrier more than 200 m above sea level, which suggests that *C. l. largipennis* and *C. l. aequatorialis* might be parapatric taxa. Nevertheless, the hypothesis of parapatry between these two taxa can only be tested after further surveys in this poorly sampled region of Colombia (see map of collecting sites in Paynter 1997).

Given the evidence presented above, we propose that not only *C. calcirupicola*, but also *C. l. diamantinensis* and *C. l. obscurus*, should be considered as independent species. The following morphological, ecological and biogeographical evidences support this proposition: 1) the lack of hybridization between *C. l. largipennis* and *C. l. aequatorialis*, even though there is no absolute barrier separating them (and they may be parapatric); 2) the important chromatic differences in the tail patterns between members of the group showing long and white LTTs and members of the group showing short and greyish LTTs; and 3) the well-marked ecological differences between Amazonian taxa and *C. l. diamantinensis*, which is fully diagnosable on morphological basis.

Summarizing the taxonomic propositions presented here, the *C. largipennis* complex is best considered as composed of four species: *C. largipennis* (lowland humid forests north of the Amazon river, from the Negro River region eastward), *C. obscurus* (lowland humid forests and pre-Andean forests in the southern bank of the Amazon river, from Belém to Napo areas of endemism), *C. diamantinensis* (“campos rupestres” in the Espinhaço range) and *C. calcirupicola* (dry forests of central-eastern Brazil).

The following key will assist in the identification of the species included in the *C. largipennis* complex. This key works well with adult and young birds, irrespective of the sex of the specimen.

Key to the species of the *Campylopterus largipennis* complex

- 1 Light tail tips (LTTs) greyish and short (sum of the length of the LTTs of the three outermost rectrices is ≤ 34 mm) *C. obscurus*
- 1' LTTs pure white and long (sum of the length of the LTTs of the three outermost rectrices is ≥ 42 mm) 2
- 2 Basal half of outer rectrices bright bluish black *C. largipennis*
- 2' Basal half of outer rectrices bright bronze green 3
- 3 Larger (body weight generally above 7.5 g); LTTs proportionally shorter (sum of the length of LTT-2 [from outside] and LTT-3 $< 44\%$ wing length); rectrices usually broader and less pointed *C. diamantinensis*
- 3' Smaller (body weight generally below 7.5 g); LTTs proportionally longer (sum of the length of LTT-2 [from outside] and LTT-3 $> 44\%$ wing length); rectrices usually narrower and more pointed *C. calcirupicola*

Conservation status of members of the *C. largipennis* complex. A quarter of century ago, Janzen (1988) stated that tropical dry forest was the most endangered major tropical forest type at that time. Today, the conservation of tropical dry forests remains neglected worldwide (Pennington *et al.* 2006), indicating that it should be accorded high conservation priority (Miles *et al.* 2006). Nevertheless, dry forests are not a conservation priority in Brazil, and in the valleys of the Paranã and São Francisco rivers the destruction of these forests by wildfires, charcoal production, timber extraction, and conversion to pasture and crops occurs at alarming rates (Olmos *et al.* 1997; Silva & Bates 2002; Lopes *et al.* 2008; Coelho *et al.* 2014). Furthermore, limestone mining, which destroys the outcrops and the deciduous forest over them, is also a common threat to the habitat of the new species (Lopes *et al.* 2008; Espírito-Santo *et al.* 2009; Coelho *et al.* 2014). All those threats led Espírito-Santo *et al.* (2009) to consider the Tropical Dry Forests as the most threatened ecosystem in Brazil. It is relevant to note that, in addition to *C. calcirupicola*, the “deciduous forests of Minas Gerais and Goiás” is an endemic bird area (Stattersfield *et al.*

1998) that harbors other little known and restricted range birds, such as *Pyrrhura pfrimeri* (Olmos *et al.* 1997), *Phylloscartes roquettei* (Lopes *et al.* 2008), and *Knipolegus franciscanus* (Silva & Oren 1992).

Campylopterus calcirupicola is usually recorded in well-preserved forests and old second growth, but was occasionally observed visiting exotic flowers in a garden adjacent to limestone outcrops covered by dry forests, in a farm near the city of Montes Claros. It is known to occur in only two conservation units: the Cavernas do Peruaçu National Park (56,800 ha) and the recently created Lapa Grande State Park (7,000 ha), which now encompasses the type locality of this species. However, neither of these parks provides effective protection for their biota.

We have no data on population size and trends for *C. calcirupicola*, which makes it difficult to evaluate its conservation status. According to IUCN (2014) “precise information on scarce taxa is usually lacking, and although the criteria are highly quantitative and defined, one can use projections, assumptions and inferences (...) in order to place a taxon in the appropriate category”. Furthermore, IUCN (2014) also state that “since Data Deficient is not a category of threat, taxa placed in this category may not be so obviously targets for conservation action (...). Assessors should use whatever information is available and relevant to make assessments and place taxa into the Data Deficient category only when there is really no alternative.”

Campylopterus calcirupicola is uncommon to locally fairly common, with a patchy distribution across eastern Brazil. Indirect evidence suggests that this species has undergone significant population reduction in the near past and that this decline will continue in the near future due to decline in area of occupancy and habitat quality. For example, 11.5% of the dry forests of northern Minas Gerais were lost between 1986 and 2006 (Espírito-Santo *et al.* 2014), and the dry forests of the Paranã River basin suffered a 66.3% decrease in extent between 1977 and 2008 (Bianchi & Haig 2012). Therefore, given the several threats faced by the habitat to which *C. calcirupicola* is endemic, we propose considering this species as Vulnerable under the A4 criterion (IUCN 2014). We suggest searching for the species in areas of potentially suitable habitat in Goiás, Minas Gerais, and Bahia, and an increase in the size and number of protected areas with suitable habitat is also strongly encouraged.

Campylopterus diamantinensis occurs in several relatively large conservation units and its habitat is not subject to major direct human disturbance (Vasconcelos *et al.* 2008; Vasconcelos & Rodrigues 2010). Nevertheless, the species is restricted to the highest summits of the Espinhaço Range, and a serious threat to it results from the forecasted climatic changes. Marini *et al.* (2009) estimated that the range of this species will contract ~75% in the near future (2045–2060) on a scenario without dispersal. Therefore, we propose considering it as Endangered under the A3 criterion (IUCN 2014).

The two Amazonian species (*C. largipennis* and *C. obscurus*) are common throughout their extremely wide geographic ranges, being frequently found in secondary and fragmented habitats. They are also found in virtually all conservation units across their ranges. Therefore, they can be considered Least Concern species.

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APPENDIX 1. Specimens of the *Campylopterus largipennis* complex examined.

Small orthographical errors were corrected in the name of many localities visited by earlier foreigner naturalists, unfamiliar with Portuguese, Spanish or indigenous names. See acknowledgments for institutional acronyms.

Campylopterus largipennis

UNSPECIFIED COUNTRY: Unspecified locality (1♂—ANSP 23316; 1♀—NRM not numbered; 7 unsexed—ANSP 23314; BMNH 1869.6.4.48, 1922.3.5.4680; SMF 85527; ZMB 8859, 8867, 2000/27030). **FRENCH GUYANA:** Unspecified locality (1♂—MNHN 3.1986; 1♀—ANSP 74091); Cayenne (14♂—AMNH 37160, 46266, 233748; CM 57016, 56939; MNHN 1818.1963, 1819.1963, 2012.78 [**Holotype of *Trochilus largipennis***]; NMW 2084; NRM not numbered; SMF 85359, 85360; USNM 24545; ZMB 8861; 3♀—NMW 2085, 2086; AMNH 37159; 4 unsexed—AMNH 479304; ANSP 48250; BMNH 1887.3.14.45, 1887.3.22.210); Maripasoula (2♂—MNHN 810.1963, 821.1963 ; 1♀—MNHN 822.1963); Maroni [River] (1♂—MNHN 3573; 1 unsexed—MNHN 3572 [**Topotypes of *Campylopterus largipennis maronicus***]); Petit Saut (10♂—AMNH 233746; CM 64897, 65396, 65466, 67949, 67996, 68021, 68052, 68054, 68100; 11♀—AMNH 233747; CM

64783, 65058, 67797, 67859, 67948, 67976, 68033, 68053, 68055, 68089); Saint-Jean du Maroni (1♀—ZSM 1909.298); Saül (2♂—MNHN 1215.1975, 1216.1976); Tamanoir (2♂—CM 61501, 61544; 1♀—CM 62341); Trois Sauts (2♂—MNHN 901.1997, 906.1997; 7♀—MNHN 902.1997, 903.1997, 904.1997, 905.1997, 907.1997, 908.1997). **SURINAME:** MAROWIJNE: Marowijne River (2 unsexed—AMNH 479302, 479303 [**Topotypes of *Campylopterus largipennis maronicus***]). NICKERIE: Kaiserberg Airstrip, Zuid River (3♂—FMNH 260204–260206; 4♀—FMNH 260207, 260208, 260210, 260211; 1 unsexed—FMNH 260209). PARA: Pawakkla (1♂—CM 142582); Zanderij (1♀—AMNH 348525). PARAMARIBO: Paramaribo (1♂—SMF 85362; 2 unsexed—SMF 85361, 85363). SIPALIWINI: Bakhnis Gebergte, 77 km S Apura (1♂—LSUMZ 17841; 1♀—LSUMZ 178414); Lely Gebergte (1♂—LSUMZ 178329). **GUIANA:** Unspecified (5♂—ANSP 50441; MBML 648; MZUSP 2502, 5659; USNM 149594; 1♀—USNM 149595; 1 unsexed—BMNH 1887.3.14.44). DEMERARA-MAHAICA: Georgetown [= Demerara] (3♂—MNHN 2003.3572, SMF 85358, USNM 84155; 2♀—BMNH 1913.3.20.1027, 1913.3.20.1028). EAST BERBICE-CORENTYNE: Berbice (1 unsexed—BMNH 1888.7.25.116); Boundary Camp, Itabu Creek Head (2♂—FMNH 120089, 120090); Supenaam River (1♂—BMNH 1922.3.5.4674; 2 unsexed—BMNH 1922.3.5.1058, 1922.3.5.1059). EAST DEMERARA-WEST COAST BERBICE: 5 km N Rockstone, E bank Essequibo River (1 unsexed—ANSP 186571); Arawai River (2♂—BMNH 1922.3.5.4673, 1922.3.5.4678; 2 unsexed—BMNH, 1922.3.5.4671, 1922.3.5.4681); Moraballi Creek, Essequibo River (1♂—BMNH 1930.6.20.39); Ororo Marali Falls [= Great Falls] (1 unsexed—BMNH 1922.3.5.4672); Rockstone, Essequibo River (1♀—FMNH 108217; 1 unsexed—FMMH 108216). CUYUNI-MAZARUNI: Kalacun (1♂—AMNH 806206); Kamarang River: (8♂—BMNH 1913.3.20.112; SMF 85352–85356; ZSM 1903.6908, 1903.6909; 1 unsexed—BMNH 1913.3.20.113); Kamaria [Fall] (1♂—USNM 627123); Kartabu [Point] (2♀—AMNH 806205, 821471); Merume Mountains (2♀—AMNH 479301; SMF 85351). MAZARUNI-POTARO: Bartica Grove: (3♂—BMNH 1887.3.22.215, 1922.3.5.4676, 1922.3.5.4682; 2♀—BMNH 1887.3.22.216; MNHN 2003.3569; 2 unsexed—BMNH 1922.3.5.1060, 1922.3.5.4679). Kamakusa (8♂—AMNH 176821, 479299; BMNH 1887.3.22.214; FMNH 45738; MNHN 2003.3571; SMF 85357; USNM 149328; ZSM 1915.233; 2♀—AMNH 479300, 806204); Lower Mazaruni River (1♂—BMNH 1922.3.5.1057); Mazaruni River (1♂—FMNH 32281; 1♀—FMNH 32282); Merume Mountains (1♂—BMNH 1887.3.22.212, 1911.11.14.49; 1♀—BMNH 1887.3.22.213); River Attabrau (1♂—BMNH 1887.3.22.211). POTARO-SIPARUNI. Iwokrama Reserve, ca. 16 road mi SW Kurupukari (1♂—ANSP 187550); Iwokrama Reserve, ca. 3 road mi SW Kurupukari (1♀—ANSP 187551); Iwokrama Reserve, E bank Burro Burro river, ca.6 river mi S Siparuni River (1♂—ANSP 187552); Iwokrama Reserve, Iwokrama mountains, Central Gorge, 6 km from Iwokrama road (1♂—ANSP 187553); Kopinang River, 7 km SW Kopinang (1♂—LSUMZ 175350); Potaro Landing (1♂—AMNH 125329, 1♀—FMNH 125330); Tumatumari, Potaro River (1♀—AMNH 12533). UPPER DEMERARA-BERBICE: Bubulay Ranch, west bank of Berbice River (1♂—USNM 610154). UPPER TAKUTU-UPPER ESSEQUIBO: Gunn's Landing, W bank upper Essequibo River (1♀—USNM 62538); Sipu River (1♂—USNM 62512); Upper Essequibo River (1♂—USNM 625388); Upper Rowa River (1♀—USNM 63704); Waruma River, E bank, ca. 15 river km S Kako River (1♂—USNM 609127). WEST DEMERARA-ESSEQUIBO COAST: Dawa Compound, Tapakuma Impoundment (2♀—FMNH 372311, 372312); Ituribisi River (1 unsexed—BMNH 1922.3.5.4675); Warimia Creek (1 unsexed—BMNH 1922.3.5.4677). **VENEZUELA:** AMAZONAS: Cerro de la Neblina, Base Camp (1♂—FMNH 318740); Opposite El Merey, right bank Río Casiquiare (1♀—AMNH 431911); Raudal Yavariven (1♀—USNM 455279); Río Huaynia, junction with Casiquiare (1♂—AMNH 431912); Solano, left bank Río Casiquiare (1♂—AMNH 431910); SW Cerro de la Neblina (1♂—AMNH 816628; 1♀—AMNH 816627); [Río] Suapure (1♀—AMNH 479297). BOLÍVAR. Aprada-Tepui, Falda Norte (1♂—MBML 646); El Dorado (1♀—CM 33948; Mt. Auyán-tepui (4♂—AMNH 323350, 324312–324314; 1 unsexed—AMNH 323351); Río Nichare, tributary of Río Caura (1♀—AMNH 479298); Salto Pará, Río Caura (1♀—MBML 651); Upper Caura River (1♀—CM 32382). DELTA AMACURO: Sacupana (1♂—AMNH 132365; 1 unsexed—132366); Caño Seco, Monte Duida (1♂—AMNH 270494); Cerro Yapacana, Upper Orinoco (1♂—USNM 328619; 1♀—USNM 328618); Chapazón, right bank brazo Casiquiare (1♂—USNM 326798); Nericagua, Río Orinoco (7♂—AMNH 177152, 479291–479295; SMF 85365; 3♀—AMNH 177153, 479296; SMF 85364). **COLOMBIA:** VAUPÉS: Opposite Tahuapunto, right bank Río Uaupés (2♂—AMNH 434093, 434094; 2♀—AMNH 434095, 434096). **BRAZIL:** RORAIMA: Igarapé Caicubi, Bacaba (1♂—MZUSP 93675); Igarapé Caicubi, Capoeira (1♂—MZUSP 93672); Igarapé Caicubi, Jabuti (2♂—MZUSP 93673, 93674); Igarapé Caicubi, Paraguai (1♀—MZUSP 93676); Pacaraima, comunidade Nova Esperança (1♂—MZUSP 79000). AMAPÁ: Alto Rio Araguari (1♂—MPEG 26901; 1♀—MPEG 26902); Boa Fortuna, alto Rio Branco, afl. Rio Maracá, Mazagão (1♂—MPEG 16204); Estação Ecológica do Jari, Rio Jari, mg. dir., Monte Dourado (1 unsexed—MPEG 58597); Fazenda Caiena, Tartarugalzinho (1♂—MPEG 53310); Foz do Rio Tajauí, afl. Rio Araguari (1♀—MPEG 26903); Igarapé Novo, afl. esq. Igarapé Amazonas, afl. esq. Rio Iratapuru, Alto Rio Jari, Mazagão: (4♀—MPEG 29461–29464); Ilha Casa dos Sete, Rio Amapari (2♀—USNM 514734, 514735); Prosperidade, Rio Maracá, Mazagão (1♂—MPEG 16413); RESEX Cajari, Vila Marinho, Laranjal do Jari (2 unsexed—MZUSP 91900, 91901); Rio Amapari, Serra do Navio (9♂—MNRJ 40342–40345, 40347, 40380, 42263; MPEG 23955, 23957; 6♀—MNRJ 40341, 40346, 42261, 42262, 42264; MPEG 23958); Rio Jari, Cachoeira Santo Antônio, Porto Paiol (3♂—MPEG 40374–40376); Rio Vila Nova, Macapá (1 unsexed—MZUSP 32033); Serra do Navio (3♂—MNRJ 29973; MZUSP 65484, 65485; 3♀—MBML 645, 647, 652); Teresinha, Serra do Navio (2♂—MPEG 24808, 24809). PARÁ. Aldeia Apalai, Rio Paru de Leste (1♀—MPEG 32615); Almeirim, Floresta Nacional do Paru (1♂—MPEG 66422; 1 unsexed—MPEG 66421); Aramapuku, Rio Paru de Leste (1♀—MPEG 32614); Cachoeira Porteira, Rio Mapuera, Perimetral Norte, km 25, Castanhal, Nova Vida (1♀—MPEG 31978; 1 unsexed—MPEG 31977); Campo São Raimundo, Faro (1 unsexed—MPEG 34085); Cruz Alta, Rio Trombetas (1♂—MPEG 34535); Estação Ecológica Grão Pará, Oriximiná (1♂—MPEG 65737; 1♀—MPEG 65738); Estação Mapium, Rio Mapuera (1♀—MPEG 43744); Floresta Nacional de Faro, ca. 70 km NW Faro (1♀—MPEG 64604); Óbidos (1♂—CM 83866); Porto do Sabão, Rio Jari, Almeirim: (2♂—MNRJ 44745, 44767); Rodovia PA-254, 6 km da Vila Mamiá, Curuá (1 unsexed—MZUSP 85941); Uaicá, Rio Uaricoera (1♂—AMNH 824631). AMAZONAS. Balaio, km 107, Estrada São Gabriel da

Cachoeira-Cucuí (1♀—MNRJ 38062); Barra do Rio Negro (1♂—NMW 2078; 3♀—NMW 2079, 2080, 18956); Campos Sales (1♂—AMNH 248518); Estrada Manaus-Itacoatiara, km 13 (1♀—MPEG 34087); Estrada Manaus-Itacoatiara, km 64 (1♂—MNRJ 40364; 1♀—MNRJ 40365); Estrada Manaus-Itacoatiara, km 70 (1♀—MNRJ 40363); Estrada Manaus-Itacoatiara, km 78 (1♀—MNRJ 40366); Estrada Manaus-Itacoatiara, km 80 (1♀—MNRJ 40367); Granja Modelo, Manaus Amazonas (4♂—MNRJ 40355, 40357–40359; 1 unsexed—MNRJ 40356); Iauareté, Rio Uaupés (1♀—MPEG 17273); Lucai (1♂—AMNH 310317); Marabitanas, Rio Negro (1♂—NMW 2082; 2♀—NMW 2081; SMF 85526); Rio Aneba, Rio Amazonas (3♂—MZUSP 17479, 19431, 19432; 6♀—MPEG 40973; MZUSP 17481, 19433–19435, 23298); Rio Cauabari, boca do Rio Tucano (2♂—MNRJ 40376, 40377; 1♀—MNRJ 40378); Rio Maturaca, Serra do Imeri (1♀—USNM 325986); Rio Negro (1♀—BMNH 1887.3.22.217); Rio Tucano, Serra da Neblina (1♂—MNRJ 40369; 1♀—MNRJ 40370; 1 unsexed—MNRJ 40368); São Gabriel da Cachoeira (1♂—NRM not numbered; 1♀—COMB 1692); Serra do Imeri (1 unsexed—USNM 325985); Tahuapunto, left bank Rio Uaupés (2♂—AMNH 434097, 434098; 1♀—AMNH 434099); Taraquá, Rio Uaupés (2♂—NRM two not numbered; 1♀—NRM not numbered).

Campylopterus obscurus

UNSPECIFIED COUNTRY: Unspecified locality (2 unsexed—BMNH 1888.7.25.230, 1888.7.25.232). **COLOMBIA:** CAQUETÁ: La Morelia, Río Bodaquiere (6♂—AMNH 115825; ANSP 151251–151255; 2♀—ANSP 151256, 151257); Puerto Venecia, 15 km SE of Florencia (1♂—USNM 446272). META: Río Duda, Mt. Macarena (2♂—AMNH 460157, 460158; 2♀—AMNH 460155, 460156). PUTUMAYO: Estación de Bombeo Guamués (2♀—FMNH 292772); [Puerto] Umbria (5♂—ANSP 159886, 159888–159891; 1♀—ANSP 159887; 1 unsexed—ANSP 159892); Río San Miguel (1♀—ANSP 164769); San Antonio Guamués (6♂—FMNH 286844–286846, 286850, 286852, 286853; 7♀—FMNH 286841–286843, 286847, 286849, 286851, 286854). **ECUADOR:** Unspecified locality (4♂—AMNH 479325; BMNH 1887.3.22.218; NMW 2087; ZMB 20090; 2♀—AMNH 37163; ZMB 20091; 2 unsexed—BMNH 1872.5.28.53 [**“Quito” = Error. Holotype of *Campylopterus aequatorialis***]; FMNH 45741). MORONA-SANTIAGO: 5 km SW of Taisha (1♂—ANSP 182308; 1♀—ANSP 182309); Santiago (1♀—ANSP 181555). NAPO: Unspecified locality (3♂—AMNH 46267, 46268, 46271; 5♀—AMNH 46270, 479323, 479324, 479332; NRM not numbered; 3 unsexed—NMW 10175; NRM two not numbered); Archidona (1♂—USNM 174188; 3♀—USNM 174187; NRM not numbered); Cerro Guataraco, Orellana (3♂—ZMB 1938/340, 1938/341, 1938/343); Cerro Lumbaquí, km 61, Lago Agrio-Quito Highway (1♀—USNM 536758); Concepción (1♀—ZMB 1938/342); Limoncocha (3♀—LSUMZ 70884, 82896; USNM 587516); Near Baeza, road to Archidona, Oriente (3♂—NRM three not numbered; 2♀—NRM two not numbered); Río Pucuno (1♂—MNRJ 41006); Río Suno Abajo (1♂—AMNH 185139; 1♀—AMNH 185140); Río Suno, above Avila (3♂—AMNH 179008–179010); San José Abajo (1♂—AMNH 185136; 2♀—AMNH 185137, 185138); Río Cotapino (4♂—MNRJ 41000–41003; 1♀—MNRJ 41004). PASTAZA: Andoas, Río Pastaza (1♂—FMNH 99506; 1♀—FMNH 99505); Canelos, Río Bobonaza (1♂—NMW 91727); Chuquisca-Yaco (1♀—MBML 641, 642); Churo Yaco (1♀—AMNH 348465); Montalvo (4♂—ANSP 162910, 162911; MBML 643; MNRJ 41005; 1♀—MBML 644); Mouth of Río Curaray (2♂—AMNH 255287, 255288); Río Conambo (1♀—ZSM 1956.28); Río Pastaza (1♂—BMNH 1969.37.31; 1♀—BMNH 1969.37.32); Río Tigre (1♂—BMNH 1969.37.30); Sarayacu, Río Bobonaza (1♂—MNHN 1474.1932; 1♀—1475.1932; 3 unsexed—BMNH 1887.3.22.219, 1888.7.25.228, 1888.7.25.229). SUCUMBIOS: 14 km N Tigre Playa (1♂—ANSP 187166). **PERU:** Unspecified locality (1♀—SMF 85532). AMAZONAS: 43 km by road NE Chiriaco (1♂—LSUMZ 87372); Carretera Corral Quemado-Nazareth, km 381 (1♂—LSUMZ 75143); Caterpiza on Quebrada Caterpiza, E bank tributary of Río Santiago (1♀—LSUMZ 99018); Kusu, Río Comaina (1♂—LSUMZ 34061; 1♀—LSUMZ 34062); La Poza, Río Santiago (1♀—LSUMZ 91730); Pomará, lower Río Marañón (1♂—AMNH 185592); Santiago River (1♀—AMNH 406931); Vicinity of San Antonio, Río Cenepa (2♂—LSUMZ 84407, 84408). AYACUCHO. Río Apurímac, Luisiana (1♂—AMNH 819676; 1♀—AMNH 819769). CUZCO: 40 km E Quincemil on Puerto Maldonado road along Río Marcapata (4♂—LSUMZ 78030, 78031, 78033, 78034; 1 unsexed—LSUMZ 78032); Consuelo, km 165, 17 road km W above Pilcopata (1♂—FMNH 311206); Hacienda Cadena (1♂—FMNH 213800); Hacienda Villa Carmen (2♂—FMNH 251597, 251598); Marcapata (2♂—SMF 8534; ZSM 1915.335); Paucartambo, Consuelo, 15.9 km SW Pilcopata (1♀—FMNH 433095); Quincemil (1♂—MNHN 1107.1967); Río Mapitunari, Cordillera Vilcabamba (1♀—AMNH 820097); [Río] Tono (1♀—FMNH 320742). HUÁNUCO: Hacienda Santa Helena, ca. 35 km NE Tingo Maria (1♂—LSUMZ 72237; 2♀—LSUMZ 72236, 72238); Tingo María, Río Azul (1♂—LSUMZ 28292; 2♀—LSUMZ 28294, 28295). JUNÍN: La Merced (3♂—AMNH 168943, 168944, 168946; 3♀—AMNH 168945, 168947, 168948); San Ramón (2♂—FMNH 47088, 282562); [Valle de] Chanchamayo (2♂—FMNH 189893, 189895; 1♀—FMNH 189894). LORETO: 1 km N Río Napo, 157 km by river NNE Iquitos (3♂—LSUMZ 109384–109386); 1.5 km S Libertad, S bank Río Napo, 80 km N Iquitos (1♂—LSUMZ 109383); 79 km WNW Contamana (1♂—LSUMZ 161581); 86 km SE Juanjuí on E bank upper Río Pauya (1♂—LSUMZ 170713; 2♀—LSUMZ 170712, 170714); Lower Río Napo region, E bank Río Yanaiacu, ca. 90 km N Iquitos (1♂—LSUMZ 114681); Pebas (5♂—AMNH 37161; BMNH 1887.3.22.220, 1887.3.22.221, 1888.7.25.233, 1888.7.25.234; 3♀—AMNH 37162; BMNH 1888.7.25.227, 1888.7.25.231; 1 unsexed—USNM 55366); Quebrada Pushaga, Río Morona (1♂—FMNH 249460). MADRE DE DIOS: Altamira, Manu (2♂—FMNH 320265; MNHN 1957.1964; 1♀—MNHN 1656.1964); Cocha Cashu, Río Manu (2♂—AMNH 824052); Hacienda Amazonia (1♂—FMNH 315307; 1♀—FMNH 315308); Hacienda Amazonia, ridge above (1♂—FMNH 315309; 1♀—FMNH 320749); Moskitania, 13.4 km NNW Atalaya, L bank Alto Madre de Dios (1♀—FMNH 433097); Quebrada Aguas Calientes, 2.75 km E Shintuya, Alto Madre de Dios (1♀—FMNH 397770); Río Palotoa, left bank, 12 km from mouth (1♀—FMNH 320743). PASCO: Chuchurras (1♀—AMNH 479317); Puerto Yessup (1♀—ANSP 92660). PUNO. Astillero (1♂—AMNH 145965, 145967, 145962; 1♀—AMNH 145966; 1 unsexed—AMNH 145963). SAN MARTÍN: 15 km by trail NE Jirillo, on trail to Balsapuerto (1♀—LSUMZ 116552); 20 km by road NE Tarapoto, on road to Yurimaguas (6♀—

LSUMZ 116540, 116541, 116544, 116546, 116548, 116549); 20 km by road NE Tarapoto, on road to Yurimaguas (5♂—LSUMZ 116543, 116545, 116547, 116550, 116551); Moyobamba (2♂—FMNH 45739, 45740; 1♀—ANSP 118315). UCAYALI: Balta, Río Curanja (2♂—LSUMZ 31302, 63995; 4♀—LSUMZ 51668–51671); [Río] Lagarto, upper Ucayali (1♂—AMNH 238871); Santa Rosa, Río Ucayali (2♂—AMNH 239906, 239907). **BOLIVIA:** COCHABAMBA: Alto Palmar, Chaparé (3♂—LSUMZ 35820, 35821, 37366); Chipiriri, Chaparé (1♀—LSUMZ 35822); Mouth of Río San Antonio, Río Espíritu Santo (1♂—AMNH 148209); Palmar, Chaparé (2♂—MNHN 346.1960, 347.1960). EL BENI: Serranía Pilón, 27 km by road N Río Quiquibey, on road to San Borja, Provincia General Ballivian (3♂—LSUMZ 123608, 123610, 123611; 3♀—LSUMZ 123606, 123607, 123609). LA PAZ: Chimate (3♂—BMNH 1902.3.13.1902, 1902.3.13.1903; USNM 332558); Chiñiri, Río Kaka (2♂—ANSP 120819, 120820; 4♀—ANSP 120821–120824); Guanay (3♂—AMNH 479321; ANSP 120825, 120826; 1♀—ANSP 120827; 1 unsexed—SMF 85528); Mapiri (1♂—BMNH 1887.3.22.223; 1 unsexed—BMNH 1887.3.22.224); San Agustín (3 unsexed—AMNH 479318–479320); Río Beni, ca. 20 km by river N Puerto Linares (2♂—LSUMZ 101724, 101725); San Ernesto (1♀—BMNH 1902.3.13.1901); Serranía Bellavista, 47 km by road N Caranavi (4♂—LSUMZ 95675–95678; 3♀—LSUMZ 95674, 95679, 95680). SANTA CRUZ: Buena Vista (3♂—CM 119948; FMNH 65395; ZSM 1927.1315); Cerro Amboró (1♂—CM 79058; 3♀—CM 79042, 79063, 79064); Cerro Hosane (2♂—CM 79372, 79478; 3♀—CM 79292, 79373, 79419; 1 unsexed—CM 79390); Río Surutú (1♂—CM 79758; 2♀—CM 43792, 80724); Río Yapacani (1♂—CM 20761; 1♀—CM 50874). **BRAZIL:** Unspecified locality (2♂—BMNH 1888.7.25.75 [**“Amazons valley?”**, **Holotype of *Campylopterus obscurus***], 1887.3.22.222). ACRE: Base de Pesquisa Restauração, Rio Tejo, Taumaturgo (1♀—MPEG 52042); Estação Ecológica do Rio Acre, 78km W Assis (2♂—MPEG 59773, 59774); Reserva Humaitá, Porto Acre (2♀—MPEG 59924, 64563); Valparaíso, Igarapé São Luiz, Porto Walter (2♂—MPEG 52551, 52552). AMAZONAS: Aldeia Traíra-Bacupaí, Terra Indígena Parintins, Humaitá (1♂—MPEG 58670; 1♀—MPEG 58669); Arimã, Rio Purus (1♂—CM 93194; 1♀—CM 93723); Barra de São Manuel, mg. esq. Rio Tapajós (2♂—MZUSP 92623, 92625; 1♀—MZUSP 92626; 1 unsexed—MZUSP 92624); Calamá, Rio Madeira (1♂—AMNH 479316); Maruim, mg. esq. do Rio Abacaxi (1♂—MZUSP 76756); Rio Parauari, mg. dir., 4 km abaixo da Cachoeira do Tambor (1♂—MZUSP 86444); mg. esq. Rio Sucunduri, abaixo da Ilha do Castanho (1♀—MZUSP 95819); mg. esq. Rio Sucunduri, acima da Ilha do Castanho (1♀—MZUSP 95818); mg. esq. Rio Sucunduri, left bank Lower Rio Acari (1♂—MZUSP 95817); Rodovia do Estanho, km 126, Manicoré (2♂—MPEG 57540, 57541; 1♀—MPEG 57542); Santa Maria dos Marmelos, Rio Madeira (1♂—AMNH 479314); Trilha do Papagaio, Rio Urucu, Coari (2♀—MPEG 62280, 62881); Vista Alegre, Foz do Rio Guariba, mg. dir. Rio Aripuanã (2♂—MPEG 31002, 31003). MARANHÃO. Alto de Alegria (1 unsexed—MNRJ 18196); Bom Jesus da Mata, Turiaçu (1♂—MPEG 34948; 1♀—MPEG 34949); Fazenda do Cachimbo, Coroatá (6♂—LSUMZ 71604–71609; 1 unsexed—LSUMZ 71603); Fazenda Santa Bárbara, Rio Gurupi, Carutapera (1♂—MPEG 36887); Floresta da Companhia Vale do Rio Doce, Buriticupu (1♂—MPEG 37408; 2♀—MPEG 37407, 37409); Horto Pompéia, Açailândia (1 unsexed—MZUSP 78749). MATO GROSSO: Cachoeira de Dardanelos, Aripuanã (2♀—DZUFMG 5980, 5981; 1 unsexed—UFMT 417); Fazenda Aliança, Rio Teles Pires, mg. esq., Paranaíta (1♂—MPEG 67276; 2 unsexed—MPEG 69165, 69166); Fazenda Ipê, Vila Rica (1♀—MZUSP 78139); Fazenda Rio Paranaíta, Paranaíta (1 unsexed—MPEG 67277); Fazenda São Nicolau, mg. esq. Rio Juruena, Cotriguaçu (1 unsexed—MPEG 63917); Fazenda São José, Rio Peixoto de Azevedo (2♀—MPEG 33543, 33544); Fazenda Zanette, mg. esq. Rio Paranaíta, Paranaíta (1♂—MPEG 67274); Foz do Apicacás, Apicacás (1♂—UFMT 1351); Juruena (1♀—MZUSP 83256); Paranorte (1 unsexed—UFMT 1567); Rio Juína-Mirim, mg. dir., Juína (1♀—MZUSP 81462); Rio Juína-Mirim, Juína (1♂—MZUSP 81463); Rio Sete de Setembro (3♂—MNRJ 18610, 18647, 18649; 1 unsexed—MNRJ 18648); Rio Teles Pires, 1 km acima do Rio Cristalino, Alta Floresta (1♀—MPEG 51330; 1 unsexed—MPEG 51329); Rio Teles Pires, mg. esq., frente boca Rio Cristalino, Alta Floresta (1♀—MPEG 51331); Linha B, mg. esq. Rio Teles Pires, Paranaíta (1 unsexed—MZUSP 87392); Sete Quedas, Rio Teles Pires, Paranaíta (1♀—MPEG 67275); Sinop (1♂—MZUSP 88403; 1♀—MNRJ 40362); Tapirapuã (1♂—MBML 639). PARÁ: Unspecified locality (1♂—MPEG 13812; 6 unsexed—MNRJ 9779, 18609, 18650, 18651; MPEG 120, 980); Água Preta, Utinga (1♂—MNRJ 40371; 2♀—MNRJ 40372, 40375); Altamira, Rio Xingu, mg. esq., área de influência da UHE Belo Monte (1♀—MPEG 55346); Apaci, Rio Tapajós (1♂—CM 77796); Apeú (1♂—ZMB 1931/1708); Aveiro, Rio Tapajós, mg. esq. (1 unsexed—MPEG 64061); Barcarena (2♀—MPEG 61183); Base Barroso, Juruti (1♂—MPEG 58249); Belém [= Pará]: 42♂—ANSP 80409; BMNH 1887.3.14.46, 1887.3.22.225, 1888.10.1.197, 1888.7.25.224; FMNH 295559; MPEG 26049; MZUSP 42798; SMF 85530, 85531, 85533; USNM 513093, 513095, 513097–513100, 513104, 513106, 513108–513117, 514016, 514018, 514020, 514022, 514026, 514027, 514030–514032, 514034, 514035, 516241; ZSM 1919.287; 20♀—ANSP 80407; BMNH 1887.3.22.226, 1887.3.22.227, 1888.10.1.198; USNM 513092, 513094, 513102, 513103, 513105, 513107, 514015, 514017, 514019, 514021, 514023–514025, 514028, 514029, 514033; 6 unsexed—BMNH 1888.7.25.225; MNRJ 9826; SMF 85529; USNM 513101, 516242, 516674); Benevides (5♂—CM 69524, 69709; MPEG 8515; USNM 516243, 516245; 7♀—CM 69651; MPEG 8511, 8513, 8514, 8911; USNM 516244, 516246; 1 unsexed—MNRJ 18194); BR-230, Transamazônica, 50 km oeste de Jacareacanga (1♀—MZUSP 84620); Bujaru, km 25 (1♀—MPEG 33121); Canoal, Rio Tocantins, mg. dir., 35 km acima barragem Tucuruí (1♀—MPEG 35716); Castanhal (1♂—ANSP 80410); Comunidade de São Francisco, Santarém, Rio Arapiuns, mg. esq. (1 unsexed—MPEG 64062); Conceição, Rio Moju (1 unsexed—MNRJ 18195); East bank of Rio Xingu, 52 km SSW Altamira (1♀—MZUSP 65146); Estrada Araguaia, km 45, Bacaba, Capitão Poço (1♂—MPEG 31424); Fazenda Fartura, Santana do Araguaia (4♂—MPEG 48539; MZUSP 88061, 89905, 97075; 3♀—MPEG 48538; MZUSP 97165, 97166); Fazenda Jamaxim, 30 km SW Castelo dos Sonhos, Altamira (1♂—MPEG 59112); Fazenda Morelândia, Estrada do Genipaúba, Santa Bárbara do Pará (1♂—MPEG 55873); Fazenda Velha, Instituto Agrônomo Norte, Belém (1♂—MNRJ 40352; 2♀—MNRJ 40353, 40379; 1 unsexed—MNRJ 40354); Fazenda Verão Vermelho, Marabá (1♀—MNRJ 44352); Fazenda Vitória, Paragominas (1♂—MPEG 39299); Gorotire, São Felix do Xingu (1 unsexed—MPEG 35452); Igarapé Aurá, Belém (1♂—MPEG 26146; 1♀—MPEG 26145; 1 unsexed—

