



# Acridomorpha (Orthoptera) species associated with the protected wetlands of Santa Lucía, Montevideo, Uruguay

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## Abstract

The diversity of Acridomorpha in protected areas of Uruguay has been little studied to date. In the protected wetlands of Humedales de Santa Lucía in the Montevideo Department, we made monthly surveys from December 2012 to March 2013. Sampling was conducted with entomological nets and by hand. We collected 1216 individuals of 26 different species belonging to seven subfamilies. Gomphocerinae and Melanoplinae were the most abundant, accounting for 71% and 16% of the individuals respectively. The Shannon index showed a medium diversity, but the Berger-Parker dominance index and Pielou equitativity index indicate a slight dominance of the acridomorph community studied. This is probably because five species accounted for 87% of the individuals collected. Although our results are similar to previous studies of acridomorph communities in grasslands of the region, our study, the first of this kind for this ecosystem in Uruguay, will be important for the conservation of this protected area.

## Keywords

Biodiversity inventories, grasslands conservation, Orthoptera, taxonomy.

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## Introduction

Biodiversity studies in natural ecosystems are of increasing importance due to the excessive rate of species extinctions (Samways 2005). This has led to the search for estimators that help us to evaluate the biodiversity losses. Therefore, knowing the state of an ecosystem is necessary for its conservation and to protect the endangered species that lives there (Reyes-Novelo et al. 2009; IUCN 2012; Hochkirch et al. 2016). Faunal and floral inventories of species support ecosystem management and conservation. The availability of scientifically

accurate species lists helps biologists develop conservation plans and environmental education (Mielke et al. 2008).

Insects are good indicators of ecosystem health because of their great diversity and sensitivity to environmental change (McGeoch 1998; Finch 2005). Orthoptera, especially Acridomorpha, have been used as indicators to assess the conservation status of pastures because of their intimate association with grasses (Bazelyet and Samways 2011, 2012; Pryke and Samways 2012).

Despite the great diversity of invertebrate species in Uruguay, they have rarely been considered in

conservation studies (Ghione et al. 2017), and a list with priority species for conservation only included continental Mollusca, vertebrates, and Tracheophyta (Soutullo et al. 2013). There is a lack of up-to-date checklists of insects in protected areas of Uruguay; the species lists from Area Protegida Quebrada de los Cuervos and Valle del Lunarejo (Simó et al. 1994; Lorier 1998) are the only published lists until now.

Acridomorpha have been studied comprehensively in Uruguay. Their taxonomy and systematics are well known (Carbonell 2003; Carbonell et al. 2018; Cigliano et al. 2019), and there are numerous studies on their biology (Miguel et al. 2014), ecology (Lorier et al. 2016), and diversity (Silveira-Guido et al. 1958; Bentos-Pereira and Lorier 1991; Lorier 1998; Bentos-Pereira 2000; Martínez 2004; Lorier 2005; Zerbino et al. 2016). However, the diversity of Acridomorpha in protected areas is poorly known, particularly in wetlands.

The Humedales de Santa Lucía is the main saline wetland in Uruguay (Ramsar 2014) and provides important ecosystem services. This wetland is in danger from anthropic activities and was included in the Sistema Nacional de Areas Protegidas (SNAP) in 2015, certified as a protected area with managed resources (IMPO 2015). To study the biodiversity associated with wetlands, inventories of species present in that ecosystem are essential to establish their conservation status and develop measures for their protection and conservation (MVOTMA and MRREE 2016). The aim of our study is to determine the biodiversity of Acridomorpha of the Humedales de Santa Lucía protected area in Montevideo, Uruguay.

## Methods

**Study site.** Our study was carried out in an area with natural wetlands, grasslands, remnant native forests, and flooded areas, as well as anthropic habitats such as parks with ornamental plant species and human constructions. The study site is part of the Área Protegida de los Humedales de Santa Lucía (34°47'07"S, 056°20'04"W; 120 ha) (Fig. 1). This protected area includes estuarine marshes with saline water intrusions and part of the Lecocq Zoo. It is also area well known for its great floristic and faunistic diversity (Caldevilla and Quintillán 2004). Since its creation, it has been considered a center for environmental education and conservation of endangered species (IM 2018; MVOTMA 2018).

**Sampling procedures.** Four monthly samplings were made from December 2012 to March 2013 in six different ecosystems (Fig. 1). This season was chosen because most Acridomorpha species of Uruguay are adult during this time of the year.

Two different direct collection methods were used: sweeping with an entomological net (diameter ring: 42 cm; net length: 70 cm; handle length: 120 cm) and hand collection. The sample unit was 200 strokes or sweeps

(Larson et al. 1999). Hand collection consisted of active searching for Acridomorpha on the vegetation for 30 minutes at each site by three collectors (following Jorge et al. 2013). This method was previously used to collect other arthropods in Uruguay, but has been little explored for use with Acridomorpha. Specimens were identified and deposited in the Entomological Collection of the Facultad de Ciencias, Universidad de la República (Montevideo), with vouchers for identification labeled with acronym: FCE-Ac. Nymphs were preserved in 70% alcohol and adults were kept in entomological beds.

**Species identification and geographic distribution.** Specimens were identified to species using taxonomic keys and published descriptions (Carbonell et al. 1967; Ronderos et al. 1968; Roberts 1978; Santoro et al. 1978; Roberts and Carbonell 1980; Cigliano and Ronderos 1994; Cigliano et al. 1996; Bentos-Pereira 2000; Cigliano and Otte 2003; Carbonell 2004; Carbonell 2007; Carbonell 2008; Carbonell et al. 2018; Cigliano et al. 2018). The geographical distribution for each species was extracted from the literature.

**Data analysis.** To study the community structure in time and space, both nymphs and adults were included in the analysis (Jiménez-Valverde and Hortal 2006).

The analysis of the community descriptors was calculated with the Shannon diversity index (H), Berger-Parker dominance (d) and Pielou equitability (J) (Magurran 1988; Moreno 2000). All analyses were carried out in PAST version 3.24 (Hammer et al. 2001).

To assess whether the sampling effort was adequate, species accumulation curves were calculated based on the nonparametric estimators: ACE, Jackknife 1, Jackknife 2, Chao 1, and Chao 2 (Colwell and Coddington 1994; Moreno 2001; Jiménez-Valverde and Hortal 2003; Colwell et al. 2004; Gotelli and Colwell 2011). Accumulation curves were obtained using EstimateS version 9.1.0 (Colwell 2013), randomizing 1000 times for each estimator employed (Mc Alecece et al. 1997).

