Artículo Original

Apu, a new genus of Euchromiina (Lepidoptera: Erebidae: Arctiinae: Arctiini), and a new species from the montane forests of southeastern Peru

Apu, un nuevo género de Euchromiina (Lepidoptera: Erebidae: Arctiinae: Arctiini), y una nueva especie de los bosques montanos del sureste de Perú

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Abstract. Based on external morphological characters and the structure of the male genitalia, a new genus of Euchromiina from the Neotropical region, *Apu* **gen. nov.** is described. A new species is described, *Apu mooreorum* **sp. nov.** and the species *Apu flavicornis* (Druce) **comb. nov.** is redescribed. The genus occurs in the montane forests of the Andes. Diagnostic characters are provided for the genus and the two species which comprise it. Photographs of the adults of both species are provided, as well as the morphological characters of the male genitalia.

Key words: Andes; *Cosmosoma*; Euchromiina; Neotropic; Puno; taxonomy.

Resumen. Basado en caracteres morfológicos externos y la estructura de los genitales masculinos, se describe un nuevo género de Euchromiina de la región Neotropical, *Apu* **gen. nov.** Una nueva especie es descrita, *Apu mooreorum* **sp. nov.** y la especie *Apu flavicornis* (Druce) **comb. nov.** es redescrita. El género se encuentra en los bosques montanos de los Andes. Se proporcionan caracteres de diagnóstico para el género y las dos especies que lo componen. Se proporcionan fotografías de los adultos de ambas especies, así como los caracteres morfológicos de los genitales masculinos.

Palabras clave: Andes; *Cosmosoma*; Euchromiina; neotrópico; Puno; taxonomía.

Introduction

The genus *Cosmosoma* Hübner, 1823 is one of the largest genera within the subtribe Euchromiina, consisting of more than 100 or 150 species, according to Draudt (1916) or Zerny (1912) respectively. The type species of the genus is *Cosmosoma omphale* Hübner, 1823 (pl. 156, figs. 1-4), by monotypy. Butler (1876) regarded *C. omphale* as a synonym for *C. auge* (Linnaeus, 1767) (*Sphinx auge*), the latter being a synonym senior. The type of *C. omphale* is presumably missing. However, the morphological characters of *C. auge* are available (Travassos Filho 1938).

Hampson (1898) considered several synonyms for the genus *Cosmosoma*, including *Erruca* Walker, 1854. It has been proposed that *Erruca* would form a different lineage from *Cosmosoma*, based on the comparison of external and genital morphological characters

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(Pinheiro & Duarte 2010). Currently, the concept of the genus *Cosmosoma* includes species with very different external and genital morphologies, such as *Cosmosoma biseriatum* Schaus, *C. coccinifera* Dognin, *C. doris* (Druce) (= *plumosa* Rothschild), *C. regia* (Schaus), *C. rubricorpus* (Kaye) and *C. phoenicophora* Dognin among others. Considering the characters as evidence, these show that the species of the genus would not share a common evolutionary history. My hypothesis is that *Cosmosoma* is a polyphyletic genus. It is necessary to define the concept of the genus based on the type species and deepen our knowledge with phylogenetic studies based on morphological and molecular traits.

A new genus is proposed, based on the external and genital morphological traits of the males. The genus consists of two species: *Apu mooreorum* sp. nov. and *Apu flavicornis* (Druce, 1883) comb. nov. The new species is described and *A. flavicornis*, previously included in *Cosmosoma*, is redescribed, providing photographs of the adults and the male genitalia. A comparison of the new genus is made with the characters of *Cosmosoma auge.*

Materials and Methods

As part of the study in Systematics, Biogeography and Evolution of the Neotropical Arctiini, trips have been made to different places in Peruvian territory, making collections of Arctiinae of diurnal and nocturnal habits. Colleagues and collaborators interested in our research help on many occasions with the capture of important specimens.

The entomological collections revised for the preparation of this work are:

MUSM: Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Perú.
NHMUK: Natural History Museum, London, United Kingdom.
ZMHB: Zoologisches Museum, Humboldt Universität, Berlin, Deutschland.

Venation terminology follows Comstock & Needman (1898, 1899), Miller (1970) and Common (1990); terminology for male genitalia follows Sibatani *et al*. (1954) and Klots (1970). Notation used for the information provided on the syntypes and the samples deposited in other museums is as follows: semicolon (;) to separate the information of the different labels and an ascending bar (/) to separate the annotations at different levels in a same label.

