

# Revision of the South American genus *Parorphula* (Orthoptera: Acrididae; Hyalopterygini) with the description of a new genus

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In this study *Parorphula* is re-described based on characters from the external morphology and genitalia. This genus comprised two species: *P. pallidinota* and *P. latipennis*, that were described based mostly on characters from external morphology. The morphological analysis conducted in this study plus the support of results from a cladistic analysis showed that external morphological characters justify the creation of a new genus for *P. latipennis*. Therefore, the genus *Neorphula* is proposed and the new combination is established.

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## Introduction

According to Amedegnato (1974), Otte (1995), and Carbonell (1998) the genus *Parorphula* Bruner belongs to the tribe Hyalopterygini within the subfamily Acridinae (Orthoptera, Acrididae).

The genus *Parorphula* was described by Bruner (1900) who included three species in it: *Parorphula graminea*, *P. pallidinota* and *P. strigata*. Later, Bruner (1911) described the species *Parorphula latipennis*. In a recent paper, Donato (2003) transferred the species *P. pallidinota* and *P. strigata* to the genus *Covasacris* Liebermann, 1970.

*Parorphula graminea* inhabits the Espinal, Pampean, and Cerrado biogeographic provinces, all belonging to the Chacoan domain in the Neotropical region (Cabrera & Willink 1973). It is noteworthy to point out that other authors (Silveira Guido *et al.* 1958) cited this species in a locality belonging to the Paranean province, Amazonian domain of the Neotropical region (Cabrera & Willink 1973). *P. graminea* has been considered harmful, mainly in grazing fields (Silveira Guido *et al.* 1958; COPR 1982). Nevertheless, in another study *P. graminea* was found only during non-outbreak years in the Argentinian pampas (Cigliano *et al.* 2003). In a study of species diversity in the Argen-

tine pampas, this species exhibited low mean relative abundance index and narrow distribution (Cigliano *et al.* 2000). Silveira Guido *et al.* (1958) mentioned that in Uruguay *P. graminea* prefers fields with median altitude and stony soil covered with grass. *Parorphula latipennis* is distributed in the Cerrado province of the Chacoan domain in the Neotropical region.

Donato (2001) performed a cladistic analysis of the species of the tribe Hyalopterygini. That analysis was based on 61 morphological characters, both external and genital. The phylogenetic hypothesis presented by Donato (2001) justifies the consideration of the species *P. latipennis* as belonging to a different genus, based mainly on external morphology. Therefore, the main objectives of this paper are the re-description of the genus *Parorphula* and the description of the new genus *Neorphula*.

## Materials and Methods

The specimens examined for this study are deposited in the following institutions: Department of Entomology, University of Nebraska State Museum (Lincoln, United States, UNSM), Facultad de Ciencias, Universidad de Montevideo