## Results

We captured 1216 individuals and 26 species belonging to the families Acrididae and Romaleidae (Acridoidea) and Proscopiidae (Proscopioidea) (Table 1). The most abundant subfamily was Gomphocerinae (71%) and Melanoplinae (16%) (family Acrididae) totaling 87.2% of collected specimens (Table 1). The subfamilies that followed in abundance were Acridinae (Acrididae), Romaleinae (Romaleidae), Copiocerinae (Acrididae), Proscopiinae (Proscopiidae), and Leptysminae (Acrididae) (Table 1). *Laplatacris dispar*, *Amblytropidia australis*, *Orphuella punctata*, and *Sinipta dalmani* (subfamily Gomphocerinae) and *Dichroplus elongatus* (subfamily Melanoplinae) were the most abundant species. *Laplatacris dispar* was the dominant species with 30% of the total individuals (Table 1).

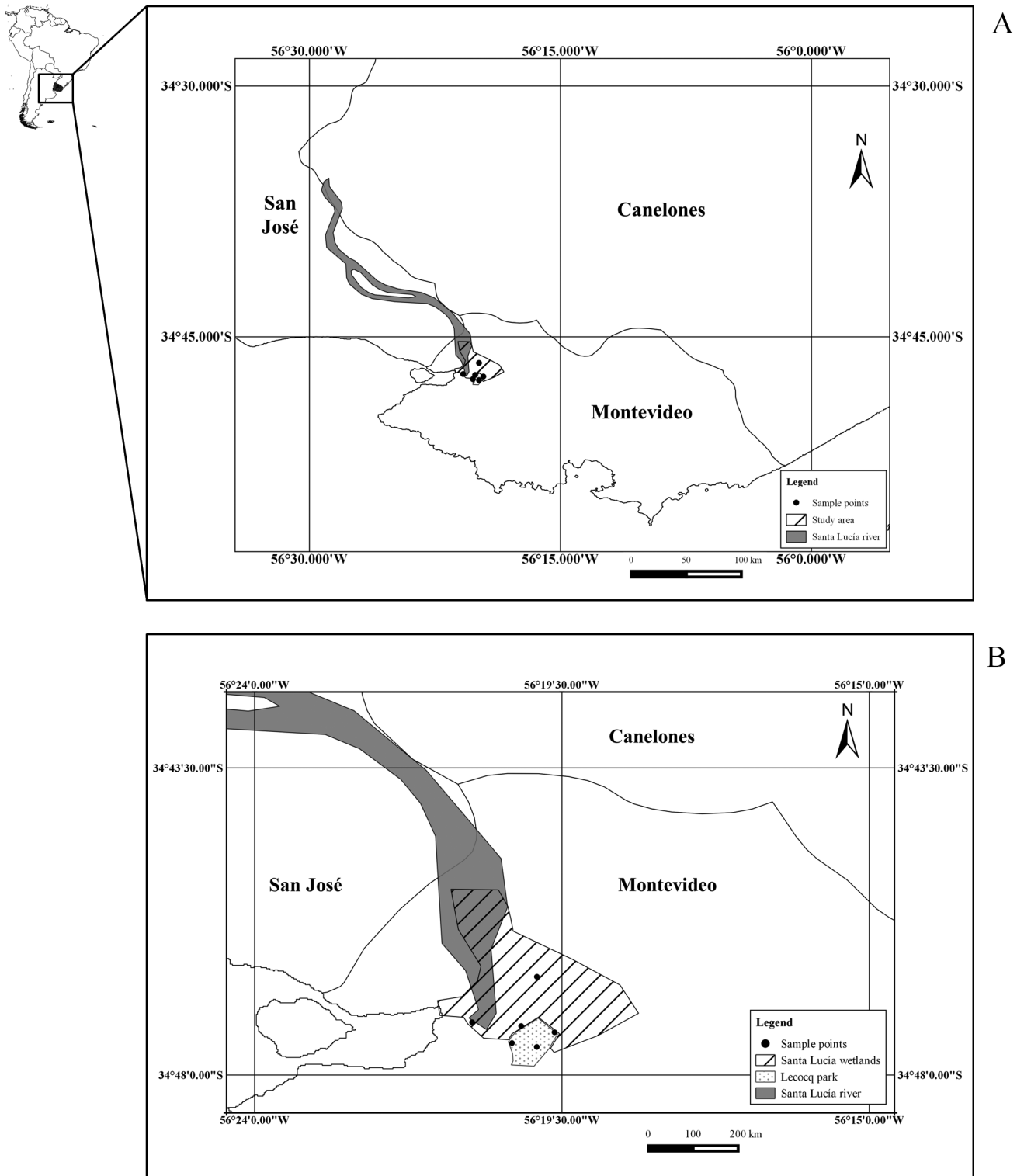


Figure 1. Study area: Humedales de Santa Lucía. Montevideo, Uruguay

Proscopiidae Serville, 1838

Proscopiinae Serville, 1838

**Orienscopia costulata (Burmeister, 1880)**

Figure 2A

**Material examined.** URUGUAY • 9 nymphs; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07''S, 056°20'04''W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4002, 4004, 4011 • 7 nymphs;

same locality; 27 Jan. 2013; S. Greco, W.S. Serra and G. Lecuona leg.; FCE-AC 4000, 4001, 4005, 4006 • 2 nymphs, 2 ♂, 1 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4007, 4008, 4248, 4249, 4251 • 8 nymphs, 2 ♀; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4003, 4009, 4010, 4012, 4013, 4331, 4384.

**Identification.** Longitudinal carinae of pronotum prominent. Lateral margins of pronotum straight. Pronotum

**Table 1.** Species list of Acridomorpha collected in the Humedales de Santa Lucía with the abundance of nymph and adults and percentage of subfamilies.

