


Revision of “*Aemilia*” *pagana* Species-Group (Lepidoptera: Erebidae: Arctiinae), with a Description of a New Endemic Species and Comments on the Conservation Status

HM BECCACECE^{1,2} , G SAN BLAS³, ME DREWNIAK^{1,4}, MJ BARRIONUEVO⁵, ER KRAUCZUK⁶, AE CHALUP⁷, AI ZAPATA¹

¹Facultad de Ciencias Exactas, Físicas y Naturales, Univ Nacional de Córdoba (UNC), Córdoba, Argentina

²Centro de Investigaciones Entomológicas de Córdoba, Instituto de Investigaciones Biológicas y Tecnológicas (IIByT), UNC-Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICET), Córdoba, Argentina

³Depto de Ciencias Naturales, Facultad de Ciencias Exactas y Naturales, Univ Nacional de La Pampa-CONICET, Santa Rosa, La Pampa, Argentina

⁴Instituto Multidisciplinario de Biología Vegetal, UNC-CONICET, Córdoba, Argentina

⁵Instituto de Ecorregiones Andinas (INECOA)-CONICET, Jujuy, Argentina

⁶Guardaparque, Ministerio de Ecología y Recursos Naturales Renovables, Misiones, Argentina

⁷Fundación Miguel Lillo, San Miguel de Tucumán, Tucumán, Argentina

Keywords

Arctiini, Phaegopterina, *Aemilia*, *Leucanopsis*, tiger moths, endemic species

Correspondence

HM Beccacece, Centro de Investigaciones Entomológicas de Córdoba, Instituto de Investigaciones Biológicas y Tecnológicas (IIByT), UNC-Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICET), Av. Vélez Sársfield 1611, Zip Code 5016 Córdoba, Argentina; hermanbeccacece@unc.edu.ar

Edited by André VL Freitas – UNICAMP

Received 23 August 2017 and accepted 15 January 2018

© Sociedade Entomológica do Brasil 2018

Abstract

A taxonomical rearrangement of “*Aemilia*” *pagana* species-group is proposed: *Leucanopsis pagana* (Schaus in Proc Zool Soc London 1894:225–243, 1894) comb. nov. and *L. ninae* (Orfila in Rev Soc Entomol Argent 21:67–70, 1959) comb. nov. A new endemic species from Pampa de Achala, Córdoba, Argentina, closer to both species, is described: *Leucanopsis navarroi* sp. nov. These three species can be recognized because the color pattern is the darkest among species of *Leucanopsis*. Characteristics of male genitalia suggest the nomenclatural rearrangement proposed. *Leucanopsis pagana* comb. nov. has a wide distribution from the center of Brazil to northeastern Argentina, including southern Paraguay. The known distribution and geospatial analysis suggest that this species is not in danger. *Leucanopsis ninae* comb. nov. is restricted to only one known locality (Villa Gesell, Buenos Aires). The restricted known distribution, the different land use practices, and geospatial analysis suggest that this species could be endangered. *Leucanopsis navarroi* sp. nov. is endemic to the high plateau present in the center of Argentina called Pampa de Achala. The known distribution and geospatial analysis suggest that this species could be endangered. Further studies are necessary to determine effectively the conservation status of these three species.

Introduction

Tiger moths or arctiid moths (Lepidoptera: Erebidae: Arctiinae) are one of the most speciose groups of Lepidoptera with almost 11,000 species and about 700 genera worldwide, of which at least half are present in the Neotropical region (Zahiri *et al* 2012, Vincent & Laguerre

2014, Rönkä *et al* 2016). This group of moths is known for the bright coloration and adult mimicry of wasps, cockroaches, and lycid beetles, and unpalatable moths and butterflies of some species (Zaspel *et al* 2014). In South America, several new species of tiger moths have been described in the past 5 years (Beccacece & Vincent 2014, Laguerre 2014a, b, Vincent 2014, Vincent & Laguerre 2014, Gibeaux 2015,

Laguerre 2015, Moraes & Duarte 2015, Cerda 2016, Gibeaux 2016a, b, c, Grados & Ramírez 2016, Laguerre 2016, Laguerre & Vincent 2016, Pinheiro 2016a, b, Pinheiro & Duarte 2016, Pinheiro *et al* 2016, Beccacece 2017, Laguerre 2017). The process of describing new species is significantly important because it is the basis for any biodiversity-related and conservation research (Ferro & Diniz 2008).

The subfamily Arctiinae is found in all Neotropical ecoregions and its diversity peaks within the tropics (Zenker *et al* 2016). However, several species appear to have restricted geographical ranges and they are also infrequently collected, being rare in entomological collections (Hernández-Baz *et al* 2013, Beccacece *et al* 2016). For example, some species have a restricted distribution to a particular mountainous region (Schmidt & De Freina 2011, Beccacece & Vincent 2014, Zenker *et al* 2015), while other species to an ecoregion (Ferro & Diniz 2008, Beccacece & Vincent 2014, Beccacece *et al* 2016, Beccacece 2017). Despite the large number of species and endemic tiger moths species present in the different ecoregions in South America, the current knowledge of conservation status is poor.

The current classification divides the subfamily into four tribes: Lithosiini, Amerilini, Syntomini and Arctiini (Zaspel *et al* 2014, Zenker *et al* 2016). Arctiini is the richest with more than 5000 species, the majority distributed in the Neotropical region. Traditionally, Arctiini encompasses six subtribes: Arctiina, Spilosomina, Phaegopterina, Pericopina, Callimorphina, Euchromiina, and Ctenuchina (Jacobson & Weller 2002, Lafontaine & Schmidt 2010), but recent studies have considered some subtribes as paraphyletic or polyphyletic groups such as Phaegopterina, Euchromiina, and Ctenuchina (Zaspel *et al* 2014, Zenker *et al* 2016). The traditional Phaegopterina contains more than 1700 species distributed in 152 genera (Vincent & Laguerre 2014).

Aemilia Kirby, 1892 is included in Phaegopterina with 14 species (Vincent & Laguerre 2014). Watson & Goodger (1986) classified 6 species in *Aemilia* “sensu lato,” due to the habitus which are very different from the type species of *Aemilia*: *Aemilia rubriplaga* (Walker, 1855). Vincent & Laguerre (2014) added this information in the new catalog of tiger moths as commentaries. *Aemilia pagana* (Schaus, 1894) was one of the species included in *Aemilia* “sensu lato.” This species was described from an unspecified number of males and females from Castro, Paraná, Brazil. Later, Watson (1971) designated a male lectotype and then dissected and photographed its genitalia. On the other hand, *Amastus ninae* Orfila, 1959 was described from a male holotype from Villa Gesell, Buenos Aires, Argentina, and later transferred to *Aemilia* by Vincent & Laguerre (2010), based on its habitus and male genitalia which are very similar to the lectotype of *A. pagana*. Recently, specimens close to *A. pagana* and *A. ninae* were collected from the high plateau located in the central mountains of Argentina called Pampa de

Achala. These specimens showed differences in habitus and genitalia confirming a new species of tiger moth. Nevertheless, the habitus of these three species, henceforth called “*Aemilia*” *pagana* species-group due their external and internal morphological similarities, are very different to the type species of *Aemilia*.

“*Aemilia*” *pagana* species-group has a restricted known distribution, based on literature and South American museum collections, except for *A. pagana* (Schaus 1894, Orfila 1959, Ferro & Romanowski 2012, Ferro & Teston 2009, Ferro 2007, Ferro *et al* 2012, Drechsel 2014). These species could be endangered if the known distribution and the different land use practices in their respective habitats are considered.

The aims of the study are to redescribe and propose a taxonomical rearrangement for *A. pagana* and *A. ninae*, and also to describe a new species closer to both species. Furthermore, known distribution and possible conservation status of these species are commented.

Materials and Methods

Specimens deposited in the Museo de Zoología Universidad Nacional de Córdoba (Argentina) and Museo de La Plata (Argentina) were used to propose the taxonomical rearrangement and to compare it with specimens of the new species. Male holotype of *A. ninae* was examined while male lectotype of *A. pagana* was examined by photo (Watson 1971).