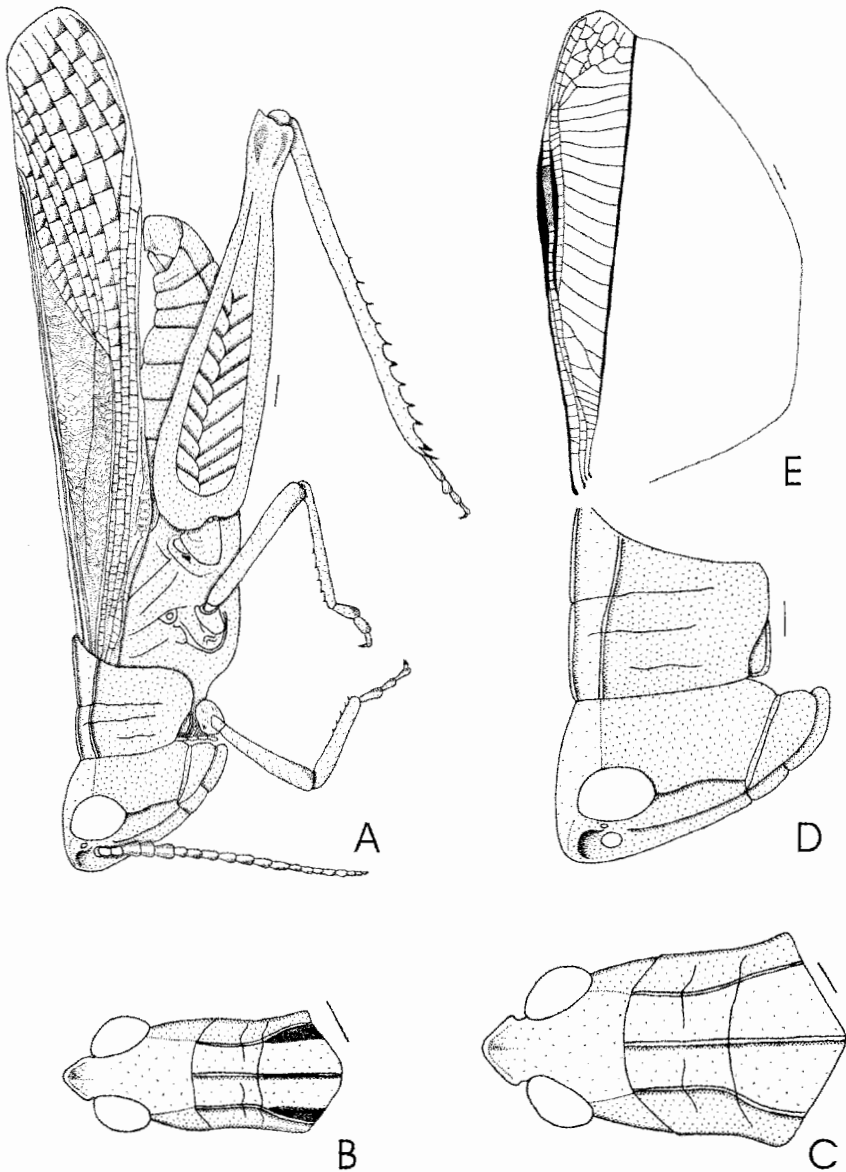


Figure 1. - *Parorphula graminea* Bruner. A, male, lateral view; B, head and pronotum, dorsal view; C- D, female, head and pronotum, dorsal and lateral views; E, male hind wing. Scale line 1 mm.

(Montevideo, Uruguay, FHCM), and Museo de La Plata (Argentina, MLP).

*Male genitalia.* – Museum specimens were softened with ammonia before dissection of the phallic complex; phallic complexes were then cleared in potassium hydroxide and stored in glycerin.

*Illustrations.* – Phallic complexes of male and female subgenital plates were illustrated based on observations conducted using an ocular grid. Camera lucida was used for the illustrations of external morphology.

***Parorphula* Bruner, 1900**

(Fig. 1)

Type species: *Parorphula graminea* Bruner by subsequent designation (Art. 69.1, ICZN 2000).

*Parorphula* Bruner, 1900: 25 (without type species designation); Rehn, 1906: 20 (type species: *Parorphula graminea* Bruner, 1900); Jago, 1971: 215; Amedegnato, 1974: 202; Otte, 1995: 251; Otte & Naskrecki, 1997: Orthoptera Species File On Line; Carbonell, 1998: 87.

**Taxonomy**

In 1900, Bruner erected the genus *Parorphula* without type species designation and he included in it the species *P. graminea*, *P. pallidinota*, and *P. strigata*. Later, Rehn (1906) designed *Parorphula graminea* Bruner, 1900 as type species for the genus.

**Systematics**

**Re-description.** – **Male:** Body compressed with opaque integument. Head with fastigium short, shallowly excavated dorsally, apex subconical. Lateral foveolae absent. Eyes little prominent. Antennae subensiform, the width of scape less than two times the width of flagellum first segment. Pronotum smooth, sides of pronotum parallel in prozona and divergent in metazona; pronotal disk flattened and subrectangular, with median carinae cut by principal sulcus, lateral carinae distinct and parallel cut by principal and secondary sulci; anterior margin of pronotum straight, posterior margin of pronotum angulate. Abdomen, male subgenital plate conical pointed at the end. Hind knees of femur III with pointed upper and lower lobes, lower lobes more produced than the upper lobes. Hindwings with 1 or 2 rectangular-shaped cells between M+Cu<sub>1</sub> and Cu<sub>2</sub> veins and 10 or 12 rectangular-shaped cells between Cu<sub>1</sub> and Cu<sub>2</sub>; end of fore wings slightly obliquely truncated. Phallic complex: as shown in Figure 2. Endophallic plates with anterior expansions well developed; aedeagal valves straight and robust, arch of dorsal valves robust and rounded at the apex; sheath of penis slightly expanded laterally and denticulate. Cingulum with apodemes narrow; ectophallic membrane with lateral sclerite well sclerotized. Epiphallus fenestrated, anterior projections of lateral plates globe-shaped, posterior projections acute and expanded laterally; anchorae constituting independent sclerites, curved inwards, with

acute apices; lophi trilobated with median lobe less sclerotized than external and internal lobes; bridge narrow and concave, sub-quadrate or sub-circular.

**Female:** similar to male but larger and more robust. Ovipositor valves short and curved. Internal genitalia: spermathecae having both apical and preapical diverticula. The apical diverticulum rounded at the apex. The preapical diverticulum longer than the apical diverticulum.

