

The grasshoppers (Orthoptera: Caelifera) of the grasslands in the southern portion of the Espinhaço Range, Minas Gerais, Brazil

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Abstract: Neotropical mountains host much of the Earth's biodiversity. The Espinhaço Range of Brazil consists of a fragmented series of low-altitude mountains with extensive areas of grasslands. As is often the case with grasslands, grasshoppers are abundant and diverse in this ecosystem, although they are poorly known. The study was carried in three regions of the Espinhaço Range, located at southeastern Minas Gerais state: Serra do Ouro Branco, Serra do Ribeiro, and Serra do Cipó. The sampling of grasshoppers was performed using sweep and insect nets. Forty-six species (Serra do Cipó with 39 species, Serra do Ouro Branco with 25 species, and Serra do Ribeiro with 21 species) were collected. The richest family and subfamily was Acrididae and Gomphocerinae, respectively. This study recorded 17 new species occurrences to Minas Gerais.

Key words: Acrididae; Diversity; Ecological Entomology; Gomphocerinae; Melanoplinae

INTRODUCTION

Tropical mountain ecosystems are home to a considerable number of plants and insects (MARTINELLI 2007). One of the most significant mountain formations in the north-eastern and southeastern Brazil—the Espinhaço Range—is a low, fragmented massif that extends from the central-south region of the Minas Gerais state to the north of the Bahia state. The two main sectors of the Espinhaço Range are represented by the Diamantina plateau (Minas Gerais) and the Chapada Diamantina (Bahia). The Espinhaço Range is influenced by three main phytogeographic domains: the Atlantic Forest, the Cerrado (Brazilian savanna), and the Caatinga (dry forest type vegetation) (RAPINI et al. 2008). The top of the mountains area mostly covered by grassland fields (namely rupestrian fields) containing a large number of plant species in the families Poaceae, Cyperaceae, Eriocaulaceae and Xyridaceae (GIULIETTI et al. 1987; SANTOS et al. 2011).

Of the insects studied in the Espinhaço Range, gall-inducing species have perhaps received the most attention (LARA & FERNANDES 1996; CARNEIRO et al. 2009), with other insect herbivores being much less frequently studied (CARNEIRO et al. 1995; RIBEIRO et al. 1998). The grasshoppers (Orthoptera: Caelifera) comprise one of the largest and most dominant groups of free-feeding insect herbivores on Earth (GANGWERE et al. 1997). Grasshoppers typically inhabit open and semi-open vegetation, where the sun's rays reach the ground directly and temperatures are higher, and where ground vegetation is in sufficient supply as a food source. They are mostly associated with open-area vegetation such as fields and savannas (CAPINERA et al. 2001, 2004). These common insects often are abundant and large in size. Grasshoppers (Caelifera) are leaf chewing, usually consuming entire leaves or large sections of leaves. They play an important role in nutrient cycling (AMÈDÈGNATO & DESCAMPS 1978). Furthermore, grasshoppers constitute the largest mass of the food consumed by grassland birds and some other vertebrate predators (CAPINERA 2010). Orthoptera assemblages are sensitive to disturbance, and they can be used as indicators of land management degradation or habitat change.

The objective of this study is to present the first list of survey the grasshopper species found in the grasslands of the southern portion of the Espinhaço Range, in Minas Gerais.

MATERIALS AND METHODS

The study was carried at three regions of the Espinhaço Range: namely Serra do Ouro Branco (20°28'53.4"S, 043°42'48.6"W), Serra do Ribeiro (20°29'01.3"S, 043°34'26.4"W) and Serra do Cipó (19°21'13.3"S, 043°36'11.9"W), located near the cities of Ouro Branco, Ouro Preto and Santana do Riacho, respectively (Figure 1). The samples from Serra do Ribeiro and Serra do Ouro Branco were collected in four months over a year-long period (February, March,

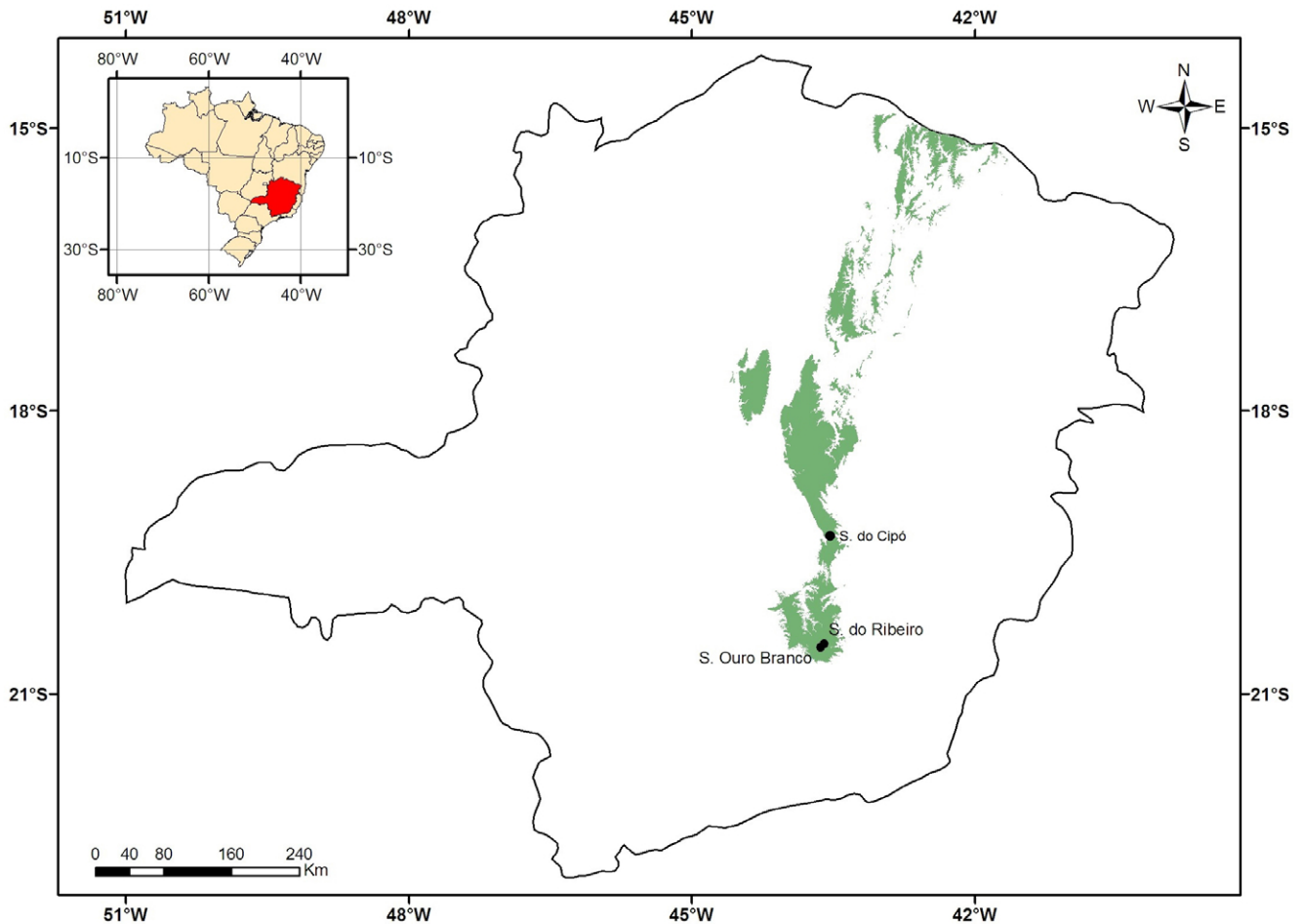


Figure 1. Localization of the areas studied in the Espinhaço Range, Minas Gerais, Brazil.

and September 2011, as well as January 2012), while those taken from Serra do Cipó were collected both during the dry season (May, June, July, and August) and the rainy season (October, November, December and January). In each of the three regions, sample areas were chosen at random and, whenever possible, in preserved areas. In Serra do Ouro Branco, sites were sampled between 1,305 and 1,513 m; in Serra do Ribeiro, between 1,277 at 1,542 m; and in Serra do Cipó, between 821 at 1,419 m.

Serra do Ouro Branco is the most significant element on the southern edge of the Iron Quadrangle, reaching altitudes of 900–1,573 m and occupying an area of approximately 65 ha (ALKMIM 1987). Serra do Ribeiro contains two smaller formations, located approximately 10 km north of Serra do Ouro Branco, with altitudes varying between 1,270 at 1,550 m (BORGES et al. 2011). Serra do Cipó is located approximately 167 km from Serra do Ouro Branco, with altitudes varying between 700 at 1,670 m. It is an important dividing point between two major Brazilian drainage basins, the São Francisco basin and the Rio Doce basin. In the southern portion of the Espinhaço Range, the climate is mesothermic – Cwb (KÖPPEN 1948), with mild, rainy summers and cold, dry winters (ANTUNES 1986). Average annual temperatures range from 17°C to 20°C and annual rainfall is roughly 1,500 mm (GIULIETTI et al. 1987).

The collection of grasshoppers (Orthoptera: Caelifera) was performed using two methods: a sweep sample and insect nets. Ten subsamples of 30 sweeps were taken walking along one line of approximately 50 m, at each sample site. Altogether, the 300 sweeps by sample site (three sample site at Ouro Branco, four sample site at Serra do Ribeiro, and seven sample site at Serra do Cipó), provided a total of 4,200 sweeps in the study. The sweeps were done by the same personnel in all sample sites, always between 09:00 and 16:00 h, and never in the rain or strong winds (Janzen 1973; Evans and Bailey 1993; Carneiro et al. 1995; Ausden and Drake 2006). Additionally, grasshoppers were also collected with 60 cm diameter insect nets. Insects were sampled during 30-minute walks, during which the collector advanced in a zigzag pattern, insect net in hand, collecting the grasshoppers jumping at his approach. This particular method ensures the collection of specimens who are larger and of greater evasive ability.

The studied grasshoppers were incorporated in the Entomological Collection of Laboratório de Entomologia Ecológica (UFOP) and Museu do Rio Grande do Sul (PUCRS), Brazil. The determination grasshopper species was done by M. K. M. Costa through the aid of the dichotomous keys of the specific genera and reference collection of the PUCRS. Given that the grasshoppers were not sampled in

Table 1. Check list of grasshopper species presents in three mountains in the Espinhaço Range, Minas Gerais, Brazil.