The genitalia of the specimens were dissected and prepared using a KOH solution (10%) in a water bath. For a better observation of the traits, Chlorazol black was used as a staining solution (Cannon 1937, 1941; Carayon 1969). Photographs of the adults were taken with a Nikon D80 camera, those of male genitalia with a camera Canon EOS Rebel T6 and a Canon MP-E 65 mm macro.

Specimens are deposited at the collection of the Entomology department of the Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Perú (MUSM), except for those indicated in the respective text.

Results

Apu **gen. nov.**
(Figs. 1-16)

Type species. *Apu mooreorum* **sp. nov.**

Diagnosis. Palpi thin and curved; head small; ocelli large and separated from the compound eyes; antennae long with rami 3-4 times the width of the flagellum axis; wings

covered with scales, presenting diaphanous areas. Forewing, with R_5 arising from $R_3 + R_4$; hindwing, with pedunculated Cu_1 and Cu_2. Tegumen clearly divided in two halves; uncus unilobate and elongated, dilated at the central part; distal valva process laterally wide; aedeagus short; caecum penis undeveloped.

Description. Head. Small, with long and ruffled scales at the frontoclypeus. Ocelli large and distant from the compound eyes. Compound eyes small; postgena wide, wider than half the width of the compound eye. Palpi narrow. Antennae bipectinate to the last segments. **Thorax.** Covered with abundant long piliform scales. Tymbal organ in the pterothorax. Wings blackish, with translucent areas. Forewing, R_1 arising previous to the anterior angle of the discal cell; R_2 past the angle; R_5 originating from R_3+R_4; M_1 from the anterior angle of the discal cell; M_2 and M_3 from the posterior angle of the discal cell; Cu_1 and Cu_2 separated; presence of 1A+2A. Posterior wing, Rs and M_1 arise from the anterior angle of the discal cell; M_3, Cu_1 and Cu_2, pedunculated from the posterior angle of the discal cell; Cu_1 and Cu_2 in turn pedunculated, separating near the edge of the wing. **Abdomen.** Male genital structure with tegumen divided; uncus unilobate and elongated; distal part of the valva laterally wide.

Etymology. *Apu* is a masculine noun in nominative singular. It is a Quechua word that means lord, sovereign. In Andean mythology, it is used by the Andean people in South America to refer to certain mountains that would possess certain powers.

Comparison of *Apu* **gen. nov.** with *Cosmosoma auge* (Linnaeus, 1767)

Apu gen. nov. has a small head, ocelli large and separated from the compound eyes, while *Cosmosoma auge* has a large head, ocelli small and close together to the compound eyes. *Apu* gen. nov. is diurnal with small compound eyes, width of the postgena is more than half the width of the compound eyes; *Cosmosoma auge* is nocturnal (León-Finalé & Barro 2014), with large compound eyes and postgena narrow. The first three tergites of the abdomen are modified in *Cosmosoma* (Travassos Filho 1938) forming an androconial organ known as valva (Hampson 1898) or double pouch (Weller *et al*. 2000), while in *Apu* gen. nov. the tergites are not modified. *Cosmosoma* has a wide tegumen; uncus trilobate, all the lobes short; the valvar distal process is narrow and elongated; caecum penis is concave and well developed (Travassos Filho 1938). *Apu* gen. nov. has the tegumen longitudinally divided in two halves; uncus unilobate, wide and elongated in its middle part; valva distal process laterally wide and caecum penis undeveloped (Figs. 5-8, 13-16).

Apu mooreorum **sp. nov.**
(Figs. 1-8)

Diagnosis. One of the largest species of all Euchromiina, with wings and body covered with black piliform scales and some parts in bluish-green hues. Easily distinguished from *A. flavicornis*, because *A. mooreorum* is larger, bears black antennae, the proximal part of the valva is narrower and the distal part triangular with internal processes of irregular shape, while *A. flavicornis* has yellow antennae and the distal part of the valva is digitiform with no internal processes present.

Male (Figs. 1-2). **Head.** Proboscis black. Palpi somewhat curved and reaching the middle of the frontoclypeus. First palpomere with large, black piliform scales of a bluish-green hue on its underside. Second palpomere twice the length of the third one; both black. Frontoclypeus with brown piliform scales of a bluish-green hue, except for the upper