**Distribution.** – The genus *Parorphula* inhabits Central Argentina, Uruguay and south of Brazil (Fig. 5).

***Parorphula graminea* Bruner, 1900**

(Fig. 2)

*Parorphula graminea* Bruner, 1900: 26 [Holotype male, Carcarañá, Santa Fe, Argentina, UNSM]; Rehn, 1906: 20; Liebermann, 1946: 9, 1948: 109; Jago, 1971: 215; COPR, 1982: 403; Otte, 1995: 252; Otte & Naskrecki, 1997: Orthoptera Species File On Line; Carbonell, 1998: 87; Cigliano *et al.*, 2000: 84.

**Diagnosis.** – **Male:** Metazona of pronotum less expanded than in *N. latipennis*. Tegmina narrow, its maximum width smaller than the maximum length of pronotum. Hindwings with 1 or 2 rectangular-shaped cells between M+Cu<sub>1</sub> and Cu<sub>2</sub> veins and 10 or 12 rectangular-shaped cells between Cu<sub>1</sub> and Cu<sub>2</sub>; end of fore wings slightly obliquely truncated. Internal genitalia: Cingulum with apodemes narrow; lophi of epiphallus with the external lobe larger than the median and internal lobes, its maximum diameter approximately two times the maximum diameter of internal lobe, median lobe less sclerotized; bridge narrow and concave, subcircular.

**Female:** Female subgenital plate with posterior margin rounded, with a slight concavity near the egg guide.

**Coloration.** – **Male:** homogeneously brown with dorsal surface of head, disk of pronotum and disk of tegmina green or brownish. Hind wing dark brown.

**Female:** Head, side of pronotum, and side of tegmina green with a dark brown stripe starting at the posterior edge of pronotum and continuing onto the side of tegmina along the M vein. Legs brown, femur III with two dark brown spots. Some specimens homogeneously brown with dark brown spots on the pronotum disk. Hind wing brownish.

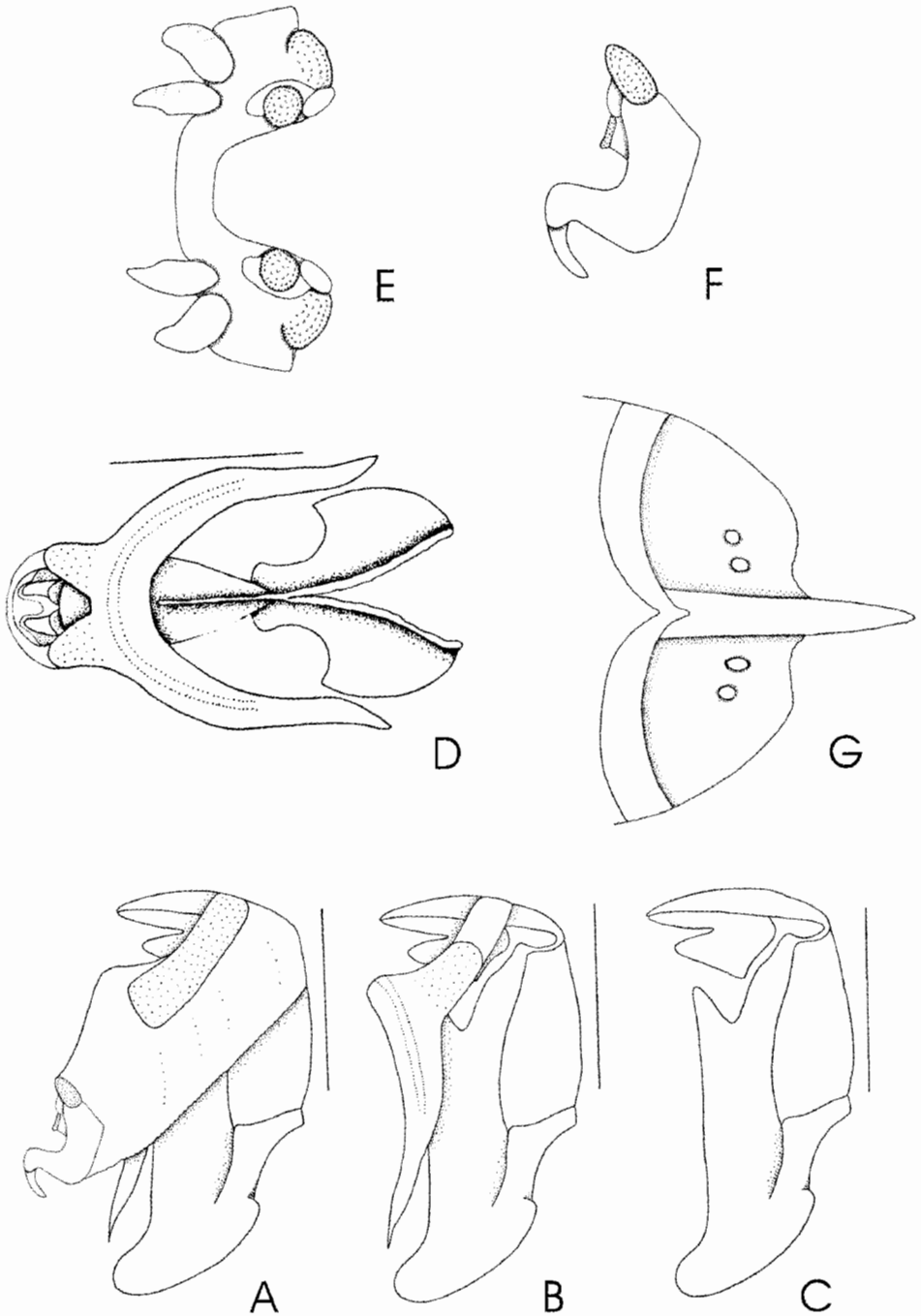


Figure 2.- *Parorophula graminea* Bruner. Phallic complex: A, whole complex, lateral view; B, phallic complex without epiphallus and lateral sclerite, lateral view; C- D endophallus and arch, dorsal and lateral views; E- F, epiphallus, dorsal and lateral views; G, female, subgenital plate, dorsal view. Scale line 1 mm.

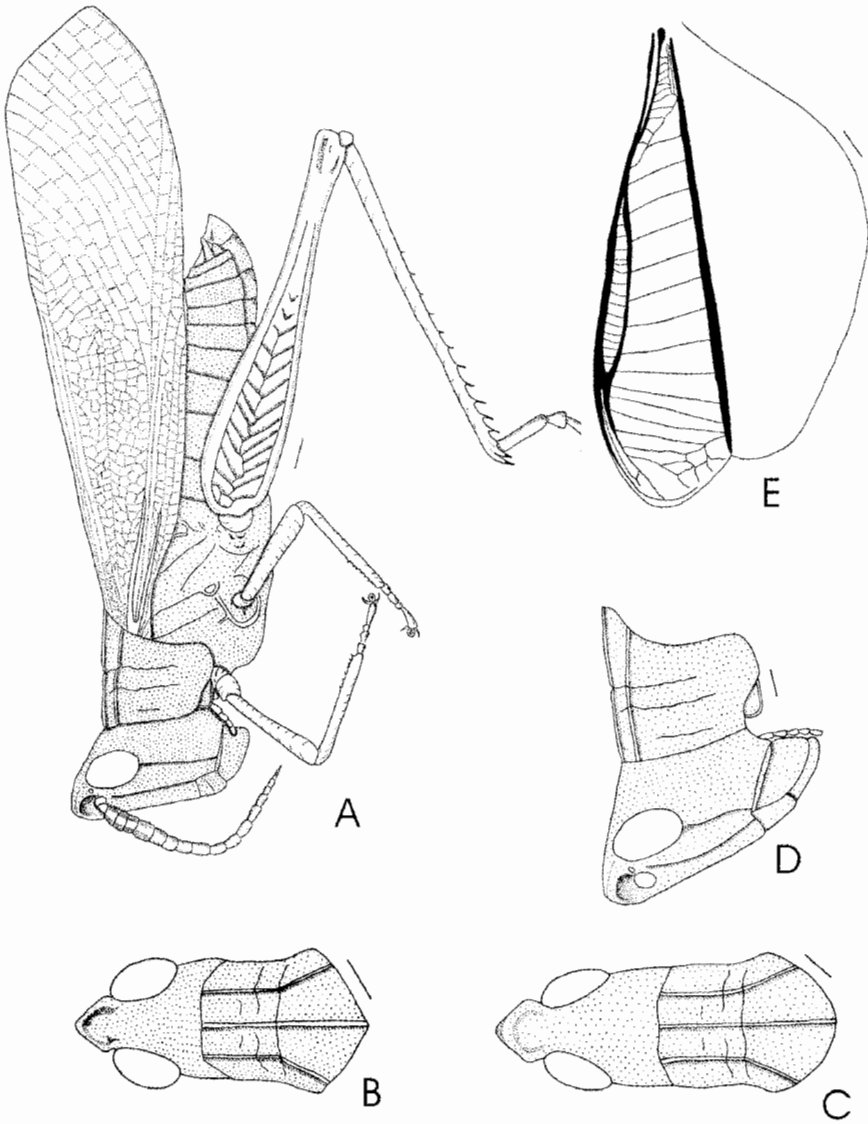


Figure 3.- *Neorophula latipennis* (Bruner). A, male, lateral view; B, head and pronotum, dorsal view; C- D, female, head and pronotum, dorsal and lateral views; E, male hind wing. Scale line 1 mm.