Grasshopper taxa	Mountains			Figures	Voucher Code
	Cipó	Ouro Branco	Ribeiro		
Acrididae					
Acridinae					
<i>Eutryxalis filata filata</i> (Walker, 1870)	x	x	x	2–3	MCTP 55162
<i>Hyalopteryx rufipennis</i> Charpentier, 1845	x			4–5	MCTP 55163
<i>Metaleptea adspersa</i> (Blanchard, 1843)		x	x		MCTP 55164
<i>Parorophula graminea</i> Bruner, 1900	x				MCTP 55165
<i>Paulacris exaggerata</i> (Burr, 1902)	x			6–7	MCTP 55166
<i>Orphula pagana</i> (Stål, 1861)	x				MCTP 55167
Copiocerinae					
<i>Aleuas lineatus</i> Stål, 1878		x			MCTP 55168
<i>Aleuas gracilis</i> Stål, 1878	x				MCTP 55169
<i>Aleuas vitticollis</i> Stål, 1878	x	x	x		MCTP 55170
Cyrtacanthacridinae					
<i>Shistocerca cancellata cancellata</i> (Serville, 1838)	x	x	x	8–9	MCTP 55171
Gomphocerinae					
<i>Amblytropidia robusta</i> Bruner, 1906	x	x	x	10–11	MCTP 55172
<i>Amblytropidia sola</i> Rehn, 1939	x	x	x	12–13	MCTP 55173
<i>Amblytropidia minor</i> Bruner, 1911		x	x		MCTP 55174
<i>Borellia bruneri</i> (Rehn, 1906)	x			14–15	MCTP 55175
<i>Borellia carinata</i> Rehn, 1906	x			16–17	MCTP 55176
<i>Borellia saezi</i> Carbonell, 1995	x			18–19	MCTP 55177
<i>Borellia</i> sp.	x			20–21	MCTP 55178
<i>Compsacris brevipennis</i> (Rehn, 1906)		x			MCTP 55179
<i>Notopomala glaucipes</i> (Rehn, 1906)	x			22–23	MCTP 55180
<i>Orphulella concinnula</i> (Walker, 1870)	x	x	x		MCTP 55181
<i>Orphulella elongata</i> Bruner, 1911	x			24–25	MCTP 55182
<i>Orphulella paraguayensis</i> (Rehn, 1906)	x	x	x	26–27	MCTP 55183
<i>Orphulella punctata</i> (De Geer, 1773)	x	x	x	28–29	MCTP 55184
<i>Orphulina pulchella</i> Giglio-Tos, 1894	x		x	30–31	MCTP 55185
<i>Parapellipedon uniformis</i> (Rehn, 1906)	x			32–33	MCTP 55186
<i>Pellipedon brunneum</i> (Rehn, 1906)	x	x	x	34–35	MCTP 55187
<i>Rhammatocerus brasiliensis</i> (Bruner, 1904)	x	x	x	36–37	MCTP 55188
<i>Rhammatocerus brunneri</i> (Giglio-Tos, 1895)	x	x	x	38–39	MCTP 55189
<i>Rhammatocerus pictus</i> (Bruner, 1900)	x	x	x	40–41	MCTP 55190
<i>Scyllinula</i> sp.	x			42–43	MCTP 55191
<i>Staurorhectus longicornis longicornis</i> Giglio-Tos, 1897	x	x	x	44–45	MCTP 55192
Leptysminae					
<i>Cylindrotettix uniformis</i> (Bruner, 1911)	x	x	x	46–47	MCTP 55193
<i>Stenopola puncticeps puncticeps</i> (Stål, 1861)	x			48–49	MCTP 55194
Melanoplinae					
<i>Leiotettix pulcher</i> (Rehn, 1913)	x			50–51	MCTP 55195
<i>Leiotettix viridis</i> Bruner, 1906		x	x		MCTP 55196
<i>Scotussa lemniscata</i> (Stål, 1861)	x				MCTP 55197
Ommatolampidinae					
<i>Orthoscaphus coriaceus</i> (Giglio-Tos, 1894)		x	x		MCTP 55198
<i>Orthoscaphus planaltinus</i> Roberts & Carbonell, 1981	x			52–53	MCTP 55199
<i>Jodacris chapadensis</i> (Bruner, 1911)	x			54–55	MCTP 55200
Ommexechidae					
Ommexechinae					
<i>Clarazella bimaculata</i> (Giglio-Tos, 1894)	x	x		56–57	MCTP 55201
<i>Ommexecha virens</i> Serville, 1831	x			58–59	MCTP 55202
Proscopiidae					
Proscopiinae					
<i>Proscopia bivittata</i> Piza, 1946	x			60–61	MCTP 55203
Romaleidae					
Romaleinae					
<i>Abila bolivari</i> Giglio-Tos, 1900	x	x		62–63	MCTP 55204
<i>Xyleus gracilis</i> (Bruner, 1905)	x	x	x	64–65	MCTP 55205
<i>Zoniopoda similis</i> Bruner, 1906		x			MCTP 55206
Tetrigidae					
Tetriginae					
<i>Tetrix subulata</i> (Linnaeus, 1758)	x	x	x	66–67	MCTP 55207

the same sampling period and that the sampling effort was not standardized in all three mountains, a comparison or analysis of the number of species collected in each location was not performed. Samples were collected under the license 32236 granted by IBAMA.

RESULTS

Overall, a total of 46 species from 32 genera and five families were collected from the three sample areas in the Espinhaço Range: in Serra do Cipó, 39 species from 29 genera and five families; in Serra do Ouro Branco, 25 species from 18 genera and four families; and finally in Serra do Ribeiro, 21 species from 15 genera and three families (see Table 1 and the respective figures). Three morphospecies remain unidentified. In the Serra do Cipó, casual observation (not a part of the grasshoppers sampling process) also revealed one species, which had not been collected: *Rhammatocerus palustris* (Carbonell, 1988).

The richest family in terms of species was Acrididae, with 39 (85%) of the total species collected. Within the subfamilies of Acrididae the richest was Gomphocerinae, with 21 (54%) of these species; followed by Acridinae with six species (15%); then Copiocerinae, Melanoplinae and Ommatolampidinae, with three species (8%) each; Leptysminae with two species (5%); and finally, Cyrtacanthacridinae with one species (3%).

Acrididae
Acridinae

Eutryxalis filata filata (Walker, 1870)

Eutryxalis filata bellula Rehn, 1944
Metaleptea minor (Giglio-Tos, 1897)

Small-sized and slender grasshoppers. General color brown. Stripe post-ocular extending of pronotal lobe up to the anterior portion of tegmen. Prominent eyes. Pronotum with median carinae prominent. Some specimens show a thin stripe next to the line on the dorsal surface of the head. Tegmina with interspersed points of black color. Wings surpassing the end of the abdomen. Subgenital plate short. Material examined: Table 1; Figure 2 and 3; MCTP 55162.

Hyalopteryx rufipennis Charpentier, 1845

Medium-sized and slender grasshoppers. General color light brown. Head with a facial line. Slightly prominent eyes. Fastigium wide, with rounded apex; pronotum with median carinae quite conspicuous; lateral carinae continuous and straight; posterior margin of pronotum expanded. Metazona with different lines, irregularly rugose. Dorso with maculations black. Wings uniformly red, distinct and rounded anterior margin, large fenestrated. Subgenital plate elongated. Material examined: Table 1; Figure 4 and 5; MCTP 55163.

Metaleptea adpersa (Blanchard, 1843)

Medium-sized and slender grasshoppers. General color of males greenish-brown and females fully green. Head a little prolonged. Fastigium with a sharp edge. Pronotum with lateral carinae cut three sulci; median carinae cut only by a main transverse sulci. Tegmina interspersed with some black spots. Hind tibiae slightly extended and flattened provided with nine of spines black. Subgenital plate long, the length of the male cerci is equal to or more than twice the length of subgenital plate. Material examined: Table 1; MCTP 55164.

Parorphula graminea Bruner, 1900

Medium-sized and slender grasshoppers. General color green, varying to brown and yellow. Pronotum with median carinae prominent, especially in the front. Sides of pronotum and metapleura with yellow diagonal stripes. Wings yellow, green costal margin, distal field with large spots and dark brown quadrangular. Hind femora with visible dark stripes. Hind tibiae yellow. Material examined: Table 1; MCTP 55165.

Paulacris exaggerata (Burr, 1902)

Hyalopteryx asinus (Rehn, 1906)
Hyalopteryx lamellipes (Bruner, 1906)

Medium-sized and slender grasshoppers. General color brown. Fastigium in dorsal aspect and in profile blunter cephalad. Tegmina of male with apices acuminate produced, the disto-sutural margin concave. Wings of male with apices of anterior field blunter, obtuse-angulate. Hind femora strongly produced and markedly unequal in development. Subgenital plate of male equal in length to that of venter of preceding four sternites combined. Material examined: Table 1; Figure 6 and 7; MCTP 55166.