part, where it bears brown laminar scales dentated at the distal area. Vertex with brown piliform scales. Ocellus brown. Postgena brown. Antennae black and bipectinate. Rami proximal small, increasing in size towards the middle part. Medial rami four times the length of the flagellum axis. Distal rami decreasing in size towards the distal end. **Thorax.** Patagia, tegulae, mesoscutum, mesoscutellum, metascutum and metascutellum covered in black piliform scales with a bluish-green hue, most pronounced on the posterior part of the tegulae and the mesoscutellum. The three pairs of black legs with a bluish-green hue. **Forewing span:** 26-28 mm (n = 4). **Forewing (dorsal).** Elongated and black, a bluish hue in all its extension. With well-defined transparent areas: a rectangular one at the central part of the discal cell; the largest, an elongated one, at the Cu_2-CuP cell. Five continuous transparent areas: an elongated, small and triangular one at the proximal part of R_5-M_1; an elongated one, subproximal at M_1-M_2; an elongated one, proximal at M_2-M_3; an oval one in the middle of M_3-Cu_1 and a triangular one, sub-distal at Cu_1-Cu_2. **Forewing (ventral).** Black and elongated, with same traits as on the dorsal side. Retinaculum brown. **Hindwing (dorsal).** Black and elongated with a bluish hue in all its extension. With three transparent areas: the largest one, proximal at M_1-M_3; a small one at the proximal part of M_3-Cu_1 + Cu_2; the last one, large and elongated, subproximal at Cu_2-1A+2A. Internal margin with piliform scales of a bluish-green hue. **Hindwing (ventral).** Similar to dorsal side. **Abdomen.** Black, long, piliform scales with a bluish hue on the first tergite. The rest of the abdomen black with short piliform scales of a greenish hue. **Male genitalia.** (genitalia # JGA-411, MUSM) (Figs. 5-8). Tegumen wider than the vinculum, sclerotized, the anterior margin "V" shaped, with a digitiform space towards the posterior part; posterior margin straight, with small lateral sclerotized processes. Separation between tegumen and uncus, membranous. Uncus unilobate and sclerotized; its base narrower than the posterior margin of the tegumen; a peduncle between the base and the distal part; dilated in its central part; setae on the sides of the dilated area; in lateral view, spindle-shaped. Juxta sclerotized on the lateral parts, ventrally membranous. Transtilla sclerotized. Valva sclerotized, wide at its proximal part, narrowing towards its central part; triangle shaped at its distal part, with setae present at the ventral area; in ventral view, with internal irregular sclerotized processes at the beginning of the posterior half. Aedeagus elongated, narrow and smaller than the genital capsule; slightly sclerotized in the proximal half and strongly sclerotized in the distal half; carina penis present.

Female (Figs. 3-4). Forewing span: 28 mm (n = 1). Same traits as the male, except for rami smaller. Frenulum with 4 bristles.

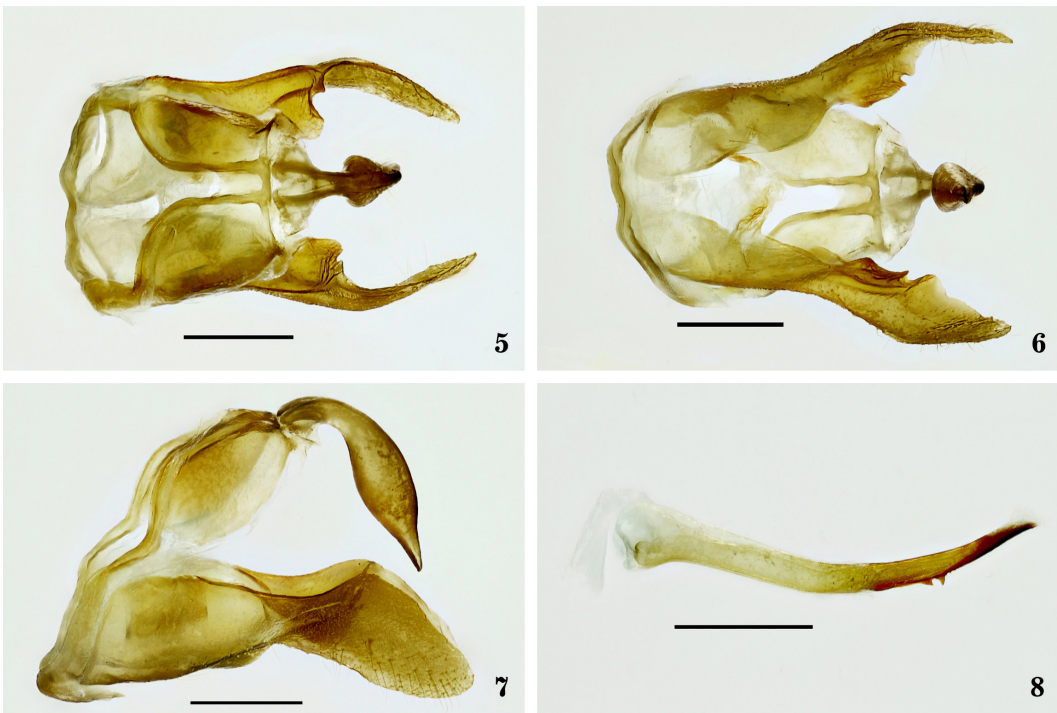
Type material. HOLOTYPE (Figs. 1-2): **PERU.** 1 male, PUNO, Chacaneque (13°39' S, 70°28' O, 1800 m), vii.2005 (J. Böttger) (diurnal collection). **PARATYPES. PERU**: 1 male, 1 female, same data of holotype; 2 males, idem except (13°40'0.6"S, 70°28'40.9"O, 1655 m), 22-23. xii.2009 (E. Huamaní). All deposited in the MUSM.

Etymology. *mooreorum* is a genitive noun, derived and dedicated in honor of Gordon and Betty Moore (Gordon and Betty Moore Foundation) for their unconditional support on the discovery new species project (Wired Amazon) in southeastern Peru.

Distribution. Known only from the montane forests of the southeastern Peru, department of Puno.

Comments. Species of diurnal habits. Known for now from the department of Puno. It is likely to occur in the montane forests of Bolivia.

Figures 1-4. *Apu mooreorum* **sp. nov.** 1-2. Holotype male. 1. Dorsal view. 2. Ventral view. 3-4. Female. 3. Dorsal view. 4. Ventral view. Scale: 5 mm. / *Apu mooreorum* **sp. nov.** 1-2. Holotipo macho. 1. Vista dorsal. 2. Vista ventral. 3-4. Hembra. 3. Vista dorsal. 4. Vista ventral. Escala: 5 mm.



Figures 5-8. Male genitalia of *Apu mooreorum* **sp. nov.** (Genitalia # JGA-411, MUSM). 5-7. 5. Vista dorsal. 6. Vista ventral. 7. Vista lateral. 8. Aedeagus. Scale: 1 mm. / Genitalia macho de *Apu mooreorum* **sp. nov.** (Genitalia # JGA-411, MUSM). 5-7. 5. Vista dorsal. 6. Vista ventral. 7. Vista lateral. 8. Edeago. Escala: 1 mm.

Apu flavicornis (Druce, 1883) **comb. nov.**
(Figs. 9-16)

Redescription. Male (Figs. 9-10). **Head.** Proboscis black. Palpi thin, somewhat curved and can reach the middle of the frontoclypeus. First palpomere black with large piliform scales on the underside. Second palpomere twice the length of the third; both black. Frontoclypeus with brown piliform scales of a greenish hue. Vertex with brown piliform scales. Eye margin and antennal alveolus, brown. Ocellus whitish. Postgena brown. Antennas bipectinate. Scape and pedicel brown. Flagellum yellow. Proximal rami medium, increasing in size towards the middle. Middle rami thrice the length of the flagellum axis. Distal rami decreasing in size towards the distal end. Cervical scales brown. **Thorax.** Patagia, tegulae, mesoscutum, mesoscutellum, metascutum and metascutellum covered with piliform scales of a bluish-green hue, most pronounced at the posterior part of the tegulae. The three pairs of legs black. **Forewing span:** 22-23 mm (n = 5). **Forewing (dorsal).** Elongated and black, with a bluish hue. It presents well-defined transparent areas: a rectangular one in the central part of the discal cell; another one the same length as the previous at the Cu_2-1A+2A cell. Five continuous ones: a triangular, elongated and small one in the proximal part of R_5-M_1; a rectangular and elongated one, subproximal in M_1-M_2; an elongated one, proximal in M_2-M_3; a subproximal one in M_3-Cu_1 and a small subdistal one in Cu_1-Cu_2. **Forewing (ventral).** Black and elongated, with the same characteristics as on the dorsal side. Retinaculum brown. **Hindwing (dorsal).** Black and elongated with a bluish hue all throughout. With three transparent areas: the largest one, proximal in M_1-M_3; another in the proximal part of M_3-Cu_1+Cu_2; and a large, elongated one, subproximal in Cu_2-1A+2A. Internal margin with piliform scales of a bluish-green hue. **Hindwing (ventral).** Similar to the dorsal side. **Abdomen.** Presence of long greenish-blue piliform scales on the first tergite. The rest of the abdomen black with short piliform scales of a greenish hue. **Male genitalia** (Genitalia # JGA–410, MUSM) (Figs. 13-16). Tegumen somewