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A segmented and clawed male foreleg in a newly described genus and species of eumaeine butterfly (Lepidoptera: Lycaenidae)

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Abstract. *Grishinata* Robbins and Busby, **new genus** (Lepidoptera: Lycaenidae: Eumaeini), possesses a five-segmented foretarsus with a clawed pretarsus, a trait that differentiates it from all eumaeine genera except *Theclopsis* Godman and Salvin. *Grishinata penny* Busby, Hall, and Robbins, **new species**, differs from all species of *Theclopsis* (and most Eumaeini) in lacking male secondary sexual organs on the wings or in the abdomen. It is recorded from the eastern slope of the Andes in Ecuador and Peru. We cannot place *Grishinata penny* in an existing Eumaeini genus based upon its wing pattern, male foreleg structure, lack of male secondary sexual organs, and male genitalic morphology. We propose names for the genus and species to document its leg morphology and to provide a name for a genome sequencing project, which will allow us to place the genus in the eumaeine Linnaean hierarchy.

Key words. Male genitalia, male secondary sexual organs, Theclinae, wing pattern.

ZooBank registration. urn:lsid:zoobank.org:pub:C22DE02B-0894-4406-AFC4-A0F85BAAA57B

Introduction

There are two morphological types of male forelegs in the lepidopteran butterfly family Lycaenidae, each of which is functionally and structurally different from male forelegs in other diurnal butterfly families.

The first male foreleg type is superficially similar to that of Nymphalidae and Riodinidae in that the tarsus is unsegmented, lacks a pretarsus, and is not used to groom the antennae (Robbins 1988, 1990). It differs functionally from these families in that it is used for walking. It differs morphologically in that it possesses tarsal alpha and beta trichoid sensilla (terminology from Chun and Schoonhoven 1973), which are lacking in Nymphalidae and Riodinidae with few exceptions (Robbins 1988). This male foreleg type occurs in more than 98% of lycaenid species (Mattoni and Fiedler 1991).

The second lycaenid male foreleg type is superficially similar to that of Hesperidae, Papilionidae, and Pieridae in that the foretarsus is segmented with a clawed pretarsus. It differs functionally from these families in that it is not used to groom the antennae (Jander 1966; Robbins 1990). It differs morphologically in that it lacks the tibial epiphysis of Hesperidae and Papilionidae or the vestigial remnant of an epiphysis that occurs in some Pieridae (Robbins 1990). Within Eumaeini, this male foreleg type is restricted to some species of *Theclopsis* Godman and Salvin, 1887 (Godman and Salvin 1887; Robbins 2004).

We discovered a species (Fig. 1) belonging to the Eumaeini with a male foreleg that has a clawed pretarsus and a five-segmented tarsus (Fig. 2), but the male genitalia, secondary sexual characters, and wing pattern (Fig. 1, 3) are dissimilar from those of *Theclopsis*. The males lack secondary sexual organs on the wings or in the abdomen (Fig. 1, 3), which is highly unusual in Eumaeini (Valencia-Montoya et al. 2021). The male genitalia (Fig. 3) lack structures that would be useful in determining its closest phylogenetic relatives. More generally, we find no clear-cut morphological evidence to place this species in an available eumaeine genus.

The purpose of this paper is to propose new generic and specific names for this newly discovered taxon. One reason is that we need a name to document its unusual leg morphology. Another is that we are currently sequencing its genome for a phylogenetic project. Phylogenetic analysis of the sequence data will allow us to place the genus in the eumaeine Linnaean hierarchy. We predict that it will show, in accord with the findings of Mattoni and Fiedler (1991), that its male foreleg with a clawed pretarsus and five-segmented tarsus evolved from a tarsus that was fused without a pretarsus.

Materials and Methods

Labels on the holotype are recorded verbatim with brackets used for information not explicitly noted on the labels and for descriptions of the labels. Otherwise, months are abbreviated by their first three letters in English. A unique combination of morphological characters is the basis for proposing the new taxonomic names. Standard



Figure 1. Adult *Grishinata penny*. Male holotype dorsal and ventral wings (top). Female dorsal and ventral wings (bottom). Scale 1 cm.



Figure 2. Male foretarsus of *Grishinata penny* showing five tarsal segments and pretarsal claws (yellow arrows). Dorsal (top) and lateral aspects.

references are Borror et al. (1981) for wing veins and Klots (1970), as modified by Robbins (1991), for genitalia. Specimens cited in this study are deposited in the following collections.

CF Private Collection of Christophe Faynel, Montpellier, France.

CFC Center for Collection-Based Research, Lund, Sweden.

JHKW Private Collection of Jason Hall and Keith Willmott, Silver Spring, Maryland, USA.

MUSM Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru.

RCB Private Collection of Robert C. Busby, Estero, Florida, USA.

USNM National Museum of Natural History [formerly United States National Museum], Smithsonian Institution, Washington DC, USA.

Taxonomy

The same characters distinguish *Grishinata* and *G. penny* from other members of the Eumaeini. To avoid redundancy, we note distinguishing traits once.

Grishinata Robbins and Busby, new genus

Type species. *Grishinata penny* Busby, Hall, and Robbins, **new species**, by present designation.

Diagnosis and description. *Grishinata penny* belongs to the tribe Eumaeini Doubleday, 1847. It has ten forewing veins in both sexes, hairy eyes, and “greyhound” shaped male genitalia (sensu Eliot 1973, Fig. 3). It differs from all other eumaeines (except for some species of *Theclopsis*) by possessing a male foreleg with a clawed pretarsus and a five-segmented tarsus (Fig. 2). This trait occurs in the six known males (a seventh male lacks forelegs). It differs from species in *Theclopsis* by lacking male secondary sexual organs on the wings (Fig. 1) and by its stouter male genitalia in lateral aspect (Fig. 3).

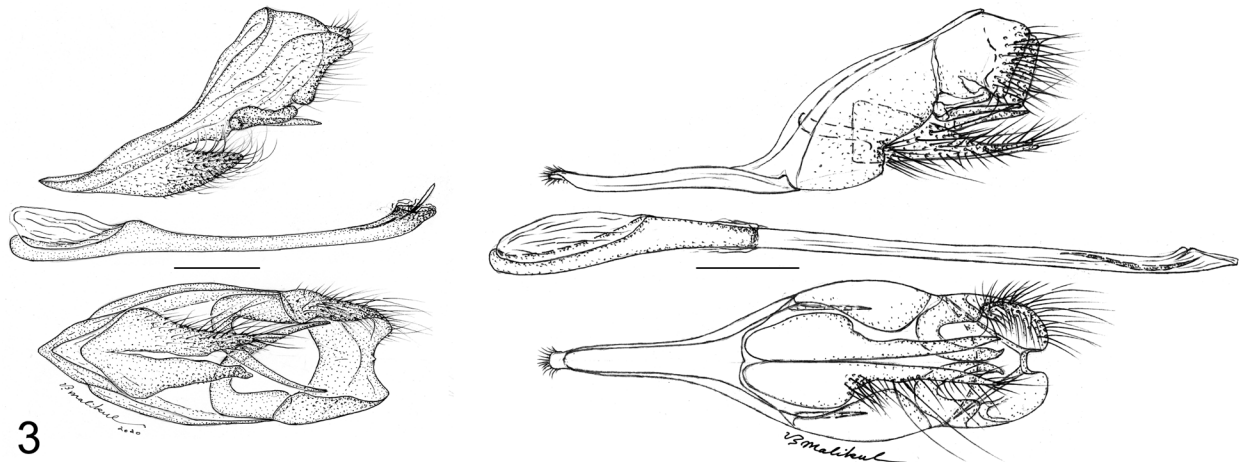


Figure 3. Male genitalia of *Grishinata penny* (left) and *Theclopsis gargara* (Hewitson, 1868) (right). Lateral view of genital capsule (top). Lateral view of penis (middle). Ventral view (bottom). Posterior of butterfly to the right. Scale 0.5 mm.

Adults of *G. penny* possess wing characters (Fig. 1) that are unusual, but not unique, in the Eumaeini. There are no secondary sexual organs on the wings, a trait shared with a variety of other taxa such as subtribe Calycopidina Duarte and Robbins, 2010 and *Symbiopsis* Nicolay, 1971. The ventral forewing of *G. penny* lacks a postmedian line, a trait shared with *Kolana* Robbins, 2004, *Exorbaetta* K. Johnson, Austin, Le Crom and Salazar, 1997, and some species of *Siderus* Kaye, 1904. The hindwing lacks a tail in both sexes, and the hindwing anal lobe is vestigial to absent, but these traits occur sporadically in many genera of Eumaeini. Wing venation is typical of Eumaeini, with forewing vein R_3 arising from the discal cell, and forewing vein M_2 arising about halfway between the origin of veins M_1 and M_3 (Fig. 1).

Forewing length (base to apex) for males is mean = 1.3 cm, sd = 0.06, N = 4. The only known female has a forewing length of 1.3 cm.

There are no abdominal brush organs associated with the male genitalia (sensu Robbins 1991; Martins et al. 2019). Most Eumaeini that lack wing secondary sexual traits, such as Calycopidina and *Symbiopsis*, have abdominal brush organs (Robbins 2004; Duarte and Robbins 2010).

The male genitalia of *G. penny* are more compact than those of *Theclopsis* (Fig. 3) and lack distinctive traits that might suggest phylogenetic relatedness.

The male and female of *G. penny* are associated based on their size, shape, and wing pattern. Both lack a postmedian line on the ventral surface of the forewing. The postmedian line on the ventral surface of the hindwing is almost indistinguishable. Both lack a hindwing tail. We are unable to associate this unique female with males of other species.

Type material. Holotype male (Fig. 2). [white printed label] ECUADOR: Napo/Rio Pimpilala (SW of Talag)/1° 04.6S. 77° 56.2W./July 2007 (600-900m)/E. Aldas, R. C. Busby, leg. [white printed label] R. C. Busby/No. 3286. [white printed label] DNA sample ID:/NVG-17075H12/c/o Nick V. Grishin. [white printed label] USNM-MENT/01102312. [red printed label] Holotype/*Grishinata penny* Busby, Hall, and Robbins. Deposited USNM.

Paratypes (8♂, 1♀). **Ecuador.** 1♂, same locality as holotype, June 2007 (RCB). 1♂, same locality as holotype, but the label has an additional Rio Jatunyacu and is restricted to 600m, 17 Apr 1995 (JHKW). 2♂, same locality as holotype, but the label has an additional Rio Jatunyacu and is restricted to 600m, 24 Sep 1996 (JHKW). 1♀, Morona Santiago, 1.8 km Santiago-Puerto Morona Rd., 3°0.24'S. 77°59.7'W., 300 m, 18 Sep 2005 (RCB). **Peru.** 1♂, Cusco, Carretera Manu, Km 89 Chontachaca, 772 m, Tierra Linda Reserve, 13°00.172'S, 71°27.849'W, 4 Aug 2021 (CF). 3♂, same locality, 22 Sep 2021 (MUSM, CFC, CF).

Etymology. The non-latinized masculine generic name *Grishinata* recognizes Nick Grishin for his contributions to eumaeine systematics using genomic sequences. The addition of 'ata' is intended to make the name euphonious.

The species *G. penny* is named for Penelope Marie Hughes, the granddaughter of author Robert Busby. It is a feminine noun in apposition.

Distribution, habitat, and behavior. *Grishinata penny* is known from three localities on the eastern slope of the Andes in Ecuador and Peru from 300–900 m elevation (Fig. 4). The Peruvian records are from the Cosñipata Valley, where this species was previously unknown (Lamas et al. 2021).

At the type locality, solitary males were observed setting up mating territories at the top of a tree (5 m above the ground) in a streamside clearing from 13:20 to 14:00 hours. In Peru, three males set up a mating territory and were flying about each other from 12:30 to 13:00 hours at the top of trees, 5 m above the ground.

Remarks. We discovered the unusual male foreleg structure of *G. penny* more than two decades ago. We subsequently tried to find other specimens in the field and looked for related species in museum collections. Despite these attempts, *Grishinata penny* is a rare species with no evident close relatives. We see no alternative to describing it as a monotypic genus. A by-product of the project in which we are sequencing the genome of *G. penny* is that we will be able to determine the genera to which *Grishinata* is most closely related. As noted, we expect that this will represent another case in which a five-segmented male foretarsus with a clawed pretarsus evolved from a fused male foretarsus lacking a pretarsus (Mattoni and Fiedler 1991).

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Figure 4. Distribution of *Grishinata penny* in Ecuador and Peru.

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