FMNH 295560); Instituto Agronômico do Norte, Belém (2♂—MPEG 24863, 23495; 1♀—MPEG 26431); Itaituba, Rio Tapajós (1♂—CM 77459); Km 120 da BR-230, Parque Nacional da Amazônia (1♂—MPEG 34086); Km 64 da BR-230, Parque Nacional da Amazônia, Itaituba, mg. esq. Rio Tapajós (1♂—MPEG 58427; 2♀—MPEG 59425, 58426); M5, Serra dos Carajás (1 unsexed—MPEG 36376); Marituba, Oriboca, Ananindeua (2♂—MPEG 25427, 25428; 1♀—MPEG 25263); Mina de cobre, Serra dos Carajás, Pojuca (2♂—MPEG 38136, 38137); Mina de Manganês, Serra Norte, Serra dos Carajás (1 unsexed—MPEG 37280); Mirituba (1♂—CM 76989; 1♀—CM 76988); Mocajuba, Rio Tocantins (4♂—AMNH 430386–430388; ZMB 1931/1713; 1♀—ZMB 1931/1712); Murutucu (1♀—MZUSP 16141); Oriboca, Marituba (1♀—MNRJ 40360); Parque Ecológico do Gunma, Santa Bárbara do Pará (1♂—MPEG 60416; 2 unsexed—MPEG 58639, 59057); Peixe Boi (1♂—ZSM 1910.1236; 1♀—MPEG 5809); Pista de Pouso do Maranhão, Floresta Nacional Amanã, Itaituba (1♂—MPEG 65112); Reserva da Companhia Vale do Rio Doce, Rio Sororó, Marabá (1♀—MPEG 37974); Reserva Florestal da Agropalma, Tailândia (8♂—MZUSP 77152, 77153, 77155, 77158–77162; 4 unsexed—MZUSP 77154–77157, 77163); Retiro de Nazaré, Benevides (1♂—MPEG 22116; 1♀—MPEG 22114); Rio Acará, Tomé Açú, Massaranduba (3♀—MPEG 26078–26080; 1 unsexed—MPEG 26077); Rio Inhangapi (1♂—ANSP 80408); Rio Teles Pires, mg. dir., Paranaíta (1♂—MPEG 69164); Linha C, mg. dir. Teles Pires, Jacareacanga (1♀—MZUSP 87396); Linha D, mg. dir. Teles Pires, Jacareacanga (2♀—MZUSP 87394, 87397); Linha G, mg. dir. Teles Pires, Jacareacanga (1♂—MZUSP 87399; 1♀—MZUSP 87393); Linha J, mg. dir. Teles Pires, Jacareacanga (2♀—MZUSP 87395, 87398); Rio Tocantins, Dom Eliseu (1 unsexed—MPEG 70126); Rio Tocantins, mg. esq., 40 km acima barragem Tucuruí (1♀—MPEG 35633); mg. dir. Rio Xingu, Altamira (1♀—MZUSP 95330); mg. dir. Rio Xingu, Senador José Porfírio (1♂—MZUSP 95332); mg. dir. Rio Xingu, Vitória do Xingu (1♀—MZUSP 95333; 1 unsexed—MZUSP 95331); Roda D'Água, Tomé-Açu (1♀—MPEG 51949); Rodovia Belém-Brasília, km 75 (1♂—MPEG 14412); Rodovia Belém-Brasília, km 86 (1♂—MZUSP 44113; 3♀—MZUSP 44111, 44112, 44114); Rodovia Belém-Brasília, km 92 (1♂—MPEG 15592; 1♀—MPEG 15593); Santa Bárbara [do Pará], Benevides (1♂—MPEG 22705); Santa Isabel [do Pará] (4♂—MPEG 6912, 7504; ZMB 1931/1710, 1931/1711; 1♀—ZMB 1931/1709); Santa Rosa, km 39, Vigia (7♂—MPEG 30529–30532, 30535, 31828, 31829; 5♀—MPEG 30533, 30534, 31826, 31827, 31830); Santo Antônio do Prata (3♂—AMNH 479306, 479307; ZSM 1909.408; 4♀—AMNH 479308–479311); Sapucajuba, Instituto Agronômico Norte, Belém (1♀—MNRJ 40361); Serra da Onça, Ourilândia do Norte (1 unsexed—MPEG 67178); Serra do Puma, Ourilândia do Norte (1♂—MPEG 67119; 2♀—MPEG 67120, 67121); Sítio Fé em Deus, km 24, Ourém (1♂—MPEG 32364; 2♀—MPEG 32365, 32366); Sossego, Foz do Igarapé Traquateua, Ananindeua (1♀—MPEG 26900); Tanaquara (1♂—MPEG 11283); Tauari, Rio Tapajós (1♂—AMNH 285952); Trilha Bacaba, Reserva Biológica do Tapirapé, Marabá (1♂—MPEG 66083); Urucurituba, Rio Tapajós (1♂—MZUSP 40653; 1♀—MZUSP 40654); Utinga (8♂—AMNH 148211, 148212; FMNH 51106, 57662; MNRJ 40374; MZUSP 16139, 16140; 1♀—MNRJ 40373; 1 unsexed—FMNH 51107); Vila de Outeiro, Ilha Caratateua, Belém (1♀—MPEG 29721). RONDÔNIA: Unspecified locality (1♂—MZUSP J1766); Aliança, Rio Madeira (1♂—AMNH 479315); Arredores do Forte do Príncipe da Beira (1♂—MNRJ 37820); Barão de Melgaço (1♂—AMNH 127391); Cachoeira Nazaré, W bank Rio Jiparaná (5♂—MPEG 39439–39442; MZUSP 65721); Chupinguaia (1 unsexed—MZUSP 85682); Fazenda Rio Candeias, Porto Velho (1♂—MPEG 35107); Linha 64, BR 429, km 87, Alvorada do Oeste (1♂—MPEG 38721); [Rio] Jamari (1 unsexed—MNRJ 18646); Maruins, Rio Machado (1♂—ZSM 1909.675); Pimenta Bueno (1♀—LSUMZ 33584); Porto Velho, Rio Madeira (1♂—AMNH 148210; MZUSP 88838); mg. dir. Rio Madeira, Abunã (1♂—MZUSP J1335; 1 unsexed—MZUSP J1593); mg. dir. Rio Madeira, Caiçara (1♂—MZUSP J1251; 1 unsexed—MZUSP J31); mg. dir. Rio Madeira, Mutum (1♂—MZUSP J2052; 1♀—MZUSP J485); Santa Isabel, Rio Preto, Rio Madeira (2♂—AMNH 479312, 479313). TOCANTINS. Araguatins (1 unsexed—MZUSP 52434); Macaúba, Ilha do Bananal (1♂—MZUSP 68543).