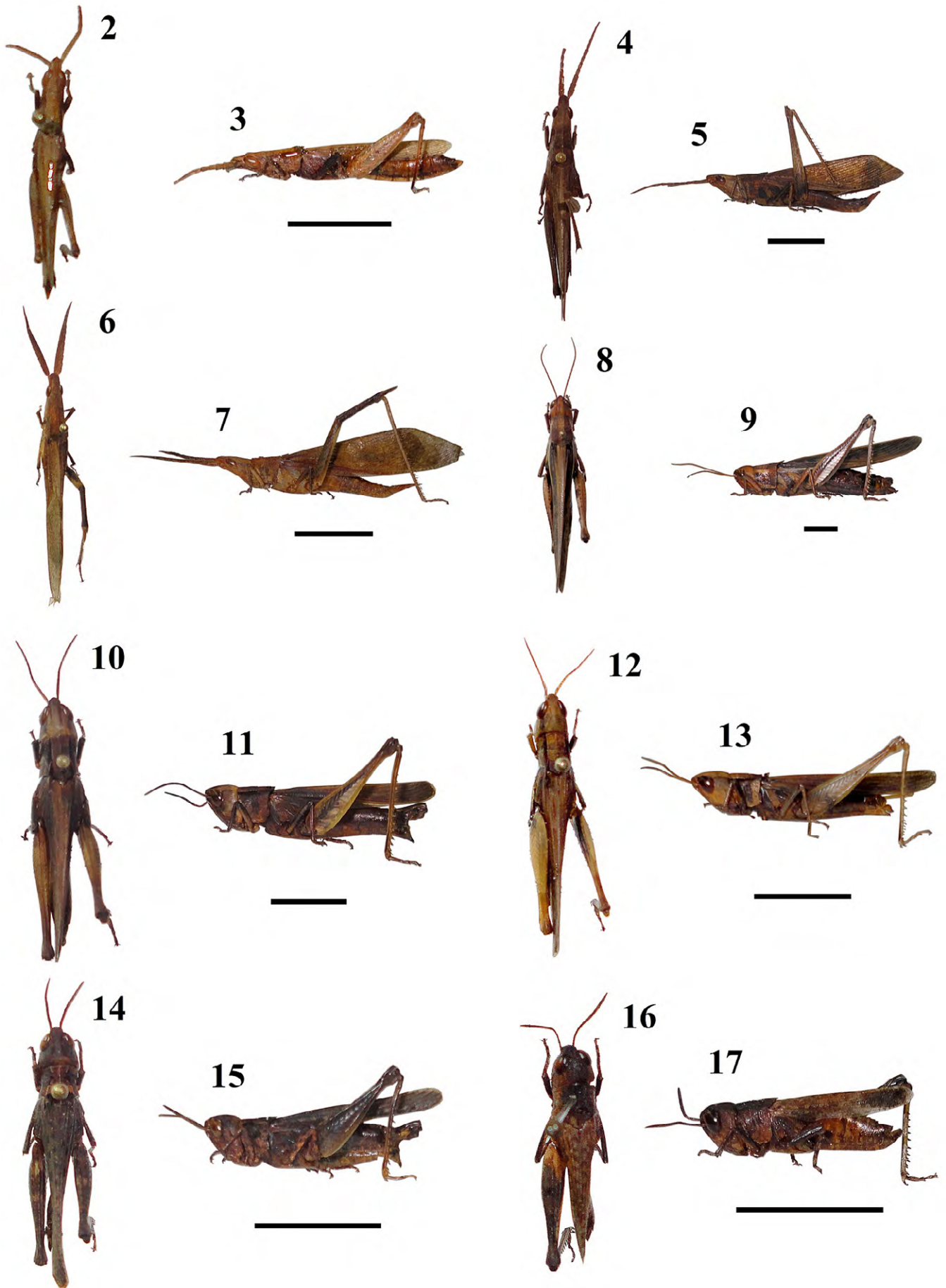
Orphula pagana (Stål, 1861)

Small-sized and slender grasshoppers. General color testaceous or ferruginous. Fastigium in dorsal aspect and in profile blunter cephalad. Fastigium broad. Tegmina are sharper and more acute. Some specimens have the dorsal dark line absent and the coloration but little varied. Hind femora robust. Subgenital plate rounded. Material examined: Table 1; MCTP 55167.

Copiocerinae

Aleuas lineatus Stål, 1878

Medium-sized and slender grasshoppers. General color greenish, with lateral line behind the antennae and a black line following the lower edge of the eyes. Fastigium obtusely triangular, with rounded apex. Pronotum ornamented by a dark dorsal band, wider following the genas, pronotum is limited externally by a narrow strip. Presence



Figures 2–17. Grasshoppers species (Orthoptera: Caelifera) found in the Espinhaço Range, Minas Gerais, Brazil. **2–3.** *Eutryxalis filata filata*. **4–5.** *Hyalopteryx rufipennis* Charpentier, 1845. **6–7.** *Paulacris exaggerata*. **8–9.** *Shistocerca cancellata cancellata*. **10–11.** *Amblytropidia robusta*. **12–13.** *Amblytropidia sola*. **14–15.** *Borellia bruneri*. **16–17.** *Borellia carinata*. Scale bars: 10 mm.

of lateral carinae only in prozone. Mandibular margin, genas and external margin of the lateral lobes of pronotum whitened. Tegmina hyaline, greenish. Hind tibiae with 8-9 spines. Epiproct slightly narrower at the posterior. Material examined: Table 1; MCTP 55168.

Aleuas gracilis Stål, 1878

Medium-sized grasshoppers. General color greenish yellow. Space interocular wide. Fastigium with obtuse apex, not prominent. Pronotum strongly rugous and punctured; median carinae distinct and ferruginous dark; lobes posterior of pronotum short. Tegmina and wings surpassing the end of the abdomen. Hind femora internally with a black band. Hind tibiae black in the base with seven spines on the outer edge. Subgenital plate short. Material examined: Table 1; MCTP 55169.

Aleuas vitticollis Stål, 1878

Aleuas brachypterus Bruner, 1906

Medium-sized grasshoppers. General color yellow ferruginous. Fastigium triangular with apex rounded. Presence of the dark band post-ocular. Stripe white lateral extends of head to the pronotum. Pronotum subcylindrical with rugose-puncturate surface; median carinae prominent. Tegmina greenish, slightly exceeding the apex of the abdomen. Hind femora narrow, not reaching the end of the abdomen and of the brown-green color. Hind tibiae reddened. Material examined: Table 1; MCTP 55170.

Cyrtacanthacridinae

Shistocerca cancellata cancellata (Serville, 1838)

Acridium emortuale Saussure, 1861

Shistocerca cancellata paranensis (Burmeister, 1861)

Large-sized and robust grasshoppers. General color brownish. Dorsum of pronotum with a yellow longitudinal stripe or slightly brownish. Lobes side of pronotum with a large brown spot, interrupted in the middle by a narrow whitish stripe. Tegmina of brown-reddish color with numerous spots irregular brown; apex of the tegmina exceeding the end of the abdomen twice the length of the pronotum. The second pair of wings is transparent, in general slightly pink to light yellow. Epiproct with sides curved. Material examined: Table 1; Figure 8 and 9; MCTP 55171.

Gomphocerinae

Amblytropidia robusta Bruner, 1906

Medium-sized and slender grasshoppers. General color pale testaceous. Head of moderate size, about as wide as front edge of the pronotum. Pronotum a little expanding posteriorly, the lateral carinae prominent. Tegmina without a definite intercalary vein, a little surpassing (male) but falling considerably short of the tip of the abdomen (female). Hind femora long and robust, surpassing the abdomen in

both sexes. Subgenital plate rounded. Material examined: Table 1; Figure 10 and 11; MCTP 55172.

Amblytropidia sola Rehn, 1939

Medium-sized grasshoppers. Form subcompressed. General color testaceous. Surface of disk and lateral lobes of pronotum, pleura and face. Head with dorsal line of the same slightly shorter than greatest length of pronotum. Fastigium prominent. Pronotum with dorsum slightly longer than dorsum of head, with carinate lateral margins, greatest width of dorsum equal to three-fifths length of same; median carinae marked, more decided than that head, cut by principal transverse sulcus. Cerci curved. Subgenital plate elongated. Material examined: Table 1; Figure 12 and 13; MCTP 55173.

Amblytropidia minor Bruner, 1911

Small-sized and moderately robust grasshoppers. General color brown. Head rather large, very little wider than the anterior portion of the pronotum. Eyes large and moderately prominent. Fastigium well rounded, and provided with strong antero-lateral margins and median longitudinal carinae. Tegmina with the costal margin undulate, the apical one-fourth plainly narrower. Hind femora robust. Subgenital plate rounded. Material examined: Table 1; MCTP 55174.

Borellia bruneri (Rehn, 1906)

Scyllinops liebermanni (Rehn, 1940)

Stirapleura signatipennis (Bruner, 1900)

Small-sized and moderately robust grasshoppers. General body light brown with dark spots. Pilous integument. Head, fastigium and region pos-ocular brown dark with median band longitudinal. Fastigium prominent. Pronotum with median carinae very prominent. Prozona and metazona subequal. Lateral lobes with brown-yellowish spots straight between the transverse sulci. Tegmina from the base with a white subcostal line, median area features a row of dark spots and subquadradas extended; rounded apex. Anterior and middle legs with robust femora with equal length. Epiproct as wide as the cerci, rectangular. Subgenital plate curved in side view up rounded apex. Material examined: Table 1; Figure 14 and 15; MCTP 55175.

Borellia carinata Rehn, 1906

Small-sized and moderately robust grasshoppers. General color dark brown marked with dark spots, the most conspicuous, the two lateral dorsal head bands and pronotal disk; the continued post-ocular bands on pronotum of sides are diffuse. Head slightly longer than the pronotal. Pronotum gently rounded dorsally; carinae side of pronotum well marked in prozone, but may be obsolete in metazona; prozone and metazona subequal in length, metazona not deeply punctured. Tegmina usually reaching the end of the hind femur. Hind femora robust. Abdomen slightly compressed. Epiproct suboval in shape, Cerci short and sharp.

Subgenital plate swollen. Material examined: Table 1; Figure 16 and 17; MCTP 55176.

Borellia saezi Carbonell, 1995

Small-sized grasshoppers. General color dark brown. Longitudinal bands on the head and pronotum often weak or vestigial. Fastigium with median dorsal carinula. Tegmina with white band on the costal area, dark spots in the middle region and reaching the genicular lobules of hind femora in females and males run to the apex. Subgenital plate rounded. Material examined: Table 1; Figure 18 and 19; MCTP 55177.

***Borellia* sp.**

Small-sized grasshoppers. General color dark brown. Fastigium and vertex with visible median carinula in lateral outline the prozona slightly shorter than metazona. Tegmina reaching or slightly surpassing apices of hind femora. White band on basal costal area, dark maculations on medial one. Males with dilated fore and middle femora. Material examined: Table 1; Figure 20 and 21; MCTP 55178.

Compsacris brevipennis (Rehn, 1906)

Small-sized and slender grasshoppers. General color dark brown. Head with the occiput slightly ascending and arched. Fastigium acute with the apex blunt; in length smaller than the space between the eyes. Abbreviated tegmina, aborted wings, the more compressed. Hind femora robust. Epiproct subtriangular. Subgenital plate rounded. Material examined: Table 1; MCTP 55179.

Notopomala glaucipes (Rehn, 1906)

Small-sized and slender grasshoppers. General color brown. Head distinctly shorter than the pronotum. Antennae dark brown. Fastigium with rounded apex. Eyes ovoid. Pronotum rounded in dorsal view, the presence of three distinct sulci. Two broad brown lines, one on each side of the fastigium extending through the eyes, pronotum to the tegmina. Hind tibiae green, dark genicular lobes, spines with black edges. Epiproct triangular. Material examined: Table 1; Figure 22 and 23; MCTP 55180.