Acridomorpha species	Abundance			
	Nymph	Adult	Total	%
<b>Proscopiidae</b>				
Proscopiinae				2.6
<i>Orienscopia costulata</i> (Burmeister, 1880)	28	2	30	
<i>Orienscopia sanmartini</i> Bentos-Pereira, 2000	2	0	2	
<b>Romaleidae</b>				
Romaleinae				3.1
<i>Chromacris speciosa</i> (Thünberg, 1824)	7	4	11	
<i>Staleochlora viridicata orientalis</i> Roberts & Carbonell, 1992	0	3	3	
<i>Xyleus discoideus discoideus</i> (Serville, 1831)	6	1	7	
<i>Zoniopoda iheringi</i> Pictet & Saussure, 1887	17	0	17	
<b>Acrididae</b>				
Melanoplinae				15.7
<i>Dichroplus conspersus</i> Bruner, 1900	0	2	2	
<i>Dichroplus elongatus</i> Giglio-Tos, 1894	67	40	107	
<i>Dichroplus obscurus</i> Bruner, 1900	0	1	1	
<i>Dichroplus pratensis</i> Bruner, 1900	0	1	1	
<i>Leiotettix politus</i> Rehn, 1913	6	22	28	
<i>Leiotettix pulcher</i> Rehn, 1913	0	1	1	
<i>Ronderosia bergii</i> (Stål, 1878)	4	9	13	
<i>Scotussa impudica</i> Giglio-Tos, 1894	4	20	24	
<i>Scotussa lemniscata</i> (Stål, 1860)	6	3	9	
<i>Scotussa liebermanni</i> Mesa & Zolessi, 1968	2	3	5	
Copioicerini				2.8
<i>Aleuas lineatus</i> Stål, 1878	28	6	34	
Leptysmiinae				1.0
<i>Leptysma argentina</i> Bruner, 1906	9	2	11	
<i>Haroldgrantia lignosa</i> Carbonell, Ronderos & Mesa, 1967	0	1	1	
Acridinae				3.3
<i>Allotruxalis gracilis</i> (Giglio-Tos, 1897)	13	24	37	
<i>Metaleptea adspersa</i> (Blanchard, 1843)	0	3	3	
Gomphocerinae				71.5
<i>Amplytropidia australis</i> Bruner, 1904	129	73	202	
<i>Laplatacris dispar</i> Rehn, 1939	195	177	372	
<i>Orphulella punctata</i> (De Geer, 1773)	63	69	132	
<i>Sinipta dalmani</i> Stål, 1860	111	10	121	
<i>Staurorhectus longicornis longicornis</i> Giglio-Tos, 1897	25	17	42	
<b>Total</b>	<b>722</b>	<b>494</b>	<b>1216</b>	<b>100</b>

of both sexes shows reliably only the lateral carina, above the notosternal suture. The differences in the epi-proct permit a rapid identification of the males. Male epi-proct elongate, much longer than the cerci.

**Geographic distribution.** Argentina, Bolivia, Brazil, Paraguay, and Uruguay (Bentos-Pereira 2000).

#### *Orienscopia sanmartini* Bentos-Pereira, 2000

Figure 2B

**Material examined.** URUGUAY • 2 nymphs; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4271

**Identification.** The smallest and commonest species of the genus. Longitudinal carinae of the pronotum

prominent. Lateral margins of pronotum semi-convex.

**Geographic distribution.** Uruguay (Bentos-Pereira 2000).

Romaleidae Pictet & Saussure, 1887

Romaleinae Pictet & Saussure, 1887

#### *Chromacris speciosa* (Thunberg, 1824)

Figure 2C

**Material examined.** URUGUAY • 7 nymphs; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4015, 4272; • 1 ♂, 1 ♀; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4369.

**Geographic distribution.** Argentina, Bolivia, Brazil, Colombia, Ecuador, Guiana, Paraguay, Peru, Venezuela, and Uruguay (Roberts and Carbonell 1982).

#### *Staleochlora viridicata orientalis* Roberts & Carbonell, 1992

Figure 2D

**Material examined.** URUGUAY • 3 ♀; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 27 Feb. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4022, 4569, 4570.

**Geographic distribution.** Brazil and Uruguay (Roberts and Carbonell 1992).

#### *Xyleus discoideus discoideus* (Serville, 1831)

Figure 2E

**Material examined.** URUGUAY • 2 nymphs; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4017, 4021 • 2 nymphs; same locality; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4023, 4355 • 1 ♂; same locality; 27 Feb. 2013; S. Greco, W. S. Serra and G. Lecuona leg. FCE-AC 4284 • 1 nymph; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4018.

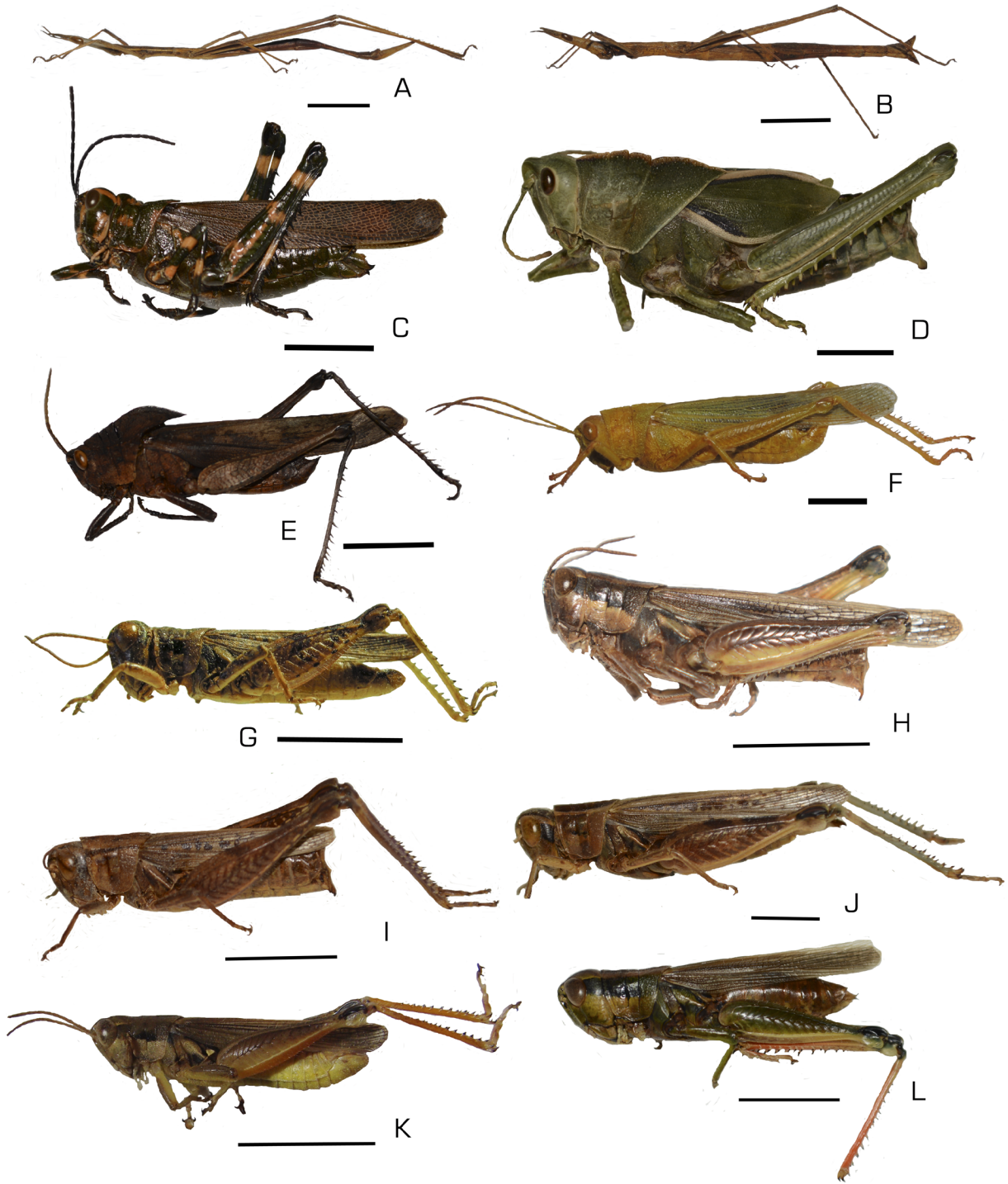
**Identification.** Dull-colored in various shades and hues of amber, fuscous, and brown. The pronotum as seen from above has the lateral angles of the metazona rounded. Pronotal crest high, especially on metazona The posterior part of the crest crenulated.