Campylopterus diamantinensis

BRAZIL: MINAS GERAIS: Alto do Palácio, Parque Nacional da Serra do Cipó, Morro do Pilar (1♀—DZUFMG 6689); Brumas do Espinhaço, Lapinha de Cima, Santana do Riacho (1♀—DZUFMG 4343); Córrego das Pedras, Diamantina (1♂—AMNH 801435 [**Holotype**]; 1♀—MBML 637); Fazenda Álamo, Serra dos Ferreira, Olhos D'Água (1♂—MCNA 2511); Morro da Torre (Landinho), Parque Nacional das Sempre Vivas (1♂—DZUFMG 7010); Pico do Inficionado, Serra do Caraça, Catas Altas (9♂—DZUFMG 2739, 2838, 2839, MCNA 1942, 1944–1948; 3♀—DZUFMG 2738, 3783; MCNA 1943); Pico do Sol, Serra do Caraça, Catas Altas (2♀—DZUFMG 2575, 2576); Serra do Breu, Santana do Riacho (1♂—DZUFMG 7138; 1♀—DZUFMG 7139); Serra do Cabral, Joaquim Felício (1♂—DZUFMG 5260; 1♀—DZUFMG 5261); Serra do Caraça, Catas Altas (3♂—MNRJ 40348–40350; 2♀—CRG 8964; MNRJ 40351); Três Barras, Serro (1♂—DZUFMG 4215; 1♀—MCNA 971).

Campylopterus calcirupicola

BRAZIL: BAHIA: Colônia do Formoso, Coribe (3♂—MPEG 45089–45091; 1♀—MPEG 45092). GOIÁS: Fazenda São Bernardo, Iaciara (1♀—MPEG 44783); Galheiros (1♂—MNRJ 18592). MINAS GERAIS: Cabeceiras do Rio do Cedro, Montes Claros (1♀—DZUFMG 7171); Distrito de Tabua, Januária (1♀—DZUFMG 7170); Distrito de Tejuco, Januária (1♂—DZUFMG 5508; 1♀—DZUFMG 5509); Fazenda Corredor, Bocaiúva (4♂—DZUFMG 5004, 5005, 5007, 5008; 1♀—DZUFMG 5006); Sítio Duboca, Montes Claros (1♂—MZUSP 99025 [Paratype]; 3♀—MZUSP 99024 [**Holotype**]; DZUFMG 5730 [Paratype]; MCNA 1754 [Paratype]).