*Types examined.* – Of *Parorophula graminea*, a male in UNSM labeled Hololectotype, Argentina, Carcarañá, CP- 292, *Parorophula graminea* Bruner type, without date and collector data. A female in UNSM labeled Alectotype, Argentina, Carcarañá, *Parorophula graminea* Bruner type, without date and collector data.

*Material examined.* – Argentina, Buenos Aires, Gral Laprida, 1♂, without date and collector data (MLP); Argentina, Buenos Aires, poco antes de Bunge, ruta

provincial 86, 2♂, 8.ii.1994, C. Lange (MLP); Argentina, Buenos Aires, Tandil, 1♂ 1♀, without date, J. J. Llano (MLP); Brazil, Minas Gerais, Curvelo, 1♀, xi.1977, Seabra, Roppa & Monné (FHCM); Brazil: Minas Gerais, Corinto, 1♂, xi.1977, Seabra, Roppa & Monné (FHCM); Brazil, Minas Gerais, Piraporá, 1♀, xi.1977, Seabra, Roppa & Monné (FHCM); Uruguay, Florida, Casupá, 2♂ 3♀, 16.i.1965, C. S. Carbonell (FHCM); Uruguay, Tacuarembó, Tacuarembó Chico, 2♀, 25.i.1960, C. S. Carbonell (FHCM); Uruguay,

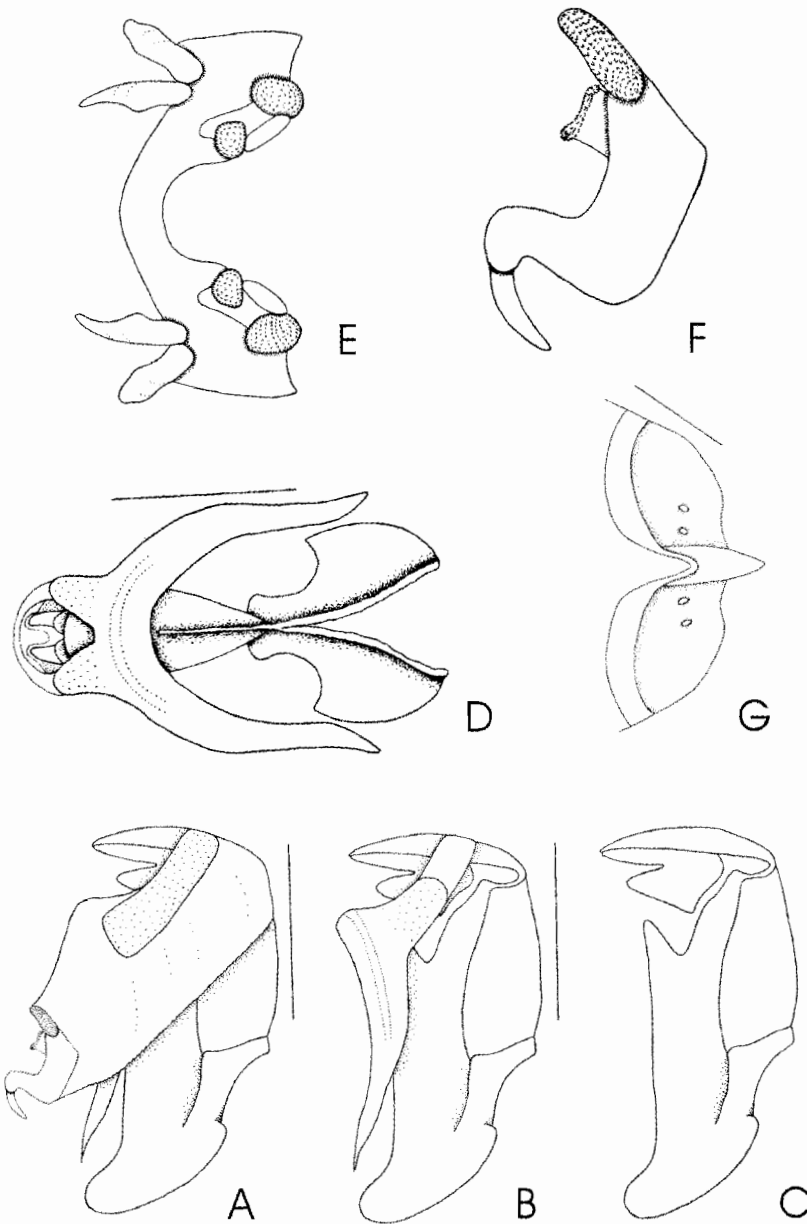


Figure 4.- *Neorphula latipennis* (Bruner). Phallic Complex: A, whole complex, lateral view; B, phallic complex without epiphallus and lateral sclerite, lateral view; C- D endophallus and arch, dorsal and lateral views; E- F, epiphallus, dorsal and lateral views; G, female, subgenital plate, dorsal view. Scale line 1 mm.

Tacuarembó, Paso Manuel Díaz, río Tacuarembó, 1♂, 21.i.1956, C. S. Carbonell (FHCM); Uruguay, Tacuarembó, Picada de Coelho, A° Yaguarí, 1♀, 10.i.1956, C. S. Carbonell (FHCM).

***Neorphula* gen. n.**

(Fig. 3)

*Type species.* – *Parorphula latipennis* Bruner, 1900 by original designation (Art. 68.2, ICZN 2000).

*Parorphula* Bruner, 1900: 25 (in part); Bruner, 1911: 21 (in part); Otte, 1995: 251 (in part); Otte & Naskrecki, 1997: Orthoptera Species File On Line (in part); Carbonell, 1998: 87 (in part).

*Etymology.* – *Neorphula*, from (Greek), Neos, new, and orphula, relative to genus *Orphula* Stål, 1873 (Acrididae: Hyalopterygini).

### Systematics

*Description.* – **Male:** Body compressed with opaque integument. Head with fastigium short, shallowly excavated dorsally, apex subconical. Lateral foveolae absent. Eyes little prominent. Antennae subensiform. Pronotum smooth, sides of pronotum parallel in prozona and divergent in metazona; pronotal disk flattened and subrectangular, with median carinae cut by principal sulcus, lateral carinae distinct and parallel cut by principal and secondary sulci; anterior margin of pronotum straight, posterior margin of pronotum angulate. Abdomen, male subgenital plate conical and pointed at the end. Hind knees of femur III with pointed upper and lower lobes, lower lobes more produced than the upper lobes. Hindwings with 11 or 12 rectangular-shaped cells between M+Cu<sub>1</sub> and Cu<sub>2</sub> veins; end of fore wings obliquely truncated. Phallic complex: as shown in Figure 4. Endophallic plates with anterior expansions well developed; aedeagal valves straight and robust, arch of dorsal valves robust and rounded at the apex; sheath of penis slightly expanded laterally and denticulate. Cingulum with apodemes wide; ectophallic membrane with lateral sclerite well sclerotized. Epiphallus fenestrated, anterior projections of lateral plates globe-shaped, posterior projections acute and expanded laterally; anchorae constituting independent sclerites, curved inwards, with acute apices; lophi trilobated with median lobe less sclerotized than external and internal lobes; bridge narrow and concave, sub-quadrate or sub-circular.

**Female:** similar to male but larger and more robust. Ovipositor valves short and curved. Internal genitalia: spermathecae having both apical and preapical diverticula. The apical diverticulum rounded at the apex. The preapical diverticulum longer than the apical diverticulum.

*Distribution.* – On the basis of the material examined, this genus occurs in Mato Grosso and Minas Gerais states in Brazil (Fig. 5).

### *Neorphula latipennis* (Bruner, 1911) comb. n.

(Fig. 4)

*Parorphula latipennis* Bruner, 1911: 21 [Syntypes male and female, Habitat.- Chapada, Brazil, UNSM]; Otte, 1995: 252; Otte & Naskrecki, 1997: Orthoptera Species File On Line; Carbonell, 1998: 87.

### Systematics

*Diagnosis.* – **Male:** Metazona of pronotum more expanded than in *P. graminea*. Tegmina broad, its maximum width equal or longer than the maximum length of pronotum. Hindwings with 11 or 12 rectangular-shaped cells between M+Cu<sub>1</sub> and Cu<sub>2</sub> veins; end of fore wings obliquely truncated. Internal genitalia: Cingulum with apodemes wide; lophi of epiphallus with external lobe larger than the internal lobe, oval-shaped; bridge narrow and concave.

**Female:** Posterior margin of female subgenital plate rounded with a slight concavity near egg guide, less produced than in *P. graminea*.

*Coloration.* – **Male:** homogeneously dark brown, dorsal surface of head, disk of pronotum, and disk of tegmina brownish. It may present irregular spots distributed throughout the body without a fixed pattern. Hind wings brownish.