**Geographic distribution.** Argentina, Bolivia, Brazil, Paraguay, and Uruguay (Carbonell 2004).

#### *Zoniopoda iheringi* Pictet & Saussure 1887

Figure 2F

**Material examined.** URUGUAY • 4 nymphs; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4031, 4032 • 6 nymphs; same locality; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4024–4026, 4028, 4030 • 3 nymphs; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4020, 4027, 4029 • 2 nymphs; same



**Figure 2.** Acridomorpha species (Orthoptera, Caelifera) found in the Área Protegida de los Humedales de Santa Lucía, Montevideo, Uruguay. **A.** *Orienscopia costulata*. **B.** *Orienscopia sanmartini*. **C.** *Chromacris speciosa*. **D.** *Staleochlora viridicata orientalis*. **E.** *Xyleus discoideus discoideus*. **F.** *Zoniopoda iheringi*. **G.** *Dichroplus conspersus*. **H.** *Dichroplus elongates*. **I.** *Dichroplus obscurus*. **J.** *Dichroplus pratensis*. **K.** *Leiotettix politus*. **L.** *Leiotettix pulcher*. Scale bars = 10 mm.

locality; 23 Mar. 2013; FCE-AC 4016, 4019.

**Identification.** Green, without the many markings present in those of the *tarsata* species group. Tegmina uniformly green. Tibiae and tarsi of all legs pale pink. Integument strongly rugose, becomes tuberculate on pronotum. Pronotum with dorsal median carina high and serrate.

**Geographic distribution.** Argentina, Brazil, Paraguay, and Uruguay (Carbonell 2007).

Acrididae MacLeay, 1821  
 Melanoplinae Scudder, 1897

***Dichroplus conspersus* Bruner, 1900**  
 Figure 2G

**Material examined.** URUGUAY • 1 ♀; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 27 Feb 2013; S. Greco and W. S. Serra leg.; FCE-AC 4281 • 1 ♂; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4329.

**Identification.** Head globular in dorsal view. Pronotum with sides expanded at metazona; with mid-longitudinal carina only faintly indicated on metazona; with a triangular black area behind the principal transverse sulcus. Pronotal disk acutely angulated behind and without prominent lateral borders. Hind femur with inner face red except distal area yellow; hind tibia yellowish. Male cerci gracile.

**Geographic distribution.** Argentina, Brazil, Chile, and Uruguay (Cigliano and Otte 2003)

***Dichroplus elongatus* Giglio-Tos, 1894**

Figure 2H

**Material examined.** URUGUAY • 39 nymphs; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4165, 4167, 4173, 4174, 4179, 4182, 4184, 4187 • 7 nymphs; same locality; 27 Jan 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4168, 4170, 4177, 4178, 4183, 4367 • 16 nymphs, 11 ♂, 13 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4160, 4166, 4169, 4172, 4180, 4181, 4186, 4202, 4219, 4220, 4223–4227 • 4 nymphs, 5 ♂, 6 ♀; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4171, 4175, 4176, 4185, 4326–4328, 4378, 4379.

**Identification.** General shape of the body graceful and elongated. Body brown or reddish brown. The union of the fastigium with the forehead is rounded (not angled) in lateral view. Dark post-ocular band clearly marked. Pronotum with longitudinal dark bands on lateral lobes sharply widening backwards. Yellow hind legs, with the upper part of femurs and tibiae brown or greenish. Hind femora thin and elegant without maculate in the upper internal part. Hind tarsus brown. Hind tibia greenish yellow. Male cerci with flat apical half and slightly spatulate.

**Geographic distribution.** Argentina, Brazil, Chile, Colombia, and Uruguay (Ronderos et al. 1968).

***Dichroplus obscurus* Bruner, 1900**

Figure 2I

**Material examined.** URUGUAY • 1 ♀; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4270.

**Identification.** A moderately large and robust species with similar characteristics to *D. pratensis*. Body brown, with a diffuse post-ocular dark brown band. Pronotal disk with lateral borders obsolete, prozona longer than metazona; metazona with multiple longitudinal carinulae. Hind tibiae purple. Male cerci slender with acute apices.

**Geographic distribution.** Argentina, Brazil, and Uruguay (Cigliano and Otte 2003).

***Dichroplus pratensis* Bruner, 1900**

Figure 2J

**Material examined.** URUGUAY • 1 ♂; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4283.

**Identification.** A large species of the *maculipennis* subgroup. Body robust, yellowish brown, mottled with dark brown dots in tegmina; a dark post-ocular band extending up to the principal transverse sulcus. Head conical in dorsal view, with fastigium gradually curving into frontal costa. Pronotum with sides straight and diverging, with mid-longitudinal carina prominent throughout, lateral borders of pronotal disk well indicated. Metazona without multiple longitudinal carinulae. Prozona about as long as metazona. Hind tibiae greenish blue. Male cerci with rather heavy apex somewhat spatulate.