Orphulella concinnula (Walker, 1870)

Linoceratium australe (Bruner, 1911)
Zonocerus bilineatus (Scudder, 1875)
Linoceratium boucardi (Bruner, 1904)
Orphulella chipmani Bruner, 1906
Stenobothrus lativittatus (Walker, 1870)
Orphulella peruna Bruner, 1910
Stenobothrus rugulosus (Walker, 1870)

Small-sized grasshoppers. General color brown. Head with post-ocular band dark extending to the end of tegmina. Antennae brown. Hind legs are light-brown color. Hind femora robust in males. Wings long that extend beyond the abdomen. Epiproct triangular. Cerci short. Subgenital plate elongated. Material examined: Table 1; MCTP 55181.

Orphulella elongata Bruner, 1911

Small-sized and slender grasshoppers. General color dull brown. Face testaceous. Head very gently wider than the anterior edge of the slightly compressed pronotum. Fastigium very gently acuminate. Eyes of moderate size, acuminate above, their anterior edge straight. Antennae slender, filiform. Pronotum with the anterior and posterior lobes about equal in length; the lateral carinae strongly and evenly arcuate in front of the last transverse. Tegmina long and slender reaching about one-fifth of their length beyond the tip of the abdomen. Hind femora slender. Subgenital plate rounded. Material examined: Table 1; Figure 24 and 25; MCTP 55182.

Orphulella paraguayensis (Rehn, 1906)

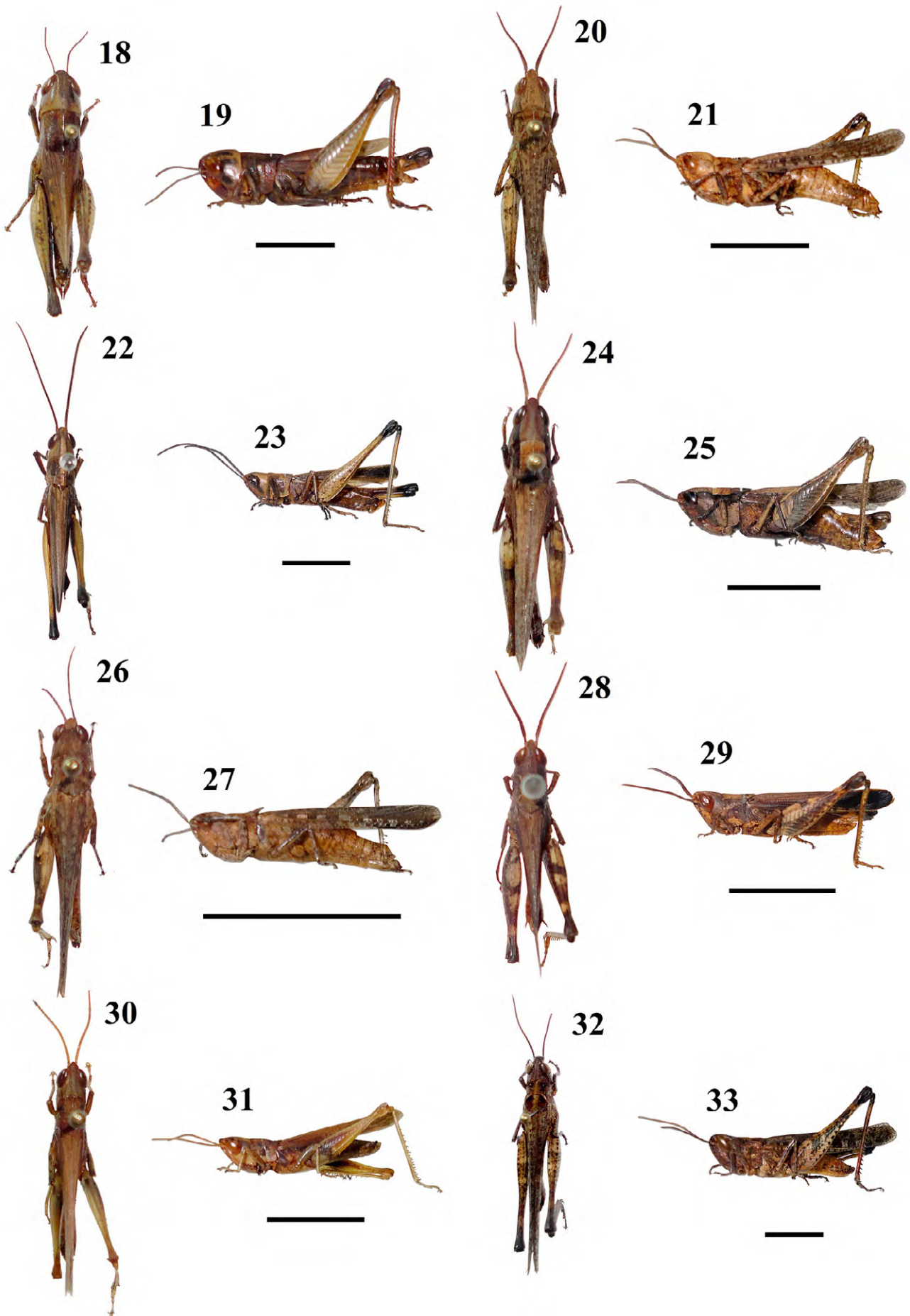
Orphulella obscura Bruner, 1906

Small-sized and slender grasshoppers. General color brown. Head slightly shorter than the pronotum. Fastigium subrectangulate in male. Pronotum with median carinae distinct, severed by the third sulcus slightly cephalad of the middle; lateral carinae strongly constricted to the first sulcus, absent between the first and second, straight between the second. Tegmina slightly exceeding the tips of the caudal femora. Wings ample. Abdomen considerably. Cerci of male styliform. Subgenital plate of the male somewhat contracted and turned in dorsal, apex moderately acute. Material examined: Table 1; Figure 26 and 27; MCTP 55183.

Orphulella punctata (De Geer, 1773)

Stenobothrus arctatus (Walker, 1870)
Orphulella compacta Bruner, 1911
Stenobothrus costalis (Walker, 1870)
Orphulella costaricensis Bruner, 1904
Stenobothrus elegans Giglio-Tos, 1894
Stenobothrus expansens (Walker, 1870)
Orphulella gracilis Giglio-Tos, 1894
Stenobothrus graciosus (Walker, 1870)
Orphulella grossa Bruner, 1911
Orphulella insularis Bruner, 1906
Orphulella interrupta Bruner, 1911
Truxalis intricata (Stål, 1873)
Gomphocerus meridionalis (Bruner, 1904)
Stenobothrus mexicanus (Walker, 1870)
Orphula olivacea (Giglio-Tos, 1898)
Stenobothrus tepanecus (Saussure, 1861)
Oxycoryphus totonacus (Saussure, 1861)
Stenobothrus viridissimus (Walker, 1870)
Oxycoryphus zapotecus (Saussure, 1861)

Small-sized grasshoppers. General color yellowish-brown with dark spots on the carinae of pronotum. Head shorter than pronotal. Pronotum with usually disk with triangular marks. Median carinae stained and well salient; distinct lateral carinae throughout its length and usually cut by two sulcus and between the previous sulci and the sulci stained median. Wings rounded and extending beyond the abdomen. Hind femur usually with spots. Hind tibiae with spines 10–11. Stridulatory structure at the hind femora. Material examined: Table 1; Figure 28 and 29; MCTP 55184.



Figures 18–33. Grasshoppers species (Orthoptera: Caelifera) found in the Espinhaço Range, Minas Gerais, Brazil. **18–19.** *Borellia saezi*. **20–21.** *Borellia* sp. **22–23.** *Notopomala glaucipes*. **24–25.** *Orphulella elongata*. **26–27.** *Orphulella paraguayensis*. **28–29.** *Orphulella punctata*. **30–31.** *Orphulina pulchella*. **32–33.** *Parapellopedon uniformis*. Scale bars. 10 mm.

Orphulina pulchella Giglio-Tos, 1894

Small-sized and narrow grasshoppers. General color greenish, the sides of the head, pronotum and pleura with a black line, sometimes lighter or darker. Face strongly oblique. Pronotal very little expanded in the trailing edge which is shorter than the previous one. Tergina extending considerably beyond the end of the abdomen. Hind femora surpassing the abdomen and yellowish. Material examined: Table 1; Figure 30 and 31; MCTP 55185.

Parapellopedon uniformis (Rehn, 1906)

Medium-sized and narrow grasshoppers. General color nut-brown. Head with post-ocular band darkened. Globular head. Fastigium rounded. Pronotum with median carinae elevated, arched slightly. Lobules of the pronotum lightly depth in the half. External face of the hind femur usually with black bands and very variable intensity, the marked inner face with dark blue and blue ventral sides. Hind tibiae slightly infuscated orange. Material examined: Table 1; Figure 32 and 33; MCTP 55186.

Pellopedon brunneum (Rehn, 1906)

Pellopedon obscurum Bruner, 1911

Medium-sized and robust grasshoppers. General color dark brown. Integument rugose. Head large and globose. Fastigium rounded. Eyes ovoid. Pronotum with rather high median carinae, lateral ones cut by three transverse sulci well marked. Presence in metazona of the dark spot. Wings developed. Interspace between the eyes very little. Lateral foveolae slightly longer than wide, impresso-punctate. Hind femur robust. Subgenital plate pointed. Material examined: Table 1; Figure 34 and 35; MCTP 55187.

Rhammatocerus brasiliensis (Bruner, 1904)

Medium-sized grasshoppers. General color dark brown. Pronotum with anterior and posterior lobes of the pronotum subequal in length. Tegmina less densely crosslinked, post-radial area provided with two rows of cells and intercalated veins. Genicular areas dark brown laterally. Hind femur robust; with the lower face red. Area external of the hind femora with stain sub-basal, basal and subapical wine-colored. Hind tibiae brown. Subgenital plate rounded. Material examined: Table 1; Figure 36 and 37; MCTP 55188.

Rhammatocerus brunneri (Giglio-Tos, 1895)

Plectrotettix conspersus (Bruner, 1904)

Medium-sized grasshoppers. General color light brown, with areas smaller dark brown and black. In side view, light brown with a black band below the eye to the previous mandibular joints. Tegmina with brown spots. Hind femora robust of light brown color on top with sub-basal and subapical spots red. Hind tibiae red at the base, gradually darkening and blue the apical third, with 9–12 spines. Subgenital plate elongated. Material examined: Table 1; Figure 38 and 39; MCTP 55189.