**Female:** Same color pattern as the male, without the dorsal brownish coloration.

*Types examined.* – Brazil: Chapada, one male and one female (here designed as holotype and allotype, respectively), August, without collector data (UNSM). In the specimens' labels only appears "Chapada" but Bruner (1911) mentioned as type locality "Habitat-Chapada, Brazil". On the other hand, Carbonell (pers. comm.) examined this material plus the paratypes deposited in the Academy of Natural Sciences of Philadelphia, and he confirmed that "Chapada" is located in Brazil.

*Material examined.* – Brazil, Minas Gerais, Lagoa Santa, 1♂, x.1956, without collector data (FHCM); Brazil, Rondonia, Colorado do Oeste, 1♀, x.1958, Roppa & Magno (FHCM); Brazil, Mato Grosso, Chapada dos Guimarães, 3♂, ix.1978, Roppa & Becker (FHCM).

### Discussion

In the cladistic analysis of the tribe Hyalopterygini carried out with species as terminals (Donato 2001), *P. graminea* appears as the sister group of *P. latipennis* and shares the character state "end of tegmina slightly obliquely truncated". This last species possesses as autapomorphy its particular hind wing venation plan, as shown in Figure 3-E,

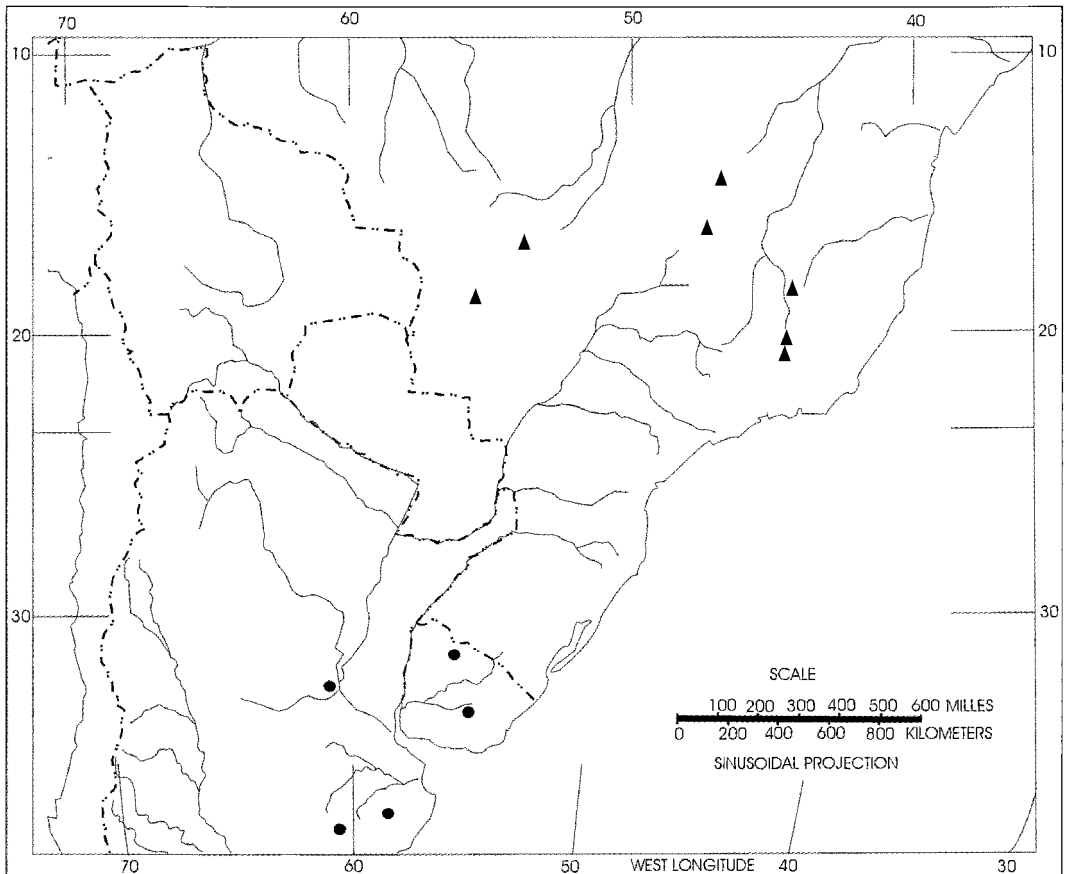


Figure 5.- Known geographic distribution of *Parorophula graminea* Bruner (black circles) and *Neorophula latipennis* (Bruner) (black triangles).

and the following combination of characters: “maximum tegmina width equal or larger than the maximum pronotum length”, “hind wing form ovoid”, “hind wing anterior field long”, and “C, Sc, M, and R veins thickened at the middle”. These characters support the creation of a new genus for *P. latipennis*. Table 1 shows a comparison between *Parorophula* and the new genus *Neorophula*. In the cladogram resulting from the cladistic analysis, the genus *Orphula* Stål is the sister group to the clade *P. graminea*+*P. latipennis*, with the synapomorphy “hind wing brownish”.

In the first papers where the tribe Hyalopterygini was discussed (Hebard 1922; Rehn 1944; Dirsh 1975) the characters used by these authors were taken mainly from external morphology. Only Dirsh (1975) mentioned a character derived from internal male genitalia. These three authors

consider the presence of hind wing fenestration as a diagnostic character but they did not look further into hind wing venation in order to determine how such fenestrations are outlined. On the other hand, this character, combined with the absence of stridulatory apparatus and very slanted face, induced Hebard (1922) and Rehn (1944) to postulate the group *Odontomeli* (Acrididae: Acridinae) as the sister group of tribe Hyalopterygini. Although, as previously stated, fenestration was used in their analysis but the authors never established a primary hypothesis of homology for this character. Donato (2001) established a primary hypothesis of homology in hind wing venation in the cladistic analysis of the tribe Hyalopterygini carried out using some members of the tribe Orphulellini (Acrididae: Gomphocerinae) as outgroup. It is worthy to point out that some members of the



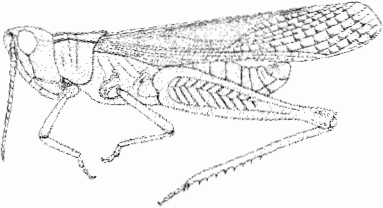
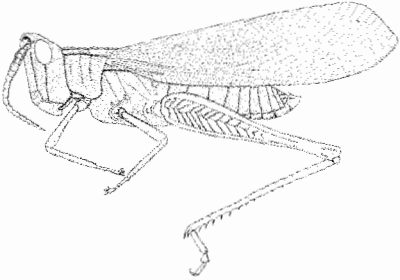
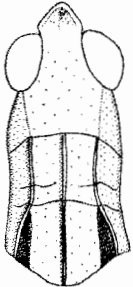
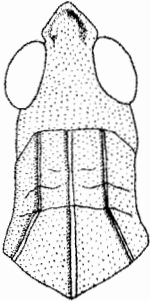
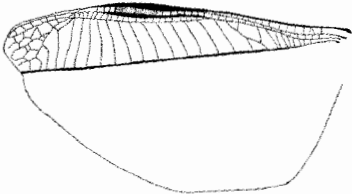
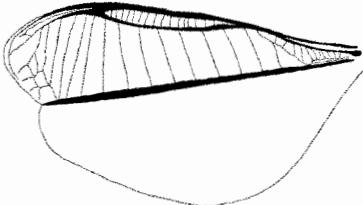
<i>Parorphula</i>	<i>Neorphula</i>
<p>Maximum width of tegmina bigger than the maximum length of pronotum</p> 	<p>Maximum width of tegmina smaller than the maximum length of pronotum</p> 
<p>Metazona of pronotum less expanded</p> 	<p>Metazona of pronotum more expanded</p> 
<p>Hind wing plan venation</p> 	<p>Hind wing plan venation</p> 

Table 1.- Comparison of *Parorphula graminea* Bruner and *Neorphula latipennis* (Bruner).

selected outgroup possess a hind wing fenestration delimited by M+ Cu1 and Cu2 in a short trajectory, and then by Cu1 and Cu2. As a result of such analysis, the fenestration observed in Orphulellini is homologous to the fenestration present in Hyalopterygini. Although in some members of the tribe the fenestrations are delimited by M+ Cu1 and Cu2 in all the cells, this is interpreted as a character state derived from the character state mentioned earlier. Based on hind wing fenestration and other characters derived from internal genitalia, the tribe Orphulellini is proposed as a possible sister group of Hyalopterygini (Donato 2001) although a new cladistic analysis including Old World Acridinae is in preparation in order to clarify the phylogenetic and taxonomic position of the tribe Hyalopterygini. Another result of the cladistic analysis of the tribe is that the hind wing plan venation is an important taxonomic character at genus level. For these reasons, I agree with Amedegnato (1974), Otte (1995), and Carbonell (1998) that the genus *Parorphula* Bruner belongs to the tribe Hyalopterygini and, on the other side, the creation of new genus *Neorphula*, also belonging to the tribe Hyalopterygini, is justified by the consideration of other characters derived from external morphology.

### Acknowledgements

This work is part of the results obtained during my Ph.D. thesis, therefore I want to thank María Marta Cigliano, who was my thesis director, and the three members of the jury, especially Carlos S. Carbonell, for their suggestions. I am also grateful to Carolina Vieytes and Cecilia Morgan who contributed their comments and corrections.

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