**Geographic distribution.** Argentina, Brazil, Bolivia, and Uruguay (Cigliano and Otte 2003).

***Leiotettix politus* Rehn, 1913**

Figure 2K

**Material examined.** URUGUAY • 4 nymphs, 2 ♂; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4164, 4195, 4196, 4267, 4268 • 4 ♂, 5 ♀; same locality; 27 Jan. 2013; FCE-AC 4337, 4340, 4341 • 1 nymph; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4197 • 7 ♂, 1 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4199, 4282, 4285, 4294, 4295 • 1 ♂; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4330.

**Identification.** Head subconical. Sides of body with discontinuous postocular band. Median longitudinal carina of pronotum sharp. Inner face of hind femur yellow.

**Geographic distribution.** Argentina and Uruguay (Cigliano and Ronderos 1994; Cigliano et al. 1996).

***Leiotettix pulcher* Rehn, 1913**

Figure 2L

**Material examined.** URUGUAY • 1 ♀; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4336.

**Identification.** Sides of body with continuous postocular band. Median longitudinal carina of pronotum weak. Distal half of male cerci compressed along the midline. Inner face of hind femur mostly red.

**Geographic distribution.** Argentina, Brazil, Paraguay, and Uruguay (Cigliano and Ronderos 1994; Cigliano et al. 1996).

***Ronderosia bergii* (Stål, 1878)**

Figure 3A

**Materials examined:** URUGUAY • 3 nymphs, 1 ♂; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4188, 4189, 4191, 4269 • 1 ♂, 2 ♀; same locality; 27 Jan. 2013; FCE-AC 4350, 4365, 4368 • 1 ♂, 2 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4200, 4297 • 1 nymph, 1 ♂, 1 ♀; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4190, 4323.

**Geographic distribution.** Argentina, Brazil, Paraguay, and Uruguay (Cigliano 1997).

***Scotussa impudica* Giglio-Tos, 1894**

Figure 3B

**Materials examined:** URUGUAY • 2 nymphs, 3 ♂, 6 ♀; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4162, 4259, 4260, 4385 • 1 ♂, 5 ♀; same locality; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4334, 4344, 4356, 4357, 4358 • 1 ♂, 3 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4217, 4246, 4247 • 3 ♀; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4385.

**Identification.** A large species with a postocular band black. Hind tibia blue greenish. Females ovipositor valves with one apical tooth. Dorsal ovipositor valves with superior margin serrate. Ventral ovipositor valves very narrow. Dorsal valves in dorsal view divergent. Ovipositor valves, lateral view, straight. Male cerci robust.

**Geographic distribution.** Argentina, Brazil, Paraguay, and Uruguay (Cigliano and Ronderos 1994; Cigliano et al. 1996).

***Scotussa lemniscata* (Stål, 1861)**

Figure 3C

**Material examined.** URUGUAY • 6 nymphs; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4161, 4194 • 1 nymph, 1 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4193, 4288 • 1 ♀; same locality, 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4386.

**Identification.** Head as wide as the frontal edge of pronotum. Head with large eyes. Internal face of hind femur reddish orange. Hind tibia orange. Female ovipositor valves with two apical teeth. Dorsal ovipositor valves with superior margin low, serrulate.

**Geographic distribution.** Argentina, Brazil, Paraguay, and Uruguay (Cigliano and Ronderos 1994; Cigliano et al. 1996).

***Scotussa liebermanni* Mesa & Zolessi, 1968**

Figure 3D

**Material examined.** URUGUAY • 2 nymphs, 1 ♀; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4163, 4192, 4252.

**Identification.** A smaller species. Postocular band dark green. Dorsal valves in dorsal view less divergent and narrower than *S. impudica*. Male cerci slender.

**Geographic distribution.** Argentina and Uruguay (Cigliano and Ronderos 1994; Cigliano et al. 1996).

Copiocerini Brunner von Wattenwyl, 1893

***Aleuas lineatus* Stål, 1878**

Figure 3E

**Materials examined:** URUGUAY • 21 nymphs; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4084, 4087–4094, 4097 • 3 nymphs, 1 ♂; same locality; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4085, 4086, 4096, 4364 • 1 nymph, 1 ♂, 2 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4095, 4218, 4250, 4298.

**Identification.** A small species. Males with cerci strongly incurved, apices spatulate. Females with pronotal disk with lines of contrasting color along sides only, lines black, marked on pro- and metazona Hind tibiae and tarsi green.

**Geographic distribution.** Argentina, Brazil, Paraguay, and Uruguay (Carbonell 2008).

Leptysmiinae Brunner von Wattenwyl, 1893

***Leptyisma argentina* Bruner, 1906**

Figure 3F

**Material examined.** URUGUAY • 1 nymph; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4078 • 2 nymphs, 1 ♂, 1 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4076, 4080, 4221 • 5 nymphs; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4071, 4079.

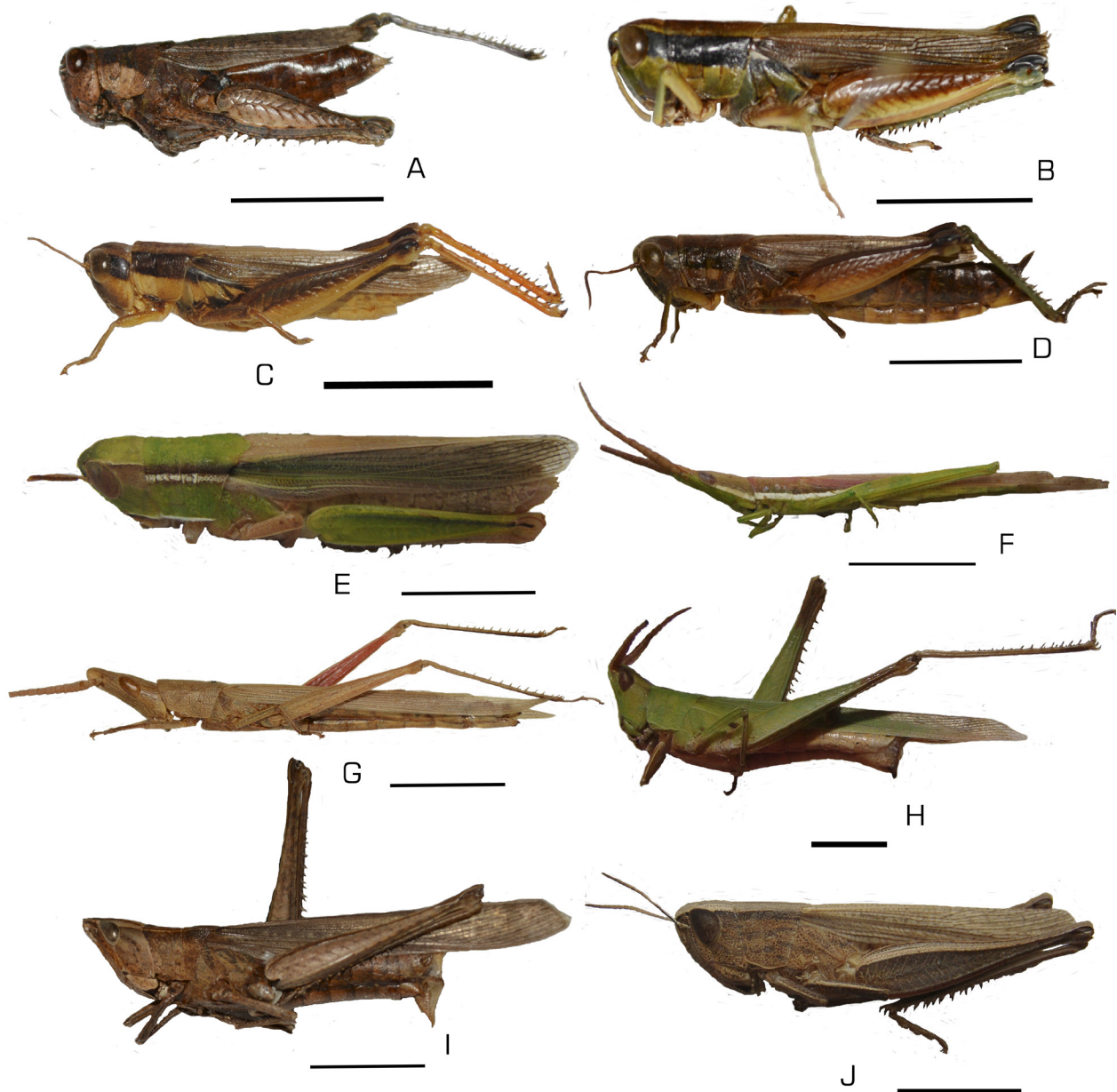
**Identification.** Fastigium as long or longer than eyes. Face pale green at the sides. Male subgenital plate flares slightly laterad near the apex. Apex of the cercus truncate. Teeth of the dorsal ovipositor valves relatively uniform in size and spacing.

**Geographic distribution.** Argentina, Brazil, Paraguay, and Uruguay (Roberts 1978).

***Haroldgrantia lignosa* Carbonell, Ronderos & Mesa, 1967**

Figure 3G

**Material examined.** URUGUAY • 1 ♀; Montevideo, Área Protegida de los Humedales de Santa Lucía;



**Figure 3.** Acridomorpha species (Orthoptera, Caelifera) found in the Área Protegida de los Humedales de Santa Lucía, Montevideo, Uruguay. **A.** *Ronderosia bergii*. **B.** *Scotussa impudica*. **C.** *Scotussa lemniscata*. **D.** *Scotussa liebermanni*. **E.** *Aleuas lineatus*. **F.** *Leptyisma argentina*. **G.** *Haroldgrantia lignosa*. **H.** *Allotruxalis gracilis*. **I.** *Metaleptea adspersa*. **J.** *Amplytropidia australis*. Scale bars = 10 mm.

34°47'07"S, 056°20'04"W; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4286.

**Identification.** Slender, fusiform. Uniform pale brown, except on inner face of hind femur red. Antennae strongly ensiform. Fastigium elongate, with raised side edges and a well-marked median carina.

**Geographic distribution.** Argentina, Brazil, and Uruguay (Carbonell et al. 1967; Roberts and Carbonell 1980).

Acridinae MacLeay, 1821

*Allotruxalis gracilis* (Giglio-Tos, 1897)

Figure 3H

**Material examined.** URUGUAY • 6 nymphs, 2 ♂; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4072, 4075, 4083, 4159, 4253 • 5 nymphs, 7 ♂, 3 ♀; same locality; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4073, 4074, 4081, 4361–4363 • 2 nymphs, 5 ♂, 1 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4077, 4082, 4222, 4238, 4239 • 4 ♂, 2 ♀; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4324, 4325.

**Geographic distribution.** Argentina, Bolivia, Brazil, Paraguay, and Uruguay (Donato 2003).



***Metaleptea adpersa* (Blanchard, 1843)**

Figure 3I

**Materials examined.** URUGUAY • 1 ♂; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4335 • 1 ♂, 1 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4287.

**Geographic distribution.** South America, east of the Andes, from northern Colombia to Argentina and Uruguay (Donato and Cigliano 2000; Carbonell et al 2007).  
Gomphocerinae Fieber, 1853

***Amblytropidia australis* Bruner, 1904**

Figure 3J

**Material examined.** URUGUAY • 75 nymphs; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4099, 4107, 4109–4111, 4113, 4114, 4116, 4117 • 44 nymphs, 11 ♂, 5 ♀; same locality; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4100–4102, 4104–4106, 4108, 4112, 4118, 4119, 4332, 4333, 4345–4349 • 7 nymphs, 22 ♂, 5 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4098, 4103, 4115, 4240, 4241–4245, 4273, 4275–4277, 4296 • 21 ♂, 10 ♀; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4299–4303, 4313, 4375–4377.

**Geographic distribution.** Along the Paraná River in Argentina, Brazil, Paraguay, and Uruguay (Carbonell 2003; COPR 1982)

***Laplatacris dispar* Rehn, 1939**

Figure 4A

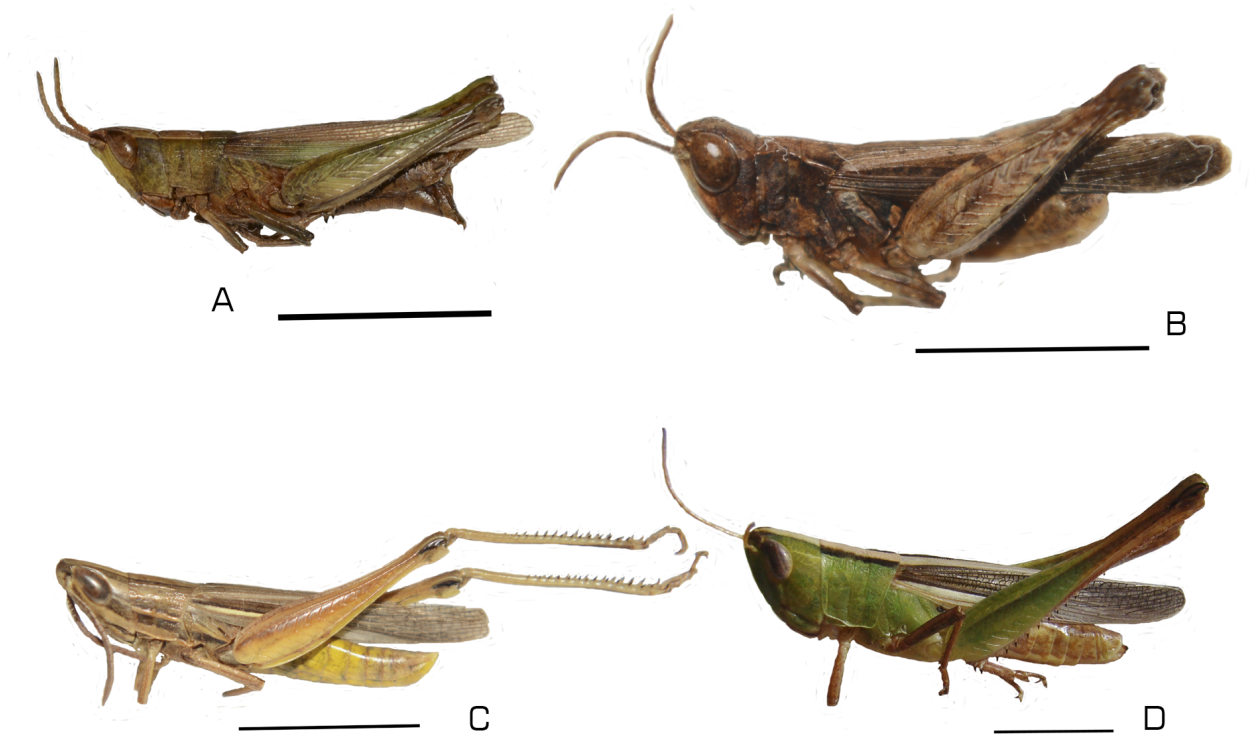
**Material examined.** URUGUAY • 64 nymphs; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4122, 4123, 4125, 4132, 4143, 4145, 4148, 4158 • 75 nymphs, 1 ♂, 1 ♀; same locality; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4120, 4121, 4124, 4129, 4135–4138, 4142, 4144, 4150, 4152, 4154, 4354 • 38 nymphs, 22 ♂, 22 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4127, 4128, 4130, 4133, 4134, 4141, 4146, 4153, 4156, 4157, 4231–4237, 4279, 4280, 4293 • 14 nymphs, 51 ♂, 74 ♀; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4126, 4139, 4140, 4147, 4149, 4151, 4155, 4304–4312, 4370–4374.

**Geographic distribution.** Argentina, Brazil, and Uruguay (Rhen 1939; COPR 1982).

***Orphulella punctata* (De Geer, 1773)**

Figure 4B

**Material examined.** URUGUAY • 1 nymph, 7 ♂, 4 ♀; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4064, 4254–4258, 4261, 4266 • 9 nymphs, 3 ♂, 4 ♀; same locality; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4063, 4069, 4351–4353, 4359, 4360 • 38 nymphs, 14 ♂, 5 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4051, 4052, 4054, 4055, 4061, 4067, 4070, 4216, 4228–4230, 4278 • 10 nymphs, 18 ♂, 16 ♀;



**Figure 4.** Acridomorpha species (Orthoptera, Caelifera) found in the Área Protegida de los Humedales de Santa Lucía, Montevideo, Uruguay. **A.** *Laplatacris dispar*. **B.** *Orphulella punctata*. **C.** *Sinipta dalmani*. **D.** *Staurorhectus longicornis longicornis*. Scale bars = 10 mm.

same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4035, 4036, 4042, 4053, 4058, 4060, 4314–4320, 4380–4383.

**Geographic distribution.** Central Mexico to Argentina: Mexico, Cuba, Hispaniola, Puerto Rico, Lesser Antilles, St. Thomas, El Salvador, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Trinidad, Guyana, Suriname, French Guiana, Ecuador, Peru, Bolivia, Brazil, Argentina, Paraguay, and Uruguay (Otte 1979; COPR 1982; Carbonell 2003; Terra et al 2017).

#### *Sinipta dalmani* (Stål, 1861)

Figure 4C

**Material examined.** URUGUAY • 1 nymph, 5 ♂, 2 ♀; Montevideo, Área Protegida de los Humedales de Santa Lucía, 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4068, 4262–4265 • 4 nymphs, 2 ♂; same locality; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4039, 4056, 4338, 4339 • 37 nymphs; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4034, 4038, 4041, 4062, 4065, 4066 • 68 nymphs; same locality; 23 Mar. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4040, 4043, 4045, 4049, 4057.

**Geographic distribution.** Argentina, Brazil, Paraguay, and Uruguay (Rehn 1939; COPR 1982; Carbonell 2003).

#### *Staurorhectus longicornis longicornis* Giglio-Tos, 1897

Figure 4D

**Materials examined.** URUGUAY • 1 nymph; Montevideo, Área Protegida de los Humedales de Santa Lucía; 34°47'07"S, 056°20'04"W; 29–30 Dec. 2012; S. Greco and E. Lorier leg.; FCE-AC 4059 • 5 nymphs, 4 ♂, 3 ♀; same locality; 27 Jan. 2013; S. Greco, W. S. Serra and G. Lecuona leg.; FCE-AC 4037, 4044, 4046, 4050, 4342, 4343 • 14 nymphs, 4 ♂, 2 ♀; same locality; 27 Feb. 2013; S. Greco and W. S. Serra leg.; FCE-AC 4047, 4048, 4289–4292 • 2 ♂, 2 ♀; same locality; 23 Mar. 2013; S.

Greco and W. S. Serra leg.; FCE-AC 4321, 4322.

**Geographic distribution.** Argentina, Bolivia, Brazil, Paraguay and Uruguay (COPR 1982; Carbonell 2003; Assis-Pujol and Pujol-Luz 2014; Terra et al 2017).

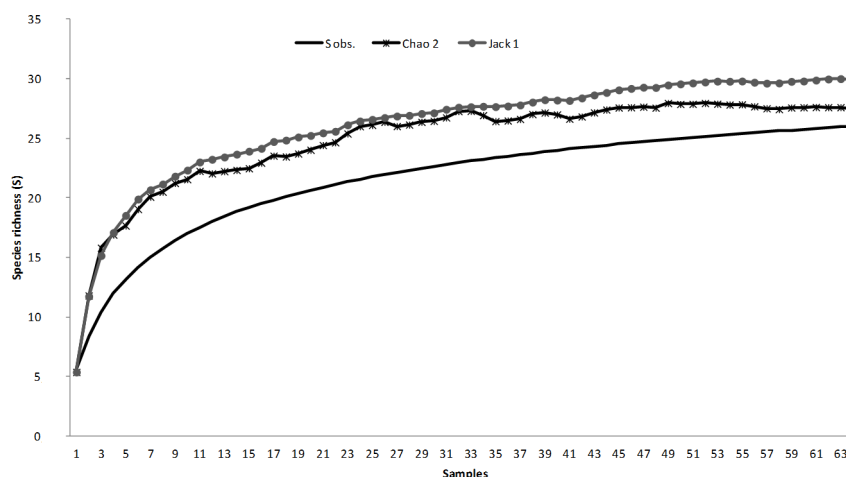
**Community descriptors.** The Berger-Parker index presented a value of 0.31; low values of this index indicates a high dominance. This might be because two species (*Laplatacris dispar* and *Amplytropidia australis*) represented 47% of the total number of specimens of Acridomorpha collected (Table 1). The Shannon index showed a moderate value ( $H = 2.28$ ). The equitability was moderately high ( $J = 0.70$ ), despite the fact that five species represented 77% of the total specimens, so it is reasonable to assume the existence of some dominant species in the community. Most of the dominant species belong to the subfamily Gomphocerinae and were uniformly distributed during the sampling period.

Chao 1 ( $S = 29$ ), Chao 2 ( $S = 28$ ), Jackknife 1 ( $S = 30$ ), and Jackknife 2 ( $S = 31$ ), estimated a number of species approximate to what it was captured ( $S = 26$ ). The accumulation curve of observed species approaches the curves obtained by the different estimators and tends to the asymptote. Therefore, the survey was sufficient because the estimators indicated a sampling effort of 92% for Chao 2 and 86% for the Jackknife 1 (Fig. 5).

## Discussion

Our study reports acridomorph biodiversity in a conservation area in Uruguay. Most information on the Acridomorpha focuses on ecological and economic impacts during outbreaks (Carbonell 1957; Joern and Gaines 1990; Bentos-Pereira and Lorier 1991; Cigliano et al. 1995; Beltrame et al. 2002; Lorier and Zerbino 2009; Lorier et al. 2010, 2016; Zerbino et al. 2016). Therefore, comparisons of our results were made only with studies of grassland communities and population outbreaks.

In the present study we observed a species richness equal to that was obtained by Lorier et al. (2016) and



**Figure 5.** Accumulation species curve of Acridomorpha collected from Humedales de Santa Lucía.

Zerbino et al. (2016) in acridomorph surveys in other grassland areas of Uruguay. We found more species than were recorded by Weiss et al. (2012) in pastures in Germany ( $S = 13$ ), by Pocco et al. (2010), and Mariottini et al. (2012, 2013) in grasslands of Argentina, but less than recorded by Kemp (1992) for rangelands in the United States and by Andersen et al. (2001) in Australia ( $S = 40$ ). Gomphocerinae and Melanoplineae were the most abundant subfamilies of Acrididae, coinciding with other communities of Acridomorpha in grasslands of the south of South America (Cigliano and Lange 1998; Torrusio et al. 2002; Pocco et al. 2010; Lorier et al. 2016; Zerbino et al. 2016). We found common grassland species like *Dicroplus elongatus*, *Dicroplus pratensis*, *Scotussa lemniscata*, *Laplatacris dispar*, *Amphytropidia australis*, and *Orphulella punctata*, and others associated with wetlands and aquatic and semiaquatic areas, like *Leptysma argentina*, *Haroldgrantia lignosa*, *Metaleptea adspersa*, *Chromacris speciosa*, and *Zoniopoda iheringi* (Carbonell et al. 1967; COPR 1982; Bentos-Pereira and Lorier 1991).

The Shannon index showed a medium diversity for the grasshopper community and is concordant with the literature. Therefore, we expected that Pielou's equity values were low. According to Joern (2000, 2005), Martínez (2004), and Scuffi et al. (2012), the diversity of acridids is mainly determined by the interaction between external (climate and vegetation) and internal factors such as population dynamics and environmental and anthropogenic disturbances. The acridomorph community of the Humedales del Santa Lucía presented a slightly dominance. This can be extrapolated by the values obtained from the Berger-Parker dominance index and the Pielou's equitativity index. This could be related with the high abundance of *L. dispar*, *A. australis*, and *D. elongatus*. These species are associated with abundantly distributed grasses in our study area, which agrees with similar results by Mariottini et al. (2013) and Luiselli et al. (2002) in grasslands of Argentina. The most abundant and widely distributed species were *L. dispar* and *A. australis* in the subfamily Gomphocerinae and *D. elongatus* in the Melanoplineae.

Concurring with Cigliano et al. (2000) and Zerbino et al. (2016) for grassland acridid communities, we also recorded few dominant species and a higher number of rare or uncommon species represented by one to three individuals.

We found that *A. australis* and *L. dispar* dominated the community while *D. obscurus*, *D. pratensis*, *D. conspersus*, *L. pulcher*, *H. lignosa*, and *M. adspersa* were infrequently found.

The species accumulation curve indicates that the sampling effort was adequate given the high percentages obtained from Jackknife 1 and Chao 2. These estimators are usually most accurate for evaluating the diversity associated with a particular community (Gotelli and Colwell 2011). Values below 80% are usually common in communities of tropical or subtropical arthropods

(Oliveira-Alves et al. 2005; Nogueira et al. 2006; Fernández-Badillo and Goyenechea-Meyer 2010). Obtaining a complete inventory of a community is difficult, especially for arthropods (Colwell and Coddington 1994; Jiménez-Valverde and Hortal 2003, 2006). However, our results indicate that a good proportion of the acridomorph community present in the Humedales de Santa Lucía protected area was detected.

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## Authors' Contributions

SGE and EL collected and identified the grasshoppers. CJ contributed to data analysis. All authors participated in the writing process and revised the manuscript.

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