Adults of the new species were attracted with a light trap and collected and killed using ethyl acetate or alcohol injection. These specimens were found in the high plateau called Pampa de Achala in Córdoba, Argentina. This place belongs to the district of Chaco Serrano forest, Chacoan province of the Neotropical region (Luti *et al* 1979). The vegetation in the region consists of a mosaic of patches dominated by tall tussock grasses alternating with lawn patches (Cabido *et al* 1999). Pampa de Achala is considered a biogeographic island due to its isolation and because there are several endemic species different to the surrounding lower areas (Nores 1995, Cabido *et al* 1998).

All adults were photographed with a Sony DSCH7 digital camera and then were dissected following the methods detailed in the literature, using a hot KOH solution (10%) and stained with mercurochrome and chlorazol black, if necessary. The genital terminology followed Schmidt (2009), Beccacece & Vincent (2014), Vincent (2016), and Beccacece (2017).

Species distribution maps were made with Simplemapp (Shorthouse 2010). The localities used were based on type material, information of museum, Global Biodiversity Information Facility (GBIF), records from the literature

(Schaus 1894, Orfila 1959, Ferro 2007, Ferro & Teston 2009, Ferro & Romanowski 2012, Ferro *et al* 2012, Drechsel 2014) and personal comments of different curators and researchers (see acknowledgements). The information of the localities was taken from the literature and the labels of the collections, and then georeferenced with GeoLocate (Ríos & Bart 2014).

The conservation status of the three species was analyzed using GeoCAT (Geospatial Conservation Assessment Tool; Bachman *et al* 2011). The analysis focuses on two aspects of the geographic range of a taxon: the extent of occurrence (EOO) and the area of occupancy (AOO) with a cell size of 2 km². These two measures are the foundation of the “B” criterion of the IUCN Red List system (IUCN 2001, Bachman *et al* 2011).

Repository abbreviations

MACN	Museo Argentino de Ciencias Naturales “Bernardino Rivadavia,” Buenos Aires, Argentina;
MC	Moser Collection, Rio Grande do Sul, Brazil;
MLP	Museo de La Plata, Buenos Aires, Argentina;
MZUC	Museo de Zoología Universidad Nacional de Córdoba, Córdoba, Argentina;
MZUSP	Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil;
NMNH	National Museum of Natural History, Washington D.C., USA.
VOB	Becker Collection, Camacã, Bahia, Brazil.

Results

Diagnosis of *pagana* species-group

Adults of the *pagana* species-group (Fig 1) can be recognized by the dark brown coloration of fore- and hindwings; abdomen yellowish brown or dark brown dorsally. Male genitalia with uncus developed; process of tegumen, sacculus and costa fused; aedeagus long and curved, caecum rounded, and vesica membranous (Fig 2). Female genitalia with corpus bursae oval and covered with little spicules; signum ovoid with a greater density of spicules than corpus, and present on the middle-right surface; bulla seminalis oval, membranous with a single chamber, smaller than the corpus bursae (Fig 3).

The three species are very different to the type species of *Aemilia*. The process of tegumen and its apex in the male genitalia suggest the association of these three species with some species of *Leucanopsis* Rego Barros, 1956a. For this reason, taxonomic changes for these species to *Leucanopsis* are proposed here:

Leucanopsis pagana (Schaus, 1894), *comb. nov.*

Halisidota [sic] *pagana* Schaus, 1894: 230. Type material: Lectotype male (photograph examined) designated by Watson (1971). Labels presented in Watson (1971). Deposited in the NMNH. Type locality: Castro, Parana, [Brazil].

Redescription. Male (Fig 1a). Head: dark brown dorsally except the yellowish orange posterior margin of scape and edge of eye. Antenna dark brown, bipectinate. Palpus yellowish orange except for the third segment which is dark brown. Proboscis yellowish, longer than the thorax. Thorax: dark brown with lateral edge of tegula and edge of patagium yellowish orange; patagium edged with yellowish orange anterolateral and medially and dark brown ventrally except for the union of wings with yellowish orange faded. Legs: dark brown except for the ventral side of coxa, trochanter, and femur yellowish brown. Forewing—length 17.5 mm: dark brown dorsally and ventral surface paler, semi-hyaline. Hindwing—length 11.5 mm: dorsal surface dark brown, semi-hyaline at center and ventral surface paler, semi-hyaline. Abdomen: dark brown dorsally, with a yellowish orange tuft of hair on the last segment. Two lateral yellowish orange tufts of hair near the thorax. Ventral surface dark brown. **Male genitalia** (Fig 2a, b): uncus developed, with base and apex fully differentiated and joined by a pedicel. Apex of uncus completely setose with a small spine at the tip, mid-posteriorly surface with two big rounded processes well marked. Base of uncus subtriangular. Tegumen robust and straight. Process of tegumen like a tube with a longitudinal depression in the ventral area, which is longer than the valva, curved and directed to the inner margin, apex has patches of spicules in the ventral area continuing into the depression. Vinculum rounded and ribbon-shaped. Saccus absent. Juxta sclerotized, thin and straight, fused with the anellus. Anellus with two lateral rounded processes. Manica membranous. Symmetrically sclerotized valves, with inner margin setose, wide at the base and shorter than the uncus. Sacculus and costa fused, with one apical rounded and straight process. Aedeagus (Fig 2c) long and curved; caecum slightly developed, rounded. Vesica completely membranous, with one bag-shaped projection directed to the dorsal anterior area, rounded and curved; another bag-shaped projection directed to the dorsal lateral area, bigger, with a thin apical process. **Female**. Unknown.

Material examined. 1 male: Argentina, Corrientes, Ituzaingó, Establecimiento Santo Domingo, –27.6927, –56.1420, 135 m, 22–VIII–2014, Krauczuk, E. leg. [MZUC]. 1 male: Argentina, Misiones, Gobernador Roca, Elena Czajkowski Private Reserve, –27.1756, –55.4618, 175 m, 16–IX–2014, Krauczuk, E. leg. (dissected, prep. code: KZCARC000185) [MZUC]. 1 male (photograph examined): Paraguay, Alto Paraná, –25.5482, –55.2240, 203 m, Drechsel, U. leg. 1 male

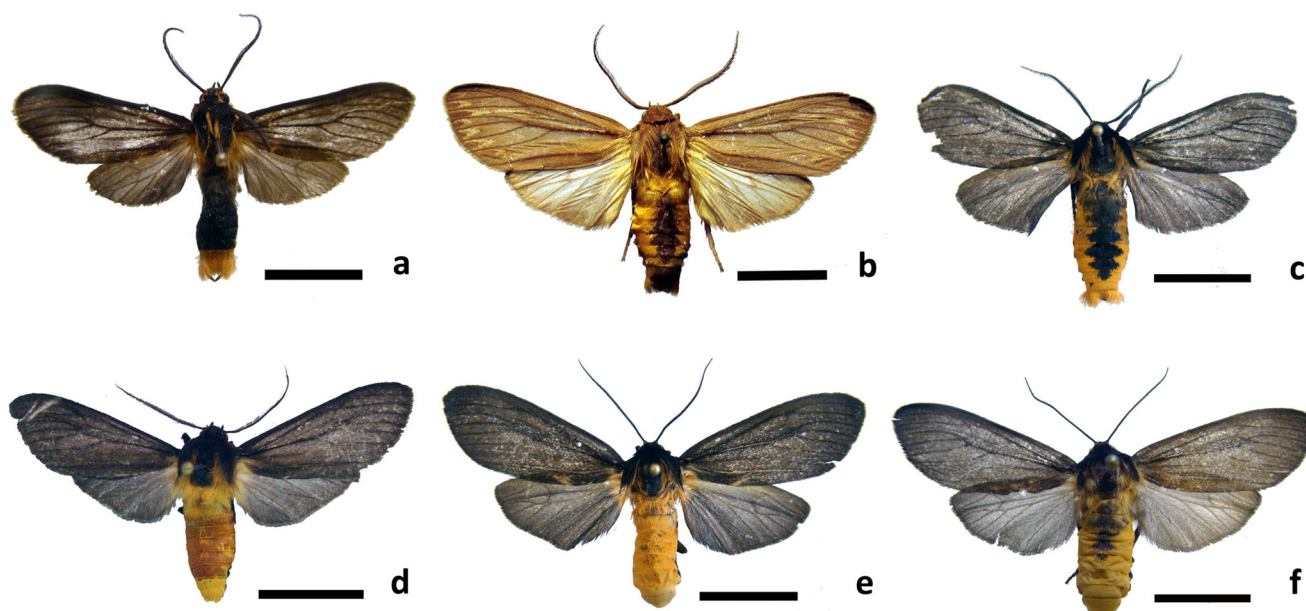


Fig. 1 Habitus of *Leucanopsis pagana* species-group. **a** *L. pagana* comb. nov. (specimen from Argentina, Corrientes, Santo Domingo stay), **b** *L. ninae* comb. nov. (specimen from Argentina, Buenos Aires, Villa Gesell), **c** *L. navarroi* sp. nov. (holotype), **d–e** Color pattern variation of *L. navarroi* sp. nov. (paratypes) (scale bar = 10 mm).