Rhammatocerus pictus (Bruner, 1900)

Medium-sized grasshoppers. General color dark brown, ventrally light yellow, pronotum dorsally ranging from green color and pale yellow, the posterior side of the pronotum are green. Lateral of pronotum green. Hind tibiae and side inferior of hind femur bright carmine color. Hind femora with clear stripes and exhibit a pre-apical ring of the same color. Wings yellowish. Hind tibiae with the apical third of wine color. Material examined: Table 1; Figure 40 and 41; MCTP 55190.

***Scyllinula* sp.**

Small-sized and slender grasshoppers. General color dark brown. Head large as compared with pronotal size than in the former Fastigium with foveolae well marked. lateral carinae of pronotum well marked, cut only by main sulcus, strongly inflexed at second sulcus. Wings developed. Material examined: Table 1; Figure 42 and 43; MCTP 55191.

Staurorhectus longicornis longicornis Giglio-Tos, 1897

Medium-sized grasshoppers. General color green-yellow, with black bands extending from the occiput to the eyes, wide and black side stripes. Fastigium limited by well defined edges. Dorsum of the pronotum externally adorned by lateral carinae white. Tegmina and wing hyaline with dark apex. Hind femora very large. Hind tibiae green and yellow. Epiproct triangular and acuminate. Cercus short and conical. Subgenital plate conical and short. Material examined: Table 1; Figure 44 and 45; MCTP 55192.

Leptysmiinae

Cylindrotettix uniformis (Bruner, 1911)

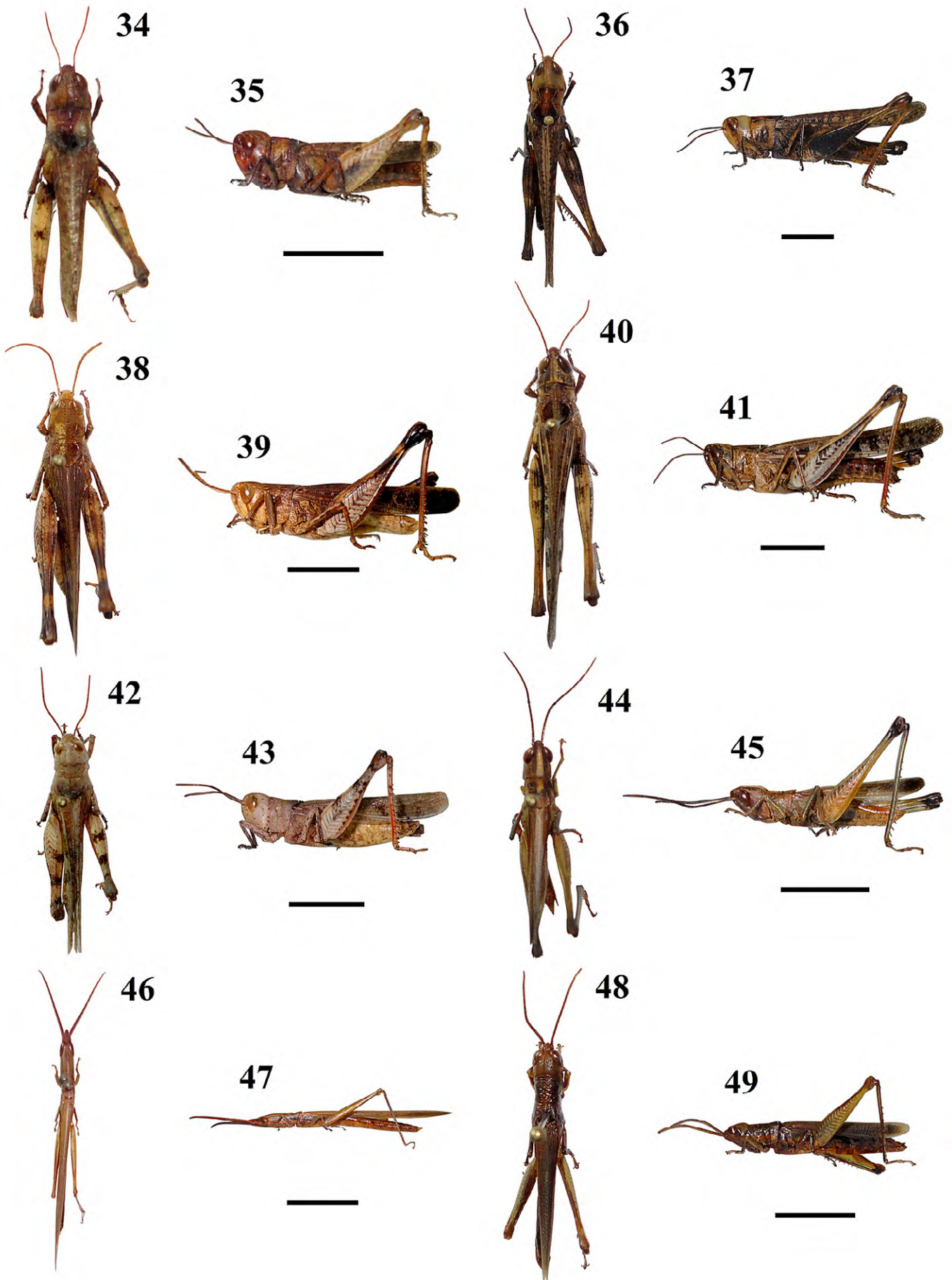
Leptysmia perlonga Hebard, 1923

Medium-sized and slender grasshoppers. General color grass-green and without the lateral longitudinal pale stripes. Form slender, cylindrical. Head horizontal, including the fastigium about one and one-half times the length of the pronotum. Eyes large. Fastigium moderately large, but prominent. Pronotum cylindrical closely and deeply punctulate. Pronotum with median carinae interrupted on anterior lobe in male. Tegmina and wings long, narrow, acuminate, greatly surpassing the apex of both the hind femur and the abdomen. Hind femur slender. Epiproct quadrate on basal half. Subgenital plate elongate and tapering, the apex emarginated. Material examined: Table 1; Figure 46 and 47; MCTP 55193.

Stenopola puncticeps puncticeps (Stål, 1861)

Oxyblepta minor Bruner, 1920

Medium-sized and slender grasshoppers. General color green-olivaceous. Lateral head and lobes of pronotum with spots pale and yellow. Head large and punctured. Fastigium elongated. Pronotum with median carinae conspicuous. Developed wings. Hind femora slender and long. Subgenital



Figures 34–49. Grasshoppers species (Orthoptera: Caelifera) found in the Espinhaço Range, Minas Gerais, Brazil. **34–35.** *Pelopedon brunneum*. **36–37.** *Rhammatocerus brasiliensis*. **38–39.** *Rhammatocerus brunneri*. **40–41.** *Rhammatocerus pictus*. **42–43.** *Scyllinula* sp. **44–45.** *Staurorhectus longicornis longicornis*. **46–47.** *Cylindrotettix uniformis*. **48–49.** *Stenopola puncticeps puncticeps*. Scale bars. 10 mm.

plate rounded. Material examined: Table 1; Figure 48 and 49; MCTP 55194.

Melanoplinae

Leiotettix pulcher (Rehn, 1913)

Medium-sized and slender grasshoppers. General color reddish-brown and head dorsally. Head, face and gena green; dark green stripe limited by a yellowish dorsally area. Pronotal side lobes with a distinct post-ocular dark green band, with some cream-colored areas. Hind femora brown in the dorsal area, green and yellow inferiorly. Cercus with compressed distal half, obliquely truncated in end. Subgenital plate rounded. Material examined: Table 1; Figure 50 and 51; MCTP 55195.

Leiotettix viridis Bruner, 1906

Leiotettix punctipes Bruner, 1906

Medium-sized grasshoppers. General color green. Eyes prominent. Fastigium rounded. Side of the body without post-ocular dark band. Pronotum with slightly angled posterior margin and with lateral darker. Abdomen of color pale yellow, with the sides of basal segments dark brown in the anterior portion. Tegmina surpassing the end of the hind femur. Hind femora yellow, except in the upper half of the dorsal area is greenish with a row of black brown spots. Cercus sharply narrowing in half, in the apical half slightly diverging. Subgenital plate rounded. Material examined: Table 1; MCTP 55196.

Scotussa lemniscata (Stål, 1861)

Leiotettix mendosensis Rehn, 1918

Small-sized and slender grasshoppers. General color yellowish brown with a continuous post-ocular stripe, black and wide extending from the head to the pronotum. Head as wide as the front end pronotum. Eyes large. Tegmina long, exceeding the end of the abdomen with dorsal and lateral areas of dark brown coloring. Hind femora yellowish brown, except in the upper half of the outer face appears dark brown; red-orange inner face. Lobules genicular black dorsally. Hind tibiae pale orange. Wing with brownish veins. Cerci robust. Subgenital plate elongated with bulky apex. Material examined: Table 1; MCTP 55197.

Ommatolampidinae

Orthoscaphus coriaceus (Giglio-Tos, 1894)

Orthoscaphus roseipennis Bruner, 1906

Medium-sized and slender grasshoppers. General color dark brown, with some indication of ferruginous upon head, pleura and hind femora. Tegmina quite evenly conspersed with small fuscous spots. Surface of head, pronotum, pleura, anterior and middle legs and carinae of hind femora also conspersed with dark brown or black. Hind wings transparent rose color, becoming smoky apically,

the veinlets on apical half and some of the veins also black. Hind femora with the inner side, lower sulcus and the lower outer edge also pitch black; upper edge with two transverse dusky bands, the outer fourth including knee brownish testaceous. Subgenital plate rounded. Material examined: Table 1; MCTP 55198.

Orthoscaphus planaltinus Roberts & Carbonell, 1981

Medium-sized and slender grasshoppers. General color dark brown. Fastigium protrudes a little beyond lateral ocelli and adjoining frontal costa, and is nearly as broad as distance between lateral ocelli. Hind femora with outer ventral portion black, and bordered above by pale yellow-brown. Inner face has black bands or patches, but differs by having red on lower portion of inner face. Red wings and red hind tibiae Male cercus weakly bifurcate at apex. Subgenital plate pointed. Material examined: Table 1; Figure 52 and 53; MCTP 55199.

Jodacris chapadensis (Bruner, 1911)

Medium-sized and slender grasshoppers. General color dark brown. Lack of dark postocular stripe with pale area below it. Fastigium rounded in apex. Hind femora with black on outer ventral side. Developed wing. Distal slender portion of male cercus strongly upturned, but shorter, slightly turned outward, and no substantial thickening towards base. Inner median lobe large. Subgenital plate rounded. Material examined: Table 1; Figure 54 and 55; MCTP 55200.

Ommexechidae

Ommexechinae

Clarazella bimaculata (Giglio-Tos, 1894)

Atrachelacris aurosignatus Piza, 1973

Parossa paludivaga Rehn, 1941

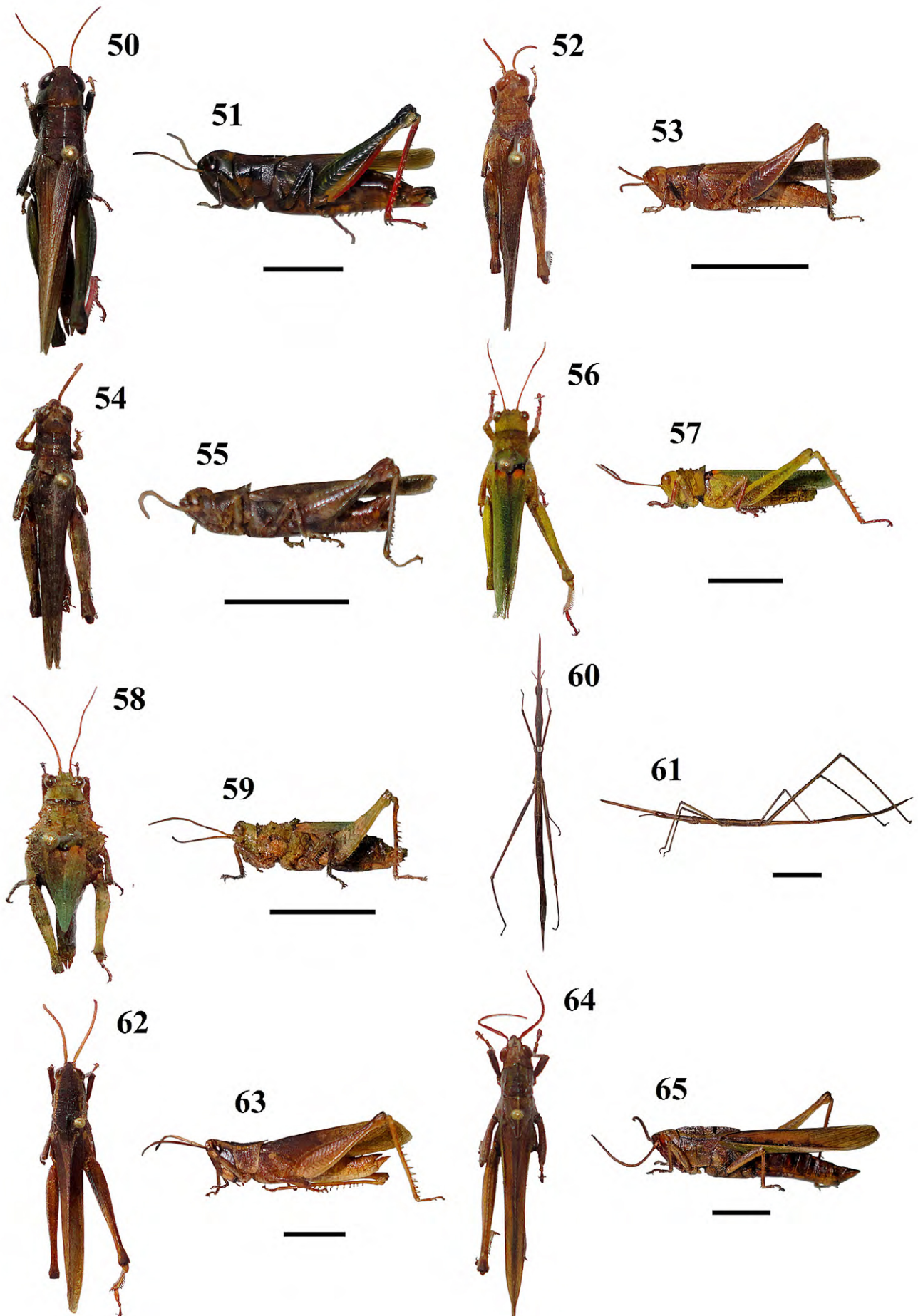
Small-sized and slender grasshoppers. General color green lemon, varying to light green-yellow. Pronotum yellowish brown, forming an oblique stripe; lateral lobes of pronotum with well marked ridges. Tegmina with orange basal spot very characteristic of the species. Hind femur with small spots light brown color. Cercus tapered and prominent. Subgenital plate with acute apex. Epiproct triangular. Material examined: Table 1; Figure 56 and 57; MCTP 55201.

Ommexecha virens Serville, 1831

Ommexecha germari Burmeister, 1838

Ommexecha servile Blanchard, 1836

Small-sized and slender grasshoppers. General color dark brown. Integument of the body rugose in the head and pronotum. Prominent eyes. Lateral lobes of the pronotum with prominent spiniform. Wings dark brown wings. Hind femora with basal spot of dark brown color. Insects brachypterous or macropterous. Subgenital plate short. Material examined: Table 1; Figure 58 and 59; MCTP 55202.



Figures 50–65. Grasshoppers species (Orthoptera: Caelifera) found in the Espinhaço Range, Minas Gerais, Brazil. **50–51.** *Leiotettix pulcher*. **52–53.** *Orthoscaphus planaltinus*. **54–55.** *Jodacris chapadensis*. **56–57.** *Clarazella bimaculata*. **58–59.** *Ommexecha virens*. **60–61.** *Proscopia bivittata*. **62–63.** *Abila bolivari*. **64–65.** *Xyleus gracilis*. Scale bars. 10 mm.

Proscopiidae
Proscopiinae

Proscopia bivittata Piza, 1946

Medium-sized and slender. General color brown. Head conical. Fastigium elongated. Pronotum tectiform; mesonotum and metanotum punctured. Mesopleurae strongly dentate. Hind femur elongated. Hind tibiae with 16 spines external and 8 internal. Abdomen enlarged. Epiproct longer than wide. Material examined: Table 1; Figure 60 and 61; MCTP 55203.

Romaleidae
Romaleinae

Abila bolivari Giglio-Tos, 1900

Homalosapar uscanonicus Rehn, 1908
Homalosapar sordidatus Rehn, 1909

Medium-sized and slender grasshoppers. General color brown. Post-ocular and genal band dark, upper parts of lateral lobes of pronotum. Tegument of body rugose. Pronotum with metazona slightly shorter than prozona; median carinae absent or very slightly marked. Tegmina and wings well developed, the former surpassing end of abdomen and of hind femora, with apices obliquely truncated but rounded. Material examined: Table 1; Figure 62 and 63; MCTP 55204.

Xyleus gracilis (Bruner, 1905)

Medium-sized and elongated grasshoppers. General color light brown. Pronotum with crest low and greenish. Tegmina with pre-costal and costal area greenish. Presence of a narrow line that starts in pronotal crest up until the sides of the pronotum. Hind femora narrow. Wings on base of the anal area are colored with shades of pink to red. Hind tibia with 15 to 18 spines. Subgenital plate pointed. Material examined: Table 1; Figure 64 and 65; MCTP 55205.

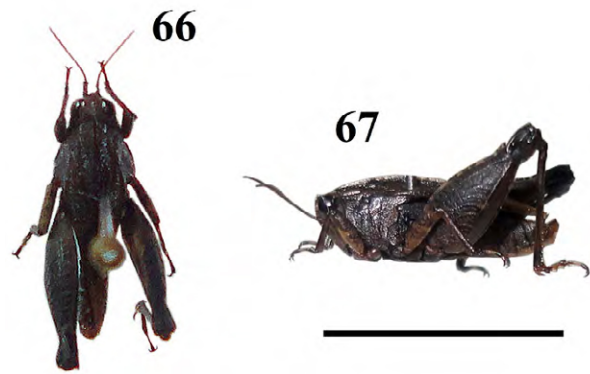
Zoniopoda similis Bruner, 1906

Medium-sized and elongated grasshoppers. General color green, with yellow spots in sides and in disk of the pronotum. The males are stained of reddish on the thighs and face. Head wide, slightly wider than the pronotum. Prominent eyes. Fastigium short and triangular. Pronotum narrow, subcylindrical. Wings blue. Hind femora narrow, not reaching the apex of the abdomen. Hind tibiae yellowish green. Subgenital plate pointed and long. Material examined: Table 1; MCTP 55206.

Tetrigidae
Tetriginae

Tetrix subulata (Linnaeus, 1758)

Tetrix subulata atrata Voroncovskij, 1928
Tetrix austriaca Schmidt & Devkota, 1989
Tetrix bielawskii Bazyluk, 1963



Figures 66–67. Grasshoppers species (Orthoptera: Caelifera) found in the Espinhaço Range, Minas Gerais, Brazil. **66–67.** *Tetrix subulata*. Scale bars. 10 mm.

Acrydium bimaculatum Herbst, 1786
Acrydium cristatum Thunberg, 1815
Acrydium dorsal Thunberg, 1815
Acrydium ephippium Thunberg, 1815
Tetrix exclamatoris Saint-Fargeau & Serville, 1825
Tetrix flavolineata Voroncovskij, 1928
Acrydium granulatum Kirby, 1837
Tetrix incurvatus Hancock, 1895
Tetrix luggeri Hancock, 1899
Acrydium lunulatum Thunberg, 1815
Tetrix marginata Saint-Fargeau & Serville, 1825
Tetrix morsei Hancock, 1899
Acrydium subulatum Kirby, 1910
Acrydium thoracicum Olivier, 1791

Small-sized body. Form elongated. General color dark brown with spots. Pronotum is highly elongated, tapered, usually covers abdomen. Hind tibiae expanded. Front and middle tarsi with 2 segments, hind tarsi with 3 segments. Auditory and stridulatory organs absent. Tegmina ovate-oblong, apex round-obtuse shaped. Wings developed, reaching or slightly extending past apex of pronotal posterior process. Subgenital plate short. Material examined: Table 1; Figure 66 and 67; MCTP 55207.

This study is the first time that the following species have been reported in Minas Gerais state: *Aleuas gracilis* Stål, 1878, *Aleuas vitticollis* Stål, 1878, *Amblytropidia robusta* Bruner, 1906, *Amblytropidia sola* Rehn, 1939, *Borellia bruneri* (Rehn, 1906), *Borellia saezi* Carbonell, 1995, *Leiotettix pulcher* (Rehn, 1913), *Notopomala glaucipes* (Rehn, 1906), *Orphula pagana* (Stål, 1861), *Orphulella elongata* Bruner, 1911, *Orphulella paraguayensis* (Rehn, 1906), *Orphulina pulchella* Giglio-Tos, 1894, *Parorphula graminea* Bruner, 1900, *Rhammatocerus pictus* (Bruner, 1900), *Schistocerca cancellata cancellata* (Serville, 1838), *Staurorhectus longicornis longicornis* Giglio-Tos, 1897, *Stenopola puncticeps puncticeps* (Stål, 1861).

DISCUSSION

In our study, grasshoppers were a conspicuous element of insect fauna in field and savanna vegetation, and were diverse and present in large numbers. This study was able

to add 17 new species occurrences to the known fauna of Minas Gerais. This is partly due to the fact that so few studies on diversity of grasshoppers have been conducted in the mountains of Brazil.

Compared to other such studies in Brazil (COSTA & JANTSCH 1999; LUTINSK et al. 2011; GUERRA et al. 2012) and in South America (CIGLIANO et al. 2000; TORRUSIO et al. 2002), the diversity of grasshoppers observed in the present study is high. Forty-six species were identified, with the richest family being Acrididae, with 39 (85%) of the species collected. Of the acridid subfamilies, the best represented was Gomphocerinae, with 21 species (54%).

The most species-rich acridid subfamily in the Neotropical Region is Melanoplinae, which accounts for a total of 43 genera and 232 species (Cigliano 2006). However, recent studies have identified a number of species of subfamily Gomphocerinae (LUTINSK et al. 2011; GUERRA et al. 2012). LUTINSK et al. (2011) found 25 species in the Chapecó National Forest Reserve in the state of Santa Catarina (southern Brazil). Of these, in the native forest the richest subfamily was Gomphocerinae, with five species (25%), though the Melanoplinae were more abundant, with 227 individuals (34%). GUERRA et al. (2012) registered 64 species in the Chapada do Parecis plateau in the state of Mato Grosso do Sul, of which 49 species (76.6%) were acridids. Of these, the subfamily Gomphocerinae was the richest, with 21 species (42.9%), and the Melanoplinae were most abundant, with 1,142 individuals sampled (37.9%), followed by Gomphocerinae with 955 individuals (31.6%). The most abundant species in the subfamily Melanoplinae was *Baecaris punctulatus* (Thunberg, 1824) with 1,023 individuals (89.6%) collected in areas of soybean cultivation. Of the 1,202 species collected in regions in the Cerrado, the subfamily that was most abundant was Gomphocerinae, with 510 individuals (42.4%).

The high diversity of Gomphocerinae in fields of the southern Espinhaço Range can be explained by the feeding behavior of this particular subfamily, whose members are oligophagous and therefore feed on only one plant family (CHAPMAN 1990). Grasshoppers of the subfamily Gomphocerinae feed exclusively on grasses (family Poaceae), while those of the subfamily Melanoplinae may feed on grasses, forbs, and shrubs (JOERN 1979; JOERN & LAWLOR 1981; CRAIG et al. 1999). The results of this study are consistent with those of PRZYBYSZEWSKI & CAPINERA (1990), who showed the subfamily Gomphocerinae to be the most abundant in North American prairies.

As demonstrated by VIANA & FILGUEIRAS (2008), the Espinhaço Range presents a high diversity of grasses, with 36 species being considered endemic to the region. Based on a compilation of data performed by the author, 340 Poaceae species have been found in the Espinhaço Range, distributed among seven families and 88 genera. Again according to the author, of these 340 species 212 are also found in the vegetation of the Cerrado. When compared to other neighboring regions, Serra do Cipó National Park, located in the central region of the Espinhaço Range is home

to the greatest number of species of Poaceae (161 species). Other regions in the range, which are home to Poaceae, include the iron quadrangle (131 species) and the Setor Baiano Espinhaço Range (114 species). In light of this, it is possible that the richness of species from Gomphocerinae observed in the present study is related to the richness and abundance of its host plants in the study area. In addition, it is also possible that the central region of the Espinhaço Range contains a richer and more abundant population of Gomphocerinae than does the iron quadrangle or Chapada Diamantina regions, due to the fact that it contains a greater species richness of Poaceae.

Species of the Melanoplinae subfamily are polyphagous and feed on a variety of plant families (CHAPMAN 1990). They possess a detoxification mechanism for dealing with the chemical defenses of their host plants, but because they feed on many different plants, they must deal with the effects of many different secondary metabolites (JOERN 1979). Therefore, Melanoplinae also feed on small parts of different plants to keep toxicity levels below a critical point. The soils in rupestrian fields are relatively poor in nutrients, and cause the plants to have a high carbon-to-nitrogen ratio. The plants are therefore more likely to employ carbon-based chemical defenses, most notably in the form of digestive impediments. This creates a distinct advantage for Gomphocerinae grasshoppers, because Poaceae are not known for their use of secondary metabolites, instead using high concentrations of silica to reduce herbivory. A future study will examine the principal determinants of grasshopper richness and abundance in their diversity patterns in grasslands.

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LITERATURE CITED

- ALKMIM, F.F. 1987. Modelo Depositional para a seqüência de metassedimentos da Serra de Ouro Branco, Quadrilátero Ferrífero, Minas Gerais. Anais do Simpósio sobre Sistemas Depositionais no Pré-Cambriano. Boletim da Sociedade Brasileira de Geologia, Núcleo Minas Gerais 6: 47-68.
- AMÈDÈGNATO, C. & M. DESCAMPS. 1978. Evolution des populations d'Orthopteres d'Amazonie du Nord-Ouest dans les cultures traditionnelles et les formations secondaires d'origine anthropique. *Acrida* 9(1): 2-33.
- AUSDEN, M. & M. DRAKE. 2006. Invertebrates; pp. 214-247, in: W. J. Sutherland (ed). *Ecological census techniques: a handbook*. Cambridge: Cambridge University Press.
- BLANCHARD, E. 1843. *Insectes de l'Amérique Meridionale recueillis*

- par Alcide d'Orbigny; pp. 58–222, in: A d'Orbigny (ed.). Voyage dans l'Amérique Meridionale: (le Brésil, la république orientale de l'Uruguay, la République argentine, la Patagonie, la république du Chili, la république de Bolivie, la république du Pérou), exécuté pendant les années 1826, 1827, 1828, 1829, 1830, 1831, 1832, et 1833, tome 6, part. 2, Insectes. Paris. <http://biodiversitylibrary.org/page/2531022>
- BORGES, R.A.X., CARNEIRO, M.A.A. & P.L. VIANA. 2011. Altitudinal distribution and richness of herbaceous plants in campos ruprestres of the Southern Espinhaço Range, Minas Gerais, Brazil. *Rodriguesia* 62(1): 139–152. <http://rodriguesia-seer.jbrj.gov.br/index.php/rodriguesia/article/view/232>
- BRUNER, L. 1900. The second report of the Merchant's Locust Investigation Commission of Buenos Aires. Lincoln: Hunter-Woodruff Printing. 80 pp. doi: [10.5962/bhl.title.9681](https://doi.org/10.5962/bhl.title.9681)
- BRUNER, L. 1904. Acrididae; pp. 105–176, in: *Biologia Centrali-Americana* Vol. 2.
- BRUNER, L. 1905. Acrididae; pp. 177–208, in: *Biologia Centrali-Americana*, Vol. 2.
- BRUNER, L. 1905. Acrididae; pp. 177–208, in: *Biologia Centrali-Americana*, Vol. 2.
- BRUNER, L. 1905. Two new South American grasshoppers. *Entomological News* 16: 214–215. <http://biodiversitylibrary.org/page/2567604>
- BRUNER, L. 1906. Synoptic list of Paraguayan Acrididae or Locusts, with descriptions of new forms. *Proceedings of the United States National Museum* 30(1461): 61–694. doi: [10.5479/si.00963801.30-1461.613](https://doi.org/10.5479/si.00963801.30-1461.613)
- BRUNER, L. 1911. I. South American Acridoidea. *Annals of the Carnegie Museum* 8(1): 5–147. <http://biodiversitylibrary.org/page/9479975>
- BURR, M. 1902. A monograph of the genus *Acrida* Stal (= *Truxalis* Fabr.) with notes on some allied genera, and description of new species. *Transactions of the Entomological Society of London* 2: 149–187. doi: [10.1111/j.1365-2311.1902.tb01380.x](https://doi.org/10.1111/j.1365-2311.1902.tb01380.x)
- CAPINERA, J. L. 2010. *Insects and wildlife: Arthropods and their relationships with wild vertebrate animals*. Chichester: Wiley Blackwell. 487 pp.
- CAPINERA, J.L., SCHERER, C.W. & J.M. SQUITIER. 2001. *Grasshoppers of Florida*. Gainesville: University Press of Florida. 143 pp.
- CAPINERA, J.L., SCOTT, R. & T.J. WALKER. 2004. *Field guide to grasshoppers, katydids and crickets of the United States and Canada*. Ithaca: Cornell University Press. 249 pp.
- CARBONELL, C.S. 1995. Revision of the tribe Scyllinini, nov. (Acrididae: Gomphocerinae), with descriptions of new genera and species. *Transactions of the American Entomological Society* 121(3): 87–152. <http://www.jstor.org/stable/25078590>
- CARBONELL, C.S. 1988. *Rhammatocerus palustris* n. sp. from central Brazil and Paraguay (Orthoptera, Acrididae, Gomphocerinae). *Boletim Museu Nacional, Rio de Janeiro* 322: 1–12.
- CARNEIRO, M.A.A., BORGES, R.A.X., ARAÚJO, A.P.A. & G.W. FERNANDES. 2009. Insetos indutores de galhas da porção sul da Cadeia do Espinhaço, Minas Gerais, Brasil. *Revista Brasileira de Entomologia* 53(4): 570–592. <http://submission.scielo.br/index.php/rbent/article/view/4843>
- CARNEIRO, M.A.A., RIBEIRO, S.P. & G.W. FERNANDES. 1995. Artrópodes de um gradiente altitudinal na Serra do Cipó, Minas Gerais, Brasil. *Revista Brasileira de Entomologia* 39(3): 597–604.
- CHAPMAN, R.F. 1990. Food Selection; pp. 39–72, in: R.F. Chapman and A. Joern (eds.). *Biology of grasshoppers*. New York: Wiley-Interscience Publication.
- CHARPENTIER, T.D. 1845. *Orthoptera descripta et depicta*. Lipsiae: Text [unnumbered pages] 60 pl.
- CIGLIANO, M.M. 2006. Review of the South American genus *Eurotettix* Bruner (Orthoptera, Acrididae, Melanoplinae). *Systematic Entomology* 32(1): 176–195. doi: [10.1111/j.1365-3113.2006.00353.x](https://doi.org/10.1111/j.1365-3113.2006.00353.x)
- CIGLIANO, M.M., DE WYSIECKI, M.L. & C. LANGE. 2000. Grasshopper (Orthoptera, Acrididae) species diversity in the pampas, Argentina. *Diversity and Distributions* 6(2): 81–91. doi: [10.1046/j.1472-4642.2000.00077.x](https://doi.org/10.1046/j.1472-4642.2000.00077.x)
- COSTA, M.K.M. & L.J. JANTSCH. 1999. Acridóideos (Orthoptera, Caelifera, Acridoidea) ocorrentes no Rio Grande do Sul, Brasil. *Biociências* 7: 135–155.
- CRAIG, D.P., BOCK, C.E., BENNETT, B.C. & J.H. BOCK. 1999. Habitat relationships among grasshoppers (Orthoptera: Acrididae) at the western limit of the Great Plains in Colorado. *The American Midland Naturalist* 142(2): 314–327. doi: <http://doi.org/cj2xgm>
- DE GEER, C. 1773. *Mémoires pour servir à l'histoire des insectes*. Pierre Hesselberg, Stockholm 3: 226–503
- EVANS, E.W. & K.W. BAILEY. 1993. Sampling grasshoppers (Orthoptera: Acrididae) in Utah grasslands: pan trapping versus sweep sampling. *Journal of the Kansas Entomological Society* 66(2): 214–222. <http://www.jstor.org/stable/25085436>
- GANGWERE, S.K., MURALIRANGAN, M.C. & M. MURALIRANGAN. 1997. *The Bionomics of Grasshoppers, Katydid and their Kin*. New York: Wallingford CAB International. 529 pp.
- GIGLIO-TOS, E. 1894. Viaggio dell dott. Alfredo Borelli nella Repubblica Argentina e nel Paraguay. VI, Ortoteri. *Bollettino dei Musei di Zoologia ed Anatomia Comparata della R. Università di Torino* 9(184): 1–46. <http://biodiversitylibrary.org/page/11243204>
- GIGLIO-TOS, E. 1895. Ortoteri del Paraguay, raccolti dal Dr. J. Bohls. *Zoologischen Jahrbüchern, Abtheilung für Anatomie und Ontogenie der Thiere* Jena 8: 804–818.
- GIGLIO-TOS, E. 1897. Viaggio del Dott. A. Borelli nel Chaco Boliviano e nella Republica Argentina. X, Ortoteri. *Bollettino dei Musei di Zoologia ed Anatomia Comparata della R. Università di Torino* 12(302): 1–47.
- GIGLIO-TOS, E. 1900. Viaggio del Dr. A. Borelli nel Matto Grosso e nel Paraguay. IV, Ortoteri. *Bollettino dei Musei di Zoologia ed Anatomia Comparata della R. Università di Torino* 15(377): 1–8.
- GIULIETTI, A.M., MENEZES, N.L., PIRANI, J.R., MEGURO, M. & M.G.L. WANDERLEY. 1987. Flora da Serra do Cipó, Minas Gerais: Caracterização e lista de espécies. *Boletim de Botânica da Universidade de São Paulo* 9: 1–152. <http://www.jstor.org/stable/42871886>
- GUERRA, W.D., OLIVEIRA, P.C. & J.R. PUJOL-LUZ. 2012. Gafanhotos (Orthoptera: Acrididae) em áreas de cerrados e lavouras na Chapada dos Parecis, Estado de Mato Grosso, Brasil. *Revista Brasileira de Entomologia* 56(2): 228–239. doi: [10.1590/S0085-56262012005000027](https://doi.org/10.1590/S0085-56262012005000027)
- JANZEN, D.H. 1973. Sweep samples of tropical foliage insects: effects of season, vegetation types, elevation, time of day, and insularity. *Ecology* 54 (3): 687–708. doi: [10.2307/1935359](https://doi.org/10.2307/1935359)
- JOERN, A. 1979. Feeding patterns in grasshoppers (Orthoptera: Acrididae): factors influencing diet specialization. *Oecologia* 38(3): 325–347. doi: [10.1007/BF00345192](https://doi.org/10.1007/BF00345192)
- JOERN, A. & L.R. LAWLOR. 1981. Guild structure in grasshopper assemblages based on food and microhabitat differences. *Oikos* 37(1): 93–104. doi: [10.2307/3544078](https://doi.org/10.2307/3544078)
- KÖPPEN, W. 1948. *Climatology: a study of the climates of the earth*. Ciudad del México: Fondo de Cultura Económica. 478 pp.
- LARA, A.C.F. & G.W. FERNANDES. 1996. The highest diversity of galling insects: Serra do Cipó, Brazil. *Biodiversity Letters* 3(3): 111–114. doi: [10.2307/2999724](https://doi.org/10.2307/2999724)
- LINNAEUS, C. 1758. *Systema naturæ per regna tria naturæ, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Tomus I. Editio decima, reformata. 824 pp. doi: [10.5962/bhl.title.542](https://doi.org/10.5962/bhl.title.542)
- LUTINSK, C.J., LUTINSK, J.A., COSTA, M.K.M. & F.R.M. GARCIA. 2011. Análise faunística de gafanhotos na Floresta Nacional de Chapecó, Santa Catarina. *Pesquisa Florestal Brasileira* 31(65): 43–50. <http://pfb.cnpf.embrapa.br/pfb/index.php/pfb/article/viewArticle/191>
- MARTINELLI, G. 2007. *Mountain Biodiversity in Brazil*. Brazilian

- Journal of Botany 30(4): 587-597. doi: [10.1590/S0100-84042007000400005](https://doi.org/10.1590/S0100-84042007000400005)
- PIZA, J. & S. DE TOLEDO. 1946. Nota sinonímica e descrição de espécies novas de Proscopiidae brasileiros. Anais da Escola Superior de Agricultura Luiz de Queiroz, Piracicaba 3(35): 157-171.
- PRZYBYSZEWski, J. & J.L. CAPINERA. 1990. Spatial and Temporal Patterns of Grasshoppers (Orthoptera: Acrididae) Phenology and Abundance on a Shortgrass Praire. Journal of the Kansas Entomological Society 63(3): 405-413. <http://www.jstor.org/stable/25085197>
- RAPINI, A., RIBEIRO, P.L., LAMBERT, S. & J.R. PIRANI. 2008. A flora dos campos rupestres da Cadeia dos Espinhaço. Megadiversidade 4(1-2): 16-24. http://www.conservation.org/global/brasil/publicacoes/Documents/megadiversidade_espinhaco.pdf
- REHN, J.A.G. 1906. Notes on South American grasshoppers of the subfamily Acridinae (Acrididae), with descriptions of new genera and species. Proceedings of the United States National Museum 30(1453): 371-391. <http://biodiversitylibrary.org/page/15786535>
- REHN, J.A.G. 1906. Studies in South and Central American Acridinae (Orthoptera), with the descriptions of a new genus and six new species. Proceedings of the Academy of Natural Sciences of Philadelphia 58: 10-50. <http://biodiversitylibrary.org/page/6390615>
- REHN, J.A.G. 1913. A contribution to the knowledge of the Orthoptera of Argentina. Proceedings of the Academy of Natural Sciences of Philadelphia 65: 273-379. <http://biodiversitylibrary.org/page/6330821>
- REHN, J.A.G. 1939. A new genus and four new species of Acrididae from Brazil and Argentina (Orthoptera). Transactions of the American Entomological Society 65(3):193-208. <http://www.jstor.org/stable/25077437>
- RIBEIRO, S.P., CARNEIRO, M.A.A. & G.W. FERNANDES. 1998. Free feeding insect herbivores along environmental gradients in Serra do Cipó: fundamentals for a management plan. Journal of Insect Conservation 2(2): 107-118. doi: [10.1023/A:1009669405776](https://doi.org/10.1023/A:1009669405776)
- ROBERTS, H.R. & C.S. CARBONELL. 1981. A revision of the Neotropical genus *Abracris* and related genera (Orthoptera, Acrididae, Ommatolampinae). Proceedings of the Academy of Natural Sciences of Philadelphia 133: 1-14. <http://www.jstor.org/stable/4064766>
- SANTOS, M.F., SERAFIM, H. & P.T. SANO. 2011. Fisionomia e Composição da Vegetação Florestal da Serra do Cipó, MG, Brasil. Acta Botanica Brasilica 25(4): 793-814. doi: [10.1590/S0102-33062011000400007](https://doi.org/10.1590/S0102-33062011000400007)
- SERVILLE, J.G.A. 1831. Revue methodique des insectes de l'Ordre des Orthoptères. Annales des Sciences Naturelles 22(86): 262-292.
- Serville, J.G.A. 1838. Histoire naturelle des insectes Orthoptères. Collection des suites a Buffon. Paris. 776 pp.
- Stål, C. 1861. Kongliga Svenska fregatten *Eugenies Resa* omkring jorden under befäl af C.A. Virgin, åren 1851-1853 (Zoologi) 2(1): 339.
- STÅL, C. 1878. Systema acridiodeorum. Essai d'une systematisation des acridoidées. Bihang till Kongliga Svenska Vetenskaps-akademien Handlingar 5(4): 1-100. <http://biodiversitylibrary.org/page/14144410>
- TORRUSIO, S., M.M. CIGLIANO & M.L. DE WYSIECKI. 2002. Grasshopper (Orthoptera: Acridoidea) and plant community relationships in the Argentine Pampas. Journal of Biogeography 29(2): 221-229. doi: [10.1046/j.1365-2699.2002.00663.x](https://doi.org/10.1046/j.1365-2699.2002.00663.x)
- VIANA, P.L. & T.S. FILGUEIRAS. 2008. Inventário e distribuição geográfica das gramíneas (Poaceae) na Cadeia do Espinhaço, Brasil. Megadiversidade 4(1-2): 71-88.
- WALKER, F. 1870. Catalogue of the specimens of Dermaptera Saltatoria in the collection of the British Museum 3: 425-604, 4: 605-809, 5: 811-850. London: British Museum (Natural History).

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