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 northeastern 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 rupetrian 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 (Amédègnato & 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, 43°42’48.6”W), Serra do Ribeiro (20°29’01.3”S, 43°34’26.4”W) and Serra do Cipó (19°21’13.3”S, 43°36’11.9”W), located near the cities of Ouro Branco, Ouro Preto and Santana do Rioacho, 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,
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

Figure 1. Localization of the areas studied in the Espinhaço Range, Minas Gerais, Brazil.
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**          |     |           |          |             |
| *Eutryxalis filata filata* (Walker, 1870) | x | x | x | 2–3 | MCTP S5162 |
| *Hyalopteryx rufipennis* Charpentier, 1845 | x |          |          | 4–5 | MCTP S5163 |
| *Metaleptea persa* (Blanchard, 1843) | x |          |          |          | MCTP S5164 |
| *Parophyla graminea* Bruner, 1900 | x |          |          |          | MCTP S5165 |
| *Paulacris exasperata* (Burr, 1902) | x |          |          | 6–7 | MCTP S5166 |
| *Orphula pagana* (Stål, 1861) | x |          |          |          | MCTP S5167 |
| **Copiocrinae**        |     |           |          |             |
| *Auleas lineatus* Stål, 1878 | x |          |          |          | MCTP S5168 |
| *Auleas gracilis* Stål, 1878 | x |          |          |          | MCTP S5169 |
| *Auleas vitticollis* Stål, 1878 | x | x | x |          | MCTP S5170 |
| **Cystacanthacridinae** |     |           |          |             |
| *Shistocerca cancellata cancellata* (Serville, 1838) | x | x | x | 8–9 | MCTP S5171 |
| **Gomphocerinae**      |     |           |          |             |
| *Amblytropidia robusta* Bruner, 1906 | x | x | x | 10–11 | MCTP S5172 |
| *Amblytropidia sola* Rehn, 1939 | x | x | x | 12–13 | MCTP S5173 |
| *Amblytropidia minor* Bruner, 1911 | x |          |          |          | MCTP S5174 |
| *Borella bruneri* (Rehn, 1906) | x |          |          | 14–15 | MCTP S5175 |
| *Borella carinata* Rehn, 1906 | x |          |          | 16–17 | MCTP S5176 |
| *Borella saezi* Carbonell, 1995 | x |          |          | 18–19 | MCTP S5177 |
| *Borella sp.* | x |          |          | 20–21 | MCTP S5178 |
| *Compacris brevipennis* (Rehn, 1906) | x |          |          |          | MCTP S5179 |
| *Notopomala glaucipes* (Rehn, 1906) | x |          |          | 22–23 | MCTP S5180 |
| *Orphulella concinnula* (Walker, 1870) | x | x | x |          | MCTP S5181 |
| *Orphulella elongata* Bruner, 1911 | x |          |          | 24–25 | MCTP S5182 |
| *Orphulella paraguayensis* (Rehn, 1906) | x | x | x | 26–27 | MCTP S5183 |
| *Orphulella punctata* (De Geer, 1773) | x | x | x | 28–29 | MCTP S5184 |
| *Orphulina pulchella* Giglio-Tos, 1894 | x | x | x | 30–31 | MCTP S5185 |
| *Parapellopedon uniformis* (Rehn, 1906) | x |          |          | 32–33 | MCTP S5186 |
| *Pelleopodon brunneum* (Rehn, 1906) | x | x | x | 34–35 | MCTP S5187 |
| *Rhammatocerus brasilienensis* (Bruner, 1904) | x | x | x | 36–37 | MCTP S5188 |
| *Rhammatocerus brunnieri* Giglio-Tos, 1895 | x | x | x | 38–39 | MCTP S5189 |
| *Rhammatocerus pictus* (Bruner, 1900) | x | x | x | 40–41 | MCTP S5190 |
| *Scyllinula sp.* | x |          |          | 42–43 | MCTP S5191 |
| *Staurothecus longicornis longicornis* Giglio-Tos, 1897 | x | x | x | 44–45 | MCTP S5192 |
| **Leptysminae**        |     |           |          |             |
| *Cylindrotettix uniformis* (Bruner, 1911) | x | x | x | 46–47 | MCTP S5193 |
| *Stenopola puncticeps puncticeps* (Stål, 1861) | x |          |          | 48–49 | MCTP S5194 |
| **Melanoplinae**       |     |           |          |             |
| *Leiotettix pulcher* (Rehn, 1913) | x |          |          | 50–51 | MCTP S5195 |
| *Leiotettix viridis* Bruner, 1906 | x | x | x |          | MCTP S5196 |
| *Scotussa lemniscata* (Stål, 1861) | x |          |          |          | MCTP S5197 |
| **Ommatolampidinae**   |     |           |          |             |
| *Orthoscapheus cariaceus* (Giglio-Tos, 1894) | x | x | x |          | MCTP S5198 |
| *Orthoscapheus planaltinus Roberts & Carbonell, 1981 | x |          |          | 52–53 | MCTP S5199 |
| *Jodacris chapadensis* (Bruner, 1911) | x |          |          | 54–55 | MCTP S5200 |
| **Ommexechidae**       |     |           |          |             |
| *Ommexecha viriens* Serville, 1831 | x |          |          | 58–59 | MCTP S5202 |
| **Proscopiidae**       |     |           |          |             |
| **Proscopiinae**       |     |           |          |             |
| *Proscopia bivittata* Piza, 1946 | x |          |          | 60–61 | MCTP S5203 |
| **Romaleidae**         |     |           |          |             |
| **Romaleinae**         |     |           |          |             |
| *Abila bolivari* Giglio-Tos, 1900 | x | x | x | 62–63 | MCTP S5204 |
| *Xyleus gracilis* (Bruner, 1905) | x | x | x | 64–65 | MCTP S5205 |
| *Zoniopoda similis* Bruner, 1906 | x |          |          |          | MCTP S5206 |
| **Tetrigidae**         |     |           |          |             |
| *Tetrix subulata* (Linnaeus, 1758) | x | x | x | 66–67 | MCTP S5207 |
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 adspersa** (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 acuminately 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 subcilindrical 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.

**Gomphocerinae**

**Shistocerca cancellata cancellata** (Serville, 1838)

*Acridioid 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.

**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 subequial 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 os 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 sub-rectangle 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 expandens (Walker, 1870)
Orphulella gracilis Giglio-Tos, 1894
Stenobothrus gratiosus (Walker, 1870)
Orphulella grossa Bruner, 1911
Orphulella insularis Bruner, 1906
Orphulella interrupta Bruner, 1911
Truxalis intricata (Stål, 1873)
Gomphocerus meridonialis (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 sulci 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. Temina 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 tibia slightly infuscadas orange. Material examined: Table 1; Figure 32 and 33; MCTP 55186.

**Pellopedon brunneum** (Rehn, 1906)

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. Temina less densely crosslinked, post-radial area provided with two rows of cells and intercalated veins. Genicular areas dark brown laterally. Hind femor 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 consperrus* (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. Temina 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 fovealae 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. Epicract triangular and acuminate. Cercus short and conical. Subgenital plate conical and short. Material examined: Table 1; Figure 44 and 45; MCTP 55192.

**Leptysminae**

**Cylindrotettix uniformis** (Bruner, 1911)

*Leptysma 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. Fastium 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. Epicract 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. Pellopedon 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.
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; 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 yellow-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 yellow-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

**Orthoscapheus coriaceus** (Giglio-Tos, 1894)

*Orthoscapheus 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 cariane 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.

**Orthoscapheus 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 52 and 53; MCTP 55200.

Ommexechidae

Ommexechinae

**Clarazella bimaculata** (Giglio-Tos, 1894)

*Atrachelacris aurosignata* Piza, 1973

*Parossa paludiwaga* 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.

**Ommexechus 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 puncturated Mesopleurae strongly dentate. Hind femur elongated. Hind tibiae with 16 spines external and 8 internal. Abdomen enlarged. Epipoctro longer than wide. Material examined: Table 1; Figure 60 and 61; MCTP 55203.

Romaleidae
Romaleinae

**Abila bolivari** Giglio-Tos, 1900
**Homalosaparus uscanonicus** Rehn, 1908
**Homalosaparus 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.

**Xylopus 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 raised. 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 australis** Schmidt & Devkota, 1989
**Tetrix bielawskii** Bazyluk, 1963

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 brunerii** (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** (Serrvic, 1838), **Stauromechus longicornis** longicornis Giglio-Tos, 1897, **Stenopelma 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 & JANTSCHE 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 Chapacó 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 & LAWLER 1981; CRAIG et al. 1999). The results of this study are consistent with those of PRZEBYSZEWSKI & 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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