(photograph examined): Brazil, São Paulo, Campos do Jordão, II–1958, Lenko, K. leg. [MZUSP]. 1 male (photograph examined): Brazil, São Paulo, Campos do Jordão, P. E. C. Jordão, T. Canhambora, 22°41'38.9"S 45°29'28.5"W, 07/08–XII–2016, Lastra, J.; Dell'Erba, R. & Silva, O. leg. [MZUSP]. 1 male (photograph examined): Brazil, Goiás, Jataí, Faz. Nova Orlandia, I–1954, Martins; Morgante & Silva leg. [MZUSP]. 2 males and 1 female (photograph examined): Brazil, São Paulo, Pico dos Marins, Serra da Mantiqueira, 22°30'09"S 45°07'16"W, 2420 m, Calor, A. R.; do Pinho, L. C. & Rogne, F. O. leg. [MZUSP]. 2 males (photograph examined): Brazil, Rio Grande do Sul, São Francisco de Paula, Pró-Mata, 920 m, 28/29–XII–2005, Moser, A. & Prestes, A. [MC]. 1 male (photograph examined): Brazil, Rio Grande do Sul, Cambará do Sul 29°13'S–50°10.8' W, 1000 m, 19/20–XII–2014, Moser, A. leg [MC].

Biology. The immature stages are unknown.

Distribution and conservation status. *Leucanopsis pagana* comb. nov. is present from center Brazil to northeastern Argentina, including southern Paraguay (Fig 4). The species has a wide altitude range (from 3 to 1700 m asl) in different ecoregions. The geospatial analysis suggests that this species is least concern (LC) using the extent of occurrence, and endangered (EN) if the area of occupancy is taken into account (Tables 1 and 2).

***Leucanopsis ninae* (Orfila, 1959), comb. nov.**

Amastus ninae Orfila, 1959: 67. Type material: Holotype male (examined): Argentina, Buenos Aires, Partido General Madariaga, Villa Gesell, 16–I–1956, Nina Petrowsky leg.

Deposited in the MACN. Type locality: Villa Gesell, Buenos Aires, Argentina.

Redescription. Male (Fig 1b). Head: brown dorsally except for the posterior margin of scape and posterior margin of vertex yellowish orange. Antenna brown, bipectinate. Ventral surface brown, palpus with the first segment yellowish orange and the rest brown, the third segment shorter. Proboscis yellowish and longer than thorax. Thorax: patagium and tegula brown except for the inner margin of the tegula, which is yellowish orange. Meso and metathorax brown. Ventral surface brown. Legs: Brown, except for the dorsal surface of coxa, trochanter, and femur which are yellowish brown. Forewing—length 19.5–20 mm: dorsal surface brown with a faded light brown spot surrounding the outer margin and base yellowish brown. Ventral surface paler than dorsal surface. Hindwing—length 14.5–15 mm: dorsal surface brown except for the base yellowish brown. Ventral area same as dorsal. Abdomen: yellowish brown dorsally with a longitudinal band striated dark brown, the width varies among specimens. Brown ventrally. **Male genitalia** (Fig 2d–e): uncus developed, with base and apex fully differentiated, both joined by a pedicel. Apex of uncus completely setose, with a small spine at the tip and mid-posteriorly surface with two rounded processes. Base of uncus subtriangular. Tegumen robust and straight. Process of tegumen like a tube with a longitudinal ventral depression, longer than the valva, almost reaching the apex of the uncus, curved and directed to the left area, apex with ventral patches of spicules. Vinculum rounded and ribbon-shaped. Saccus area concave. Juxta sclerotized, thin and straight, fused with anellus. Manica membranous. Symmetrical sclerotized valves with

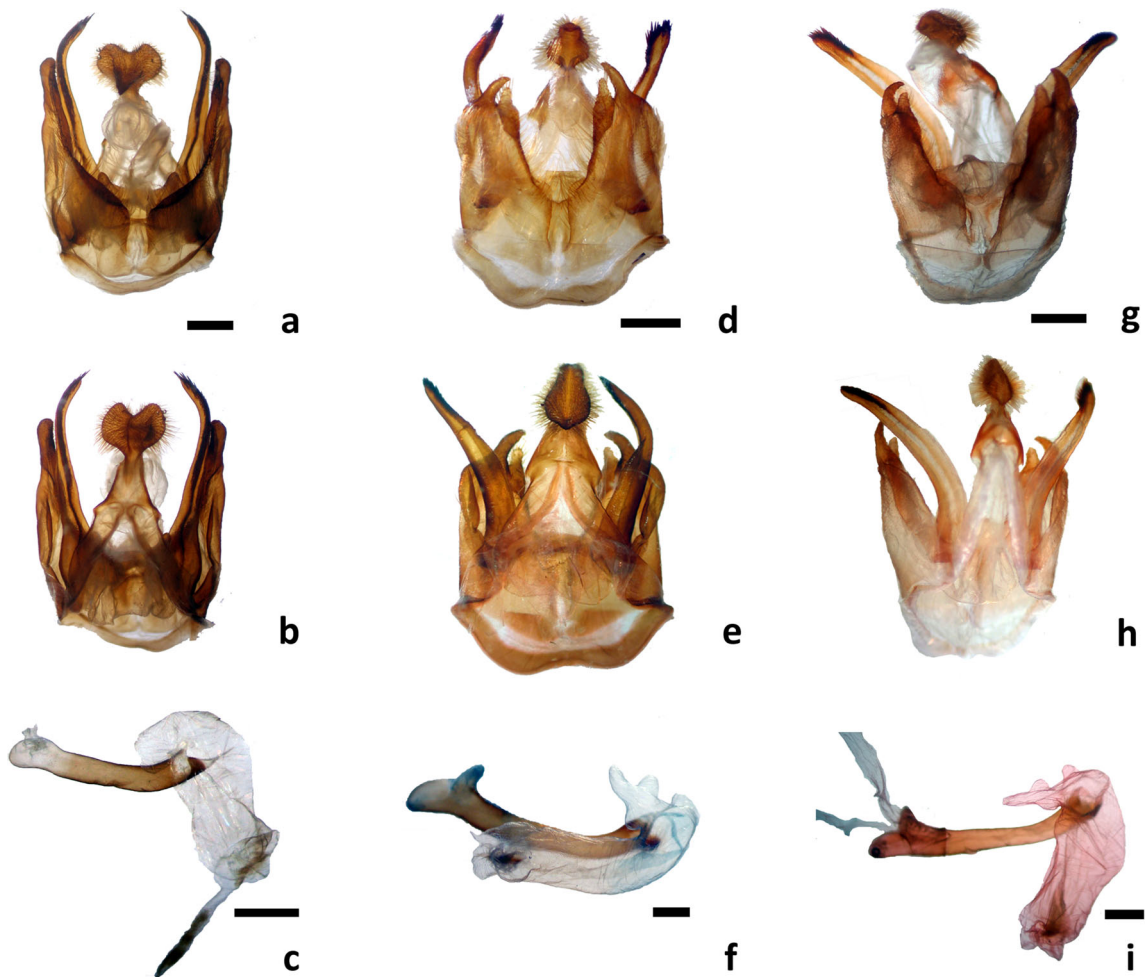


Fig. 2 Ventral and dorsal view of male genitalia, and lateral view of aedeagus of *Leucanopsis pagana* species-group. **a–c** *L. pagana* comb. nov., **d–f** *L. ninae* comb. nov., **g–i** *L. navarroi* sp. nov. (scale bar = 1 mm).

inner margin setose, wide at the base, and shorter than the uncus. Sacculus and costa fused with two apical processes like a claw-shaped crab. Anterior process shorter and lobular, whereas posterior process robust and curved like a hook. Aedeagus (Fig 2f) long and deeply curved; caecum developed and rounded. Vesica membranous, with one bag-shaped

projection directed to the dorsal anterior area, with three rounded diverticula and finger-shaped apex; another bag-shaped projection directed to the anterolateral area, bigger and curved, with two rounded diverticula at the apex and one as a spine. **Female.** Externally like male except for the following features: antennae with smaller rami, abdomen rounder without tuft of hair on last abdominal segment. **Female genitalia** (Fig 3a): anal papillae trapezoid and setose. Anal pseudopapillae conspicuous. Anterior apophyses longer than posterior apophyses. Pheromone glands slightly visible like a membranous bag. Eighth sternite sclerotized and not divided. Seventh sternite divided mid-ventrally. Ductus bursae sclerotized and longer than wide, creased at the distal part. Corpus bursae oval and covered with little spicules. Signum ovoid, present on the middle-right surface, densely covered with spicules. Bulla seminalis membranous, with a single chamber, oval and smaller than the corpus bursae.

Material examined. 1 male (holotype): Argentina, Buenos Aires, Partido General Madariaga, Villa Gesell, 16–I–1956, Nina Petrowsky leg. [MACN]. 1 male (paratype): Argentina,

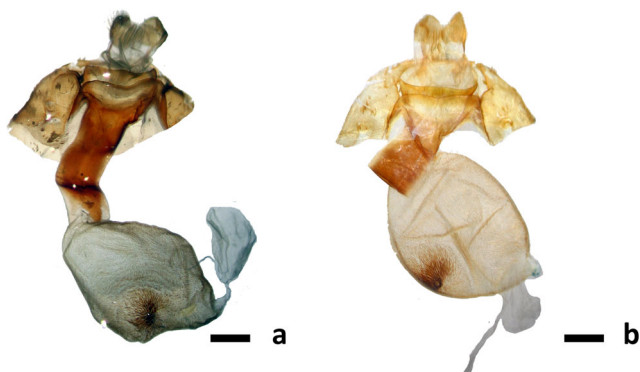


Fig. 3 Ventral view of female genitalia of *Leucanopsis pagana* species-group. **a** *L. ninae* comb. nov., **b** *L. navarroi* sp. nov. (scale bar = 1 mm).

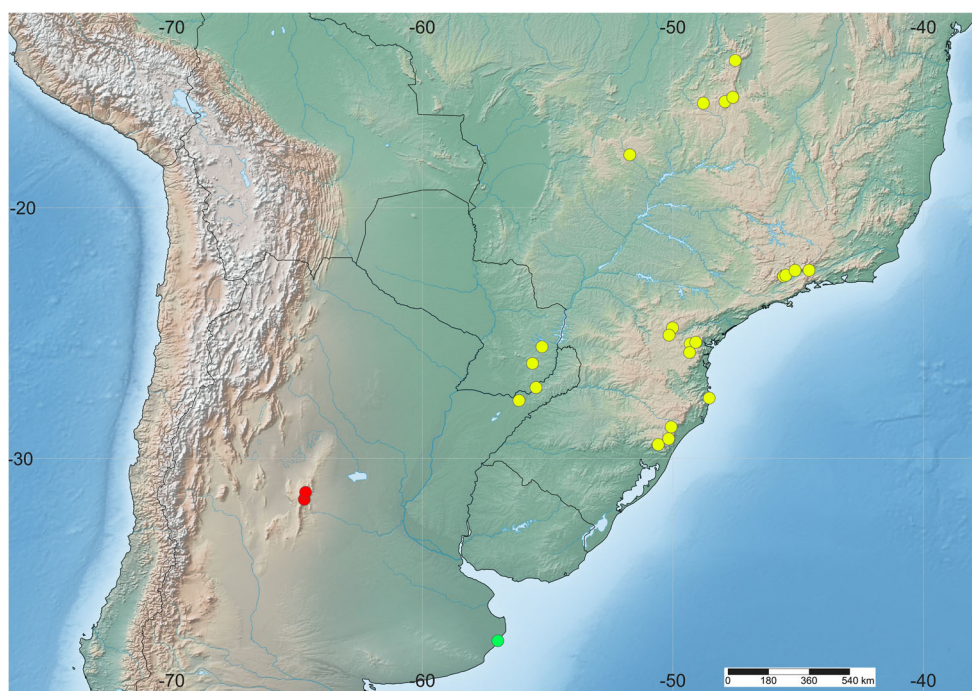


Fig. 4 Distribution map of *Leucanopsis pagana* species-group. Yellow circles = *L. pagana* comb. nov., green circle = *L. ninae* comb. nov., and red circles = *L. navarroi* sp. nov.

Buenos Aires, Partido General Madariaga, Villa Gesell, 11–II–1956, Nina Petrowsky leg. [MACN]. 1 male: Argentina, Buenos Aires, Islas, Breyer leg. (dissected, prep. code: ARCMLP00019) [MLP]. 1 male: Argentina, Buenos Aires, Partido General Madariaga, Villa Gesell, 10–II–1964, Nina Petrowsky leg. (dissected, prep. code: ARCMLP00050) [MLP]. 1 female: Argentina, Buenos Aires, Partido General Madariaga, Villa Gesell, 22–XII–1963, Nina Petrowsky leg. (dissected, prep. code: ARCMLP00051) [MLP].

Biology. The immature stages are unknown. Caterpillar could be associated to dune vegetation of the Pampean coast (Orfila 1959).

Distribution and conservation status. *Leucanopsis ninae* comb. nov. is restricted to only one known locality: Villa Gesell, Buenos Aires, Argentina (Fig 4). There is another unknown locality labeled by Breyer only as “Islas.” The altitude is below 10 m. The geospatial analysis suggests that the species is critically endangered (CR) following the IUCN criteria (Tables 1 and 2).

Leucanopsis navarroi sp. nov.

Type material. Holotype male: Argentina, Córdoba, Quebrada del Condorito National Park, – 31.6334, – 64.7125, 1827 m, 5–I–2013, col. Beccacece, H.; Zapata, A. I.; Drewniak, M. E. and Villafañe, N. Paratypes: 1 male: Argentina, Córdoba, Quebrada del Condorito National Park, – 31.6334, – 64.7125, 1827 m, 15–I–2010, Beccacece, H.; Zapata, A. I.; Drewniak, M. E. and Villafañe, N. col. (dissected, prep. code: ARCO0440). 1 female: Argentina, Córdoba, Cerro Blanco Wildlife Nature Reserve, – 31.3499, – 64.6598,

1295 m, 5–I–2013, Beccacece, H. and Drewniak, M. E. col. (dissected, prep. code: ARCO0930). 2 females: Argentina, Córdoba, Quebrada del Condorito National Park, – 31.6334, – 64.7125, 1827 m, 5–I–2013, Beccacece, H.; Zapata, A. I. and Ludueña-Almeida, F. F. col. Holotype and paratypes deposited in MZUC.

Etymology. The species is named in honor to Fernando R. Navarro, an important Argentinian lepidopterologist whom we had the pleasure to meet. He formed and trained all the authors of this article.

Diagnosis (Figs 1c–i and 3b). Color pattern of the head, thorax, and wings darker than *L. pagana* and *L. ninae*. Uncus complex with well-differentiated base and apex. Apex of uncus with a rounded and small spine at the tip. Tegumen thin and straight. Processes of tegumen directed to the outer margin. Saccus area slightly rounded. Seventh sternite slightly divided mid-ventrally. Signum ovoid, with a greater density of spicules than *L. ninae*.

Description. Male (Fig 1c). Head: dark brown dorsally except the posterior margin of scape coppery brown. Antenna dark brown, bipectinate. Rami medium, same color as the head. Face dark brown ventrally, with a small spot yellowish brown at the base of the scape. Palpus, same color, third segment shorter than the others. Proboscis yellowish, longer than the thorax. Thorax: patagium and tegula dark brown except for the margins of tegula yellowish brown diffused. Meso and metathorax yellowish brown. Legs: dark brown except for the dorsum coxa yellowish brown. Forewing—length 21 mm: dark brown except for the base yellowish brown. Hindwing—length 14 mm: dark grayish dorsally except for the base and costal margin yellowish brown. Ventral

Table 1 Distribution of *Leucanopsis pagana* species-group, based on material deposited in museums and literature.

Species	Country	Province/state/ department	Locality	Latitude	Longitude	Altitude (m)	Ecoregion	Number of specimens	Collection/museum/references
<i>L. pagana</i>	Argentina	Corrientes	Ituzaingó, Establecimiento Santo Domingo	-27.6927	-56.1420	135	Southern Cone Mesopotamian savanna	1m	MZUC
<i>L. pagana</i>	Argentina	Misiones	Gobernador Roca, Elena Czajkowski PR	-27.4756	-55.4618	175	Southern Cone Mesopotamian savanna	1m	MZUC
<i>L. pagana</i>	Brazil	Distrito Federal	Brasília	-15.7700	-47.9200	1171	Cerrado	?	Ferro (2007)
<i>L. pagana</i>	Brazil	Distrito Federal	Brasília	-15.5956	-47.6057	1100	Cerrado	2m	VOB
<i>L. pagana</i>	Brazil	Goiás	Alto Paraíso de Goiás	-14.1300	-47.5100	1186	Cerrado	2m	VOB
<i>L. pagana</i>	Brazil	Goiás	Jataí	-17.8872	-51.7182	712	Cerrado	1m	MZUSP
<i>L. pagana</i>	Brazil	Goiás	Parque Estadual dos Pireneus	-15.8333	-48.7833	1300	Cerrado	?	de Oliveira (2014)
<i>L. pagana</i>	Brazil	Paraná	Castro	-24.7908	-50.0119	988	Araucaria moist forest	1m; 4f	Schaus (1894), Rothschild (1910)
<i>L. pagana</i>	Brazil	Paraná	Curitiba	-25.4228	-49.3077	920	Araucaria moist forest	2m; 1f	VOB
<i>L. pagana</i>	Brazil	Paraná	Mandirituba	-25.7742	-49.3310	850	Araucaria moist forest	1f	VOB
<i>L. pagana</i>	Brazil	Paraná	Ponta Grossa	-25.0833	-50.15	836	Araucaria moist forest	?	Ferro (pers. com.)
<i>L. pagana</i>	Brazil	Paraná	Quatro Barras	-25.3667	-49.0833	910	Atlantic forest	?	Ferro (pers. com.)
<i>L. pagana</i>	Brazil	Rio de Janeiro	Itatiaia	-22.4961	-44.5633	600	Atlantic Forest	?	Nascimento et al (2016)
<i>L. pagana</i>	Brazil	Rio Grande do Sul	São Francisco de Paula	-29.4481	-50.5836	920	Araucaria moist forest	?	MC; Ferro and Teston (2009)
<i>L. pagana</i>	Brazil	Rio Grande do Sul	São José dos Ausentes	-28.7483	-50.0658	1200	Atlantic forest	2	Ferro and Romanowski (2012)
<i>L. pagana</i>	Brazil	Rio Grande do Sul	Cambará do Sul	-29.2167	-50.1667	1000	Atlantic forest	1m	MC
<i>L. pagana</i>	Brazil	Santa Catarina	Florianópolis	-27.5961	-48.5489	3	Atlantic forest	?	Ferro et al (2012)
<i>L. pagana</i>	Brazil	São Paulo	Campos do Jordão	-22.7340	-45.5784	1700	Atlantic Forest	1m; 1f	VOB
<i>L. pagana</i>	Brazil	São Paulo	Campos do Jordão	-22.6944	-45.4913	1535	Atlantic Forest	1m	MZUSP
<i>L. pagana</i>	Brazil	São Paulo	Pico dos Marins, Serra da Mantiqueira	-22.5025	-45.1211	2420	High grassland - Atlantic Forest	2m; 1f	MZUSP
<i>L. pagana</i>	Paraguay	Alto Paraná	-	-25.5482	-55.2240	203	Alto Paraná Atlantic Forest	1m	Drechsel 2014
<i>L. pagana</i>	Paraguay	Caazapá	Colonia Neufeld	-26.2107	-55.6034	174	Alto Paraná Atlantic Forest	1m	Drechsel (2014)
<i>L. ninae</i>	Argentina	Buenos Aires	Villa Gesell	-37.2695	-56.9850	8	Pampas	3m; 1f	MLP; Orfila (1959)
<i>L. navarroi</i>	Argentina	Córdoba	Quebrada del Condorito NP	-31.6334	-64.7125	1827	High grassland - Chaco	2m; 2f	MZUC
<i>L. navarroi</i>	Argentina	Córdoba	Cerro Blanco WNR	-31.3499	-64.6598	1295	High grassland - Chaco	1f	MZUC

Latitude and longitude are shown in decimal degrees and altitude in meters above sea level.

WNR Wildlife Natural Reserve, NP National Park, PR Private Reserve, m male, f female, ? unknown sex.

Table 2 Conservation status of *Leucanopsis pagana* species-group based on extent of occurrence (EOO) and area of occupancy (AOO).

	EOO (km ²)	AOO (km ²)	Status
<i>L. pagana</i>	969,658.844	80,000	LC/EN
<i>L. ninae</i>	–	4000	CR
<i>L. navarroi</i>	–	8000	CR

AOO based on cell width of 2 km.

LC least concern, EN endangered, CR critically endangered.

area same as dorsal with yellowish brown faded. Abdomen: yellowish brown dorsally, with a longitudinal striated band dark brown; this band can be absent (Fig 1d). Dark brownish ventrally. Last abdominal segment with a tuft of hairs yellowish brown. **Male genitalia** (Fig 2g–h): uncus developed, with base and apex fully differentiated and joined by a pedicel. Apex of uncus completely setose, rounded, with a small apical spine. Base of uncus subtriangular, with two small and lobular processes surrounding the pedicel at each side. Tegumen thin and straight. Process of tegumen like a tube with a longitudinal depression in the ventral zone, longer than the valva, almost reaching the apex of the uncus, curved and directed to the outer margin, apex with patches of spicules in ventral area. Vinculum rounded and ribbon-shaped. Saccus area slightly rounded. Juxta sclerotized, thin and straight, fused with anellus. Manica membranous. Symmetrically sclerotized valves, with inner margin setose, wide at the base and shorter than the uncus. Sacculus and costa fused, with two apical processes like a claw-shaped crab. Anterior process short and lobular and posterior process curved like a hook. Aedeagus (Fig 2i) long and curved; caecum developed and rounded. Vesica completely membranous, with one bag-shaped projection directed to the dorsal anterior area, thinner, finger-shaped apex and with three rounded diverticula; another bag-shaped part directed to the dorsal lateral area, bigger and slightly curved with rounded diverticula at the apex. **Female** (Fig 1e–f). Equal size and similar as male except for the following features: antenna has smaller rami, abdomen rounded, hair of tufts on the last abdominal segment absent. **Female genitalia** (Fig 3b): anal papillae trapezoid and setose. Anal pseudopapillae conspicuous. Anterior and posterior apophyses of the same length. Pheromone glands slightly visible like a membranous bag. Eighth sternite sclerotized and not divided. Seventh sternite slightly divided mid-ventrally. Ductus bursae sclerotized and longer than wide, creased at distal part. Corpus bursae oval, completely covered with little spicules. Signum ovoid, present on the middle-right surface, with a greater density of spicules. Bulla seminalis membranous, with a single chamber, oval, smaller than corpus bursae.

Biology. The immature stages are unknown.

Distribution and conservation status. *L. navarroi* sp. nov. is present in the high plateau of Pampa de Achala, Córdoba, Argentina at high altitude, between 1295 and 2790 m (Fig 4). The geospatial analysis suggests that this species is critically endangered (CR) following the IUCN criteria (Tables 1 and 2).

Discussion

The color pattern of the now called *Leucanopsis pagana* species-group is the darkest among the species of *Leucanopsis*. A full review of this genus has been hindered by its high specific diversity, currently including 125 valid species (Vincent & Laguerre 2014, Vincent 2016). In addition, the male genital of the type species of *Leucanopsis*: *L. leucanina* (Felder & Rogenhofer, 1874) is asymmetrical while most species with known genitalia included in this genus are not (do Rego Barros 1956a, Watson 1971, Vincent 2016). Nevertheless, the process of tegumen and its apex in the male genitalia would suggest the association with some species of *Leucanopsis* such as *L. falacra* (Dognin, 1891), *L. pulvereae* (Schaus, 1896), *L. acuta* (Hampson, 1901), *L. dinellii* (Rothschild, 1909), *L. mancina* (Schaus, 1920), *L. orooca* (Schaus, 1924), *L. huacina* (Schaus, 1933), *L. marimba* (Schaus, 1933), *L. lomara* (Schaus, 1941), *L. terola* (Schaus, 1941) (see do Rego Barros 1956a, b, Watson 1971) rather than *A. rubriplaga* and the species of *Aemilia* “sensu stricto” (Watson & Goodger 1986, Vincent & Laguerre 2014). Further studies should focus on the review of *Leucanopsis* to confirm its monophyly. On the other hand, it is necessary to review the other species included in *Aemilia* “sensu lato” to confirm if it belongs to this genus or not: *Aemilia asignata* Hampson, 1901, *Aemilia crassa* (Walker, [1865]), *Aemilia testudo* Hampson, 1901, *Aemilia melanchnra* Schaus, 1905, and *Aemilia mincosa* (Druce, 1906).

Leucanopsis navarroi sp. nov. is almost externally identical to *L. pagana* comb. nov. and *L. ninae* comb. nov., but can be recognized because its darkest color pattern. Tegula dark brown with margins diffuse, thinner apex of the uncus and valva, thinner and straight tegumen, and smaller lobular process of the tegumen than in *L. ninae*, tegumen processes directed to the outer margin while these are directed to the inner margin in *L. pagana* and to the left margin in *L. ninae*, the area of saccus slightly rounded while this is concave in *L. ninae* and rounded in *L. pagana*. The female genitalia are practically identical to *L. ninae* comb. nov., except for the higher density of spicules of the corpus bursae and the slightly mid-ventral division of the seventh sternite.

Leucanopsis pagana comb. nov. has the widest known distribution, from center of Brazil (Santa Catarina) to Northeast of Argentina, including South of Paraguay. It is frequently associated with grassland areas (Ferro & Romanowski 2012). On the other hand, this species can be

found in a wide altitude range and different ecoregions. This, together with the spatial analysis, suggests that this species is not in danger. It is necessary to review those specimens present in higher altitudes (upper 1000 m above sea level) to confirm if they are effectively *L. pagana* comb. nov. or a new species.

The known distribution of *L. ninae* comb. nov. is restricted to one locality: Villa Gesell, Buenos Aires. This species could be associated with dune vegetation (Orfila 1959). To our knowledge, there are only six specimens, counting the specimen types, of *L. ninae* comb. nov. deposited in the MLP and MACN, in the same locations but collected in different years. This species was not reported or collected by anyone else since 1963 (information of the label of one specimen). The modification of the natural area in the Pampean coast zone due to different land use practices such as urbanization, tourism and routes could affect many species (Montserrat 2010, Celsi 2016). *Leucanopsis ninae* comb. nov. could be in danger because Villa Gesell and its surroundings are completely modified by urbanization and tourism (Benseny 2007). However, the scarce information of distribution of *L. ninae* com. Nov. could be attributed to the fewer sampling and studies of moths done in the area. It is necessary to collect further samples in the pampean coast zone to analyze the real conservation status and confirm the result of GeoCat. Furthermore, it is necessary to identify the life-cycle to know how this species could be affected by land use practices.

Leucanopsis navarroi sp. nov. has a restricted geographical distribution in Pampa de Achala associated with high grassland vegetation. Specimens of this new species were not found in a previous sample study in the ecoregion of Chaco Serrano, which is below the altitudinal range of the distribution of Pampa de Achala (Beccacece *et al* 2012). The authors collected 20 samples in Pampa de Achala including sites at different altitudes in 2010, 2013, and 2016. However, specimens were found in only two of them. These samples were restricted to the summer due to weather conditions, because average temperatures range from 5°C in winter and 11.4°C in summer, with frequent frosts, and snowfalls in winter and occasionally in spring (Capitanelli 1979). One of the two areas where specimens were collected is a protected area (Quebrada del Condorito National Park). Therefore, this endemic species would be temporally protected. Nevertheless, it is necessary to highlight that Pampa de Achala is damaged due to land degradation caused by high grazing pressure, exotic species and occasional fires (Renison *et al* 2002). For this reason, it is necessary to carry out more studies, such as the life-cycle, to determine the real conservation status of this species.

Taxonomic work on species description is far from complete (Ferro & Diniz 2008). New species of tiger moths are being described in neotropical ecoregions where the

Lepidoptera fauna has not been studied before, such as Pampa de Achala, an isolated high plateau with a particular vegetation. This place has a conservation importance due to several endemic species and subspecies of plants, mushrooms, vertebrates and invertebrates (Nores & Yzurieta 1983, Polop 1989, Nores 1995, Acosta & Rosso de Ferradás 1996, Cabrera 1996, Robledo *et al* 2006, Lescano *et al* 2015). Notwithstanding, studies of endemic moths and butterflies in Pampa de Achala are scarce and further studies are needed to learn more about Lepidoptera species present in this fragile environment.

Acknowledgments We are grateful to APN (Administración de Parques Nacionales) and forest rangers of Quebrada del Condorito National Park who allowed us to collect, to Raúl Müller and Francisco Ludueña-Almeida for helping us in managing field samples, to Arturo Roig Alsina for authorizing access to the holotype of *L. ninae* deposited in MACN, and to Analía Lanteri for giving permission to access the specimens of *L. ninae* deposited in MLP. The authors are grateful to Benoit Vincent, who kindly sent us photos of adult and male genitalia of *A. rubriplaga* to compare with these specimens; to Marcelo Duarte da Silva and Alfred Moser who kindly sent us photos of the specimens of *L. pagana* deposited in the MZUSP and MC; to Vitor Becker who kindly sent us information about specimens of *L. pagana* deposited in his collection; and to Viviane Ferro and José Teston for the information *L. pagana*. Dra. Cecilia Saleme (Fac. Filosofía y Letras, UNT) for reading and correcting the manuscript. We also thank to two anonymous reviewers for their helpful comments on the manuscript. Neotropical Grassland Conservancy (NGC) provided a grant for field equipment.

Nomenclature ZooBank registration can be found at: <http://zoobank.org/urn:lsid:zoobank.org:pub:FDB282E1-1EFA-4869-814B-E9521F9BF24E>

References

- Acosta LE, Rosso de Ferradás B (1996) Arácnidos de la provincia de Córdoba. In: Di Tada IE, Bucher EH (eds) Biodiversidad de la Provincia de Córdoba, Fauna. Universidad Nacional de Río Cuarto, Córdoba, pp 71–99
- Bachman S, Moat J, Hill AW, de la Torre J, Scott B (2011) Supporting red list threat assessments with GeoCAT: geospatial conservation assessment tool. *ZooKeys* 150:117–126
- Beccacece HM (2017) A new species of the genus *Bertholdia* Schaus, 1896 (Lepidoptera: Erebiidae: Arctiinae) from the Neotropical region: *Bertholdia zoenia* sp. n. *Zootaxa* 4238(1):88–96. <https://doi.org/10.11646/zootaxa.4238.1.6>
- Beccacece HM, Vincent B (2014) A new species of the genus *Mazaeras* Walker, 1855 (Lepidoptera: Erebiidae: Arctiinae). *Zootaxa* 3847(4): 595–600. <https://doi.org/10.11646/zootaxa.3847.4.10>
- Beccacece HM, Zapata AI, Villafañe NA, Drewniak ME (2012) Ártidos nocturnos (Lepidoptera: Erebiidae: Arctiinae) del Bosque Serrano de Córdoba, Argentina. *Rev Soc Entomol Argent* 71(1–2):99–103
- Beccacece HM, Zeballos SR, Zapata AI (2016) Changes in species richness and composition of tiger moths (Lepidoptera: Erebiidae: Arctiinae) among three neotropical ecoregions. *PLoS One* 11(9):e0162661. <https://doi.org/10.1371/journal.pone.0162661>
- Benseny G (2007) Turismo y territorio litoral. Realidad y perspectivas de la política turística en Villa Gesell (Argentina). VIII Jornadas Nacionales

- y II Simposio Internacional de Investigación-Acción en Turismo, Posadas, Argentina
- Cabido M, Funes G, Pucheta E, Vendramini F, Díaz S (1998) A chorological analysis of the mountains from central Argentina. Is all what we call Sierra Chaco really Chaco? *Candollea* 53:321–331
- Cabido M, Molina S, Perez-Harguindeguy N, Valladares G, Pucheta E, Gardner S (1999) Uso de la tierra, estructura del hábitat y biodiversidad en ecosistemas del centro de Argentina. In: Matteucci SD, Solbrig OT, Morello J, Halffter G (eds) Biodiversidad y uso de la tierra. Conceptos y ejemplos de Latinoamérica. Editorial Universitaria de Buenos Aires, Buenos Aires, pp 421–442
- Cabrera MR (1996) Lista y distribución geográfica de saurios, anfisbenas y tortugas (Amniota, Reptilia) de la provincia de Córdoba. In: Di Tada IE, Bucher EH (eds) Biodiversidad de la Provincia de Córdoba, Fauna. Universidad Nacional de Río Cuarto, Córdoba, pp 215–238
- Capitanelli R (1979) Clima. In: Vázquez J, Miatello R, Roqué M (eds) Geografía física de la provincia de Córdoba. Editorial Boldt, Buenos Aires, pp 45–138
- Celsi C (2016) La vegetación de las dunas costeras pampeanas. In: Athor J, Celsi C (eds) La Costa Atlántica de Buenos Aires. Naturaleza y Patrimonio Cultural. Fundación de Historia Natural Félix de Azara pp 116–138
- Cerda JA (2016) Addenda et corrigenda à la monographie << Euchromiini de Guyane française >>, Cerda, 2008 (1ère partie) (Lepidoptera Erebidae Arctiinae Arctiini Euchromiina). *Antenor* 3(1):65–77
- de Oliveira LB (2014) Importância das fitofisionomias e estações climáticas na distribuição espacial e temporal de mariposas noturnas (Lepidoptera: Arctiinae, Saturniidae e Sphingidae) no Parque Estadual dos Pirineus, GO. Tese (Doutorado em Ecologia). Universidade de Brasília, Brasil, p 166
- do Rego Barros AR (1956a) Fauna do Distrito Federal. 34: Novo gênero para *Halisidota leucanina* Feld., 1874 (Lepidoptera-Heterocera). *Bol Mus Nac RJ (N.S.) (Zool.)* 132:1–19
- do Rego Barros AR (1956b) *Lepidonetonia* novo genero para *Halisidota acuta* Hampson, 1901. (Lepidoptera Heterocera). *Bol Mus Nac NS Zool* 140:1–11
- Drechsel U (2014) Paraguay Biodiversidad (PyBio). <http://www.pybio.org/en/5890/galeria-de-especies-arctiinae/>. Accessed 23 Aug 2017
- Ferro VG (2007) Diversidade de mariposas Arctiidae (Lepidoptera) do Cerrado. Tese (Doutorado em Ecologia), Universidade de Brasília, Brasil, p 130
- Ferro VG, Diniz IR (2008) Biological attributes affect the data of description of tiger moths (Arctiidae) in the Brazilian Cerrado. *Divers Distrib* 14(3):472–482. <https://doi.org/10.1111/j.1472-4642.2007.00450.x>
- Ferro VG, Romanowski HP (2012) Diversity and composition of tiger moths (Lepidoptera: Arctiidae) in an area of Atlantic Forest in southern Brazil: is the fauna more diverse in the grassland or in the forest? *Zoologia (Curitiba)* 29(1):7–18. <https://doi.org/10.1590/S1984-46702012000100002>
- Ferro VG, Teston JA (2009) Composição de espécies de Arctiidae (Lepidoptera) no sul do Brasil: relação entre tipos de vegetação e entre a configuração espacial do habitat. *Rev Bras Entomol* 53(2): 278–286. <https://doi.org/10.1590/S0085-56262009000200010>
- Ferro VG, Resende IMH, Duarte M (2012) The Arctiinae moths (Lepidoptera: Erebidae) of Santa Catarina state, Brazil. *Biota Neotrop* 12(4):166–180. <https://doi.org/10.1590/S1676-06032012000400018>
- Gibeaux C (2015) *Zatrephes laguerrei* n. sp., espèce distincte de *Z. trailii* Butler, 1877 (Lepidoptera Erebidae Arctiinae Phaegopterini). *Entomologiste (Paris)* 71(6):377–383
- Gibeaux C (2016a) Deux *Bertholdia* nouveaux du Venezuela (Lepidoptera Erebidae Arctiinae Phaegopterini). *Entomologiste (Paris)* 72(5):307–313
- Gibeaux C (2016b) Les *Bertholdia* Schaus, 1896, de Guyane française, avec la description d'espèces inédites (10e note) (Lepidoptera Erebidae Arctiinae Phaegopterina). *Antenor* 3(2):114–132
- Gibeaux C (2016c) *Ruforbifer*, nouveau genre néotropical (Lepidoptera Erebidae Arctiinae Phaegopterini). *Entomologiste (Paris)* 72(2):71–81
- Grados J, Ramírez JJ (2016) *Rhipha ignea* sp. nov. (Lepidoptera: Erebidae: Arctiini), nueva especie del grupo flammans de la Amazonía de Perú. *Rev Peru Biol* 23(2):83–87. <https://doi.org/10.15381/rpb.v23i2.12369>
- Hernández-Baz F, Coates R, Teston JA, González JM (2013) *Scena propylea* (Druce, 1894) (Lepidoptera: Erebidae: Arctiinae: Euchromiina) an endemic species of Mexico. *Neotrop Entomol* 42(3):246–251. <https://doi.org/10.1007/s13744-013-0119-3>
- IUCN Red List Categories and Criteria, Version 3.1 (2001) IUCN species survival commission. IUCN, Gland and Cambridge, p 30
- Jacobson NL, Weller SJ (2002) A cladistic study of the Arctiidae (Lepidoptera) by using characters of immatures and adults. *Entomol Soc America, Thomas Say Monographs*, Lanham, Maryland, p 98
- Lafontaine JD, Schmidt BC (2010) Annotated check list of the Noctuoidea (Insecta, Lepidoptera) of North America north of Mexico. *Zookeys* 40: 1–239. <https://doi.org/10.3897/zookeys.40.414>
- Laguerre M (2014a) Description of a new species of Euchromiina from Dominican Republic (Lepidoptera Erebidae Arctiinae Ctenuchini). *Antenor* 1(1):3–10
- Laguerre M (2014b) Partial revision of the genus *Homoecocera* Felder, 1874, and description of three new species. *Antenor* 1(2):153–172
- Laguerre M (2015) Revision of the genus *Glaucostola* Hampson, 1901, description of two new genera and of two new species from Brazil and recombination of several species. *Antenor* 2(2):154–175
- Laguerre M (2016) Revision of the complex of *Idalus vitrea* (Cramer, [1780]) and description of three new species (Lepidoptera Erebidae Arctiinae Arctiini). *Antenor* 3(1):86–112
- Laguerre M (2017) Revision of the complex of *Echeta trinotata* Reich, 1933: description of two new species (Lepidoptera: Erebidae: Arctiinae). *Zootaxa* 4276(4):591–599. <https://doi.org/10.11646/zootaxa.4276.4.10>
- Laguerre M, Vincent B (2016) Two new *Neonerita* Hampson species with redescription of *Neonerita dorsipuncta* Hampson, 1901 (Lepidoptera: Erebidae: Arctiinae: Phaegopterina). *JIB* 4(11):1–18
- Lescano JN, Nori J, Verga E, Robino F, Bonino A, Miloch D, Ríos N, Leynaud GC (2015) Anfibios de las Sierras Pampeanas Centrales de Argentina: diversidad y distribución altitudinal. *Cuad Herpetol* 29(2): 103–115
- Luti R, Bertrán de Solís MA, Galera MF, Muller de Ferreira M, Bersal M, Nores M, Herrera MA, Barrera JC (1979) Vegetación. In: Vázquez J, Miatello R, Roque M (eds) Geografía Física de la provincia de Córdoba. Boldt, Buenos Aires, pp 297–368
- Monserrat AL (2010) Evaluación del estado de conservación de dunas costeras: dos escalas de análisis de la costa pampeana. PhD. Thesis, Universidad de Buenos Aires, Buenos Aires, Argentina, p 235
- Moraes SS, Duarte M (2015) Description of four new species of tiger moth genus *Dysschema* Hübner (Lepidoptera: Erebidae, Arctiinae, Arctiini, Pericopina). *Zootaxa* 4006(3):540–550. <https://doi.org/10.11646/zootaxa.4006.3.7>
- Nascimento MS, Ferro VG, Monteiro RF (2016) Arctiinae (Lepidoptera: Erebidae) in the state of Rio de Janeiro, Brazil. *Biota Neotrop* 16(2): e20150112
- Nores M (1995) Insular biogeography of birds on mountaintops in north western Argentina. *J Biogeogr* 22(1):61–70. <https://doi.org/10.2307/2846073>
- Nores M, Yzurieta D (1983) Especiación en las Sierras Pampeanas de Córdoba y San Luis (Argentina), con descripción de siete nuevas subespecies de aves. *Hornero (B. Aires)* 12(1 extra):88–102
- Orfila RN (1959) Una especie nueva de Arctiidae (Lep.) argentina. *Rev Soc Entomol Argent* 21:67–70
- Pinheiro LR (2016a) Description of three new species of *Galethalea* Butler, 1876 (Lepidoptera: Erebidae), with comments on the genus. *Zootaxa* 4078(1):354–365. <https://doi.org/10.11646/zootaxa.4078.1.30>

- Pinheiro LR (2016b) Description of two new species of *Nelphe* Herrich-Schäffer, with comments on the genus (Lepidoptera, Erebidae, Arctiinae, Arctiini, Ctenuchina). *Zootaxa* 4079(4):487–494. <https://doi.org/10.11646/zootaxa.4079.4.8>
- Pinheiro LR, Duarte M (2016) Description of nine new species of *Heliura* Butler from South America (Lepidoptera, Erebidae, Arctiinae, Arctiini, Ctenuchina). *Ann Soc Entomol Fr* 51(4):310–330
- Pinheiro LR, Cerda JA, Duarte M (2016) Description of five new species of *Heliura* Butler (Lepidoptera: Erebidae: Arctiinae: Arctiini: Ctenuchina), with discussion on *H. Pierus* (Cramer) and the *H. stollii* (Rothschild) species group. *Can Entomol* 148(4):396–415. <https://doi.org/10.4039/tce.2015.79>
- Polop JJ (1989) Distribution and ecological observations of wild rodents in Pampa de Achala, Córdoba, Argentina. *Stud Neotrop Fauna Environ* 24(2):53–59. <https://doi.org/10.1080/01650528909360776>
- Renison D, Cingolani AM, Suárez R (2002) Efectos del fuego sobre un bosquecillo de *Polylepis australis* (Rosaceae) en las montañas de Córdoba, Argentina. *Rev Chil Hist Nat* 75:719–727
- Ríos N, Bart H (2014) GEOLocate. Web Standard Client. Tulane University Museum of Natural History, Belle Chasse, LA. <http://www.museum.tulane.edu/geolocate/web/WebGeoref.aspx>. Accessed 23 Aug 2017
- Robledo G, Urcelay C, Domínguez L, Rajchenberg M (2006) Taxonomy, ecology and biogeography of Polypores (Basidiomycetes) from Argentinian *Polylepis* woodlands. *Can J Bot* 84(10):1561–1572. <https://doi.org/10.1139/b06-109>
- Rönkä K, Mappes J, Kaila L, Wahlberg N (2016) Putting *Parasemia* in its phylogenetic place: a molecular analysis of the subtribe Arctiina (Lepidoptera). *Syst Entomol* 41(4):844–853. <https://doi.org/10.1111/syen.12194>
- Rothschild W (1910) Catalogue of the Arctiinae in the Tring museum, with notes and descriptions of new species. *Novit Zool* 17(1):1–85. <https://doi.org/10.5962/bhl.part.13688>
- Schaus W (1894) On new species of Heterocera from Tropical America. *Proc Zool Soc London* 1894:225–243
- Schmidt C (2009) Revision of the “*Aemilia*” *ambigua* (Strecker) species-group (Noctuidae, Arctiinae). *ZooKeys* 9:63–78. <https://doi.org/10.3897/zookeys.9.149>
- Schmidt BC, De Freina JJ (2011) Generic placement of the Neotropical species of “*Phragmatobia*” (Erebidae, Arctiinae), with a remarkable
- matrivororous species from the Peruvian Andes. *Zookeys* 149(149):69–88. <https://doi.org/10.3897/zookeys.149.2382>
- Shorthouse DP (2010) SimpleMapp, an online tool to produce publication-quality point maps <http://www.simplemapp.net>. Accessed 23 Aug 2017
- Vincent B (2014) Description of two new species of Phaegopterina from Brazil (Lepidoptera: Erebidae, Arctiinae, Arctiini). *Antenor* 1(1):11–21
- Vincent B (2016) Description of two new species of Arctiini from Peru (Lepidoptera: Erebidae, Arctiinae, Arctiini). *Antenor* 3(1):78–85
- Vincent B, Laguerre M (2010) Changements nomenclaturaux en vue de l’actualisation du catalogue des Arctiinae néotropicales (Lepidoptera, Arctiidae). *Bull Soc Entomol France* 115(2):175–184
- Vincent B, Laguerre M (2014) Catalogue of the Neotropical Arctiini Leach, [1815] (except Ctenuchina Kirby, 1837 and Euchromiini Butler, 1876). *Zoosystema* 36(2):137–533. <https://doi.org/10.5252/z2014n2a1>
- Walker F (1855) List of the specimens of Lepidopterous insects in the collection of the British Museum 3, London, pp 582–775
- Watson A (1971) An illustrated catalogue of the Neotropical Arctiinae types in the United States National Museum (Lepidoptera: Arctiidae) part I. *Smith Contrib Zool* (50):1–361
- Watson A, Goodger DT (1986) Catalogue of the Neotropical Tiger-moths. Department of Entomology, British museum (natural history). *Occas Pap Syst Entomol* 1:1–71
- Zahiri R, Holloway JD, Kitching IJ, Lafontaine JD, Mutanen M, Wahlberg N (2012) Molecular phylogenetics of Erebidae (Lepidoptera, Noctuoidea). *Syst Entomol* 37(1):102–124. <https://doi.org/10.1111/j.1365-3113.2011.00607.x>
- Zaspel JM, Weller SJ, Wardwell CT, Zahiri R, Wahlberg N (2014) Phylogeny and evolution of pharmacophagy in tiger moths (Lepidoptera: Erebidae: Arctiinae). *PLoS One* 9(7):e101975. <https://doi.org/10.1371/journal.pone.0101975>
- Zenker MM, DeVries PJ, Penz CM, Teston JA, Freitas AVL, Pie MR (2015) Diversity and composition of Arctiinae moth assemblages along elevational and spatial dimensions in Brazilian Atlantic Forest. *J Insect Conserv* 19(1):129–140. <https://doi.org/10.1007/s10841-015-9753-x>
- Zenker MM, Wahlberg N, Brehm G, Teston JA, Przybylowicz L, Pie MR, Freitas AVL (2016) Systematics and origin of moths in the subfamily Arctiinae (Lepidoptera, Erebidae) in the Neotropical region. *Zool Scr* 46(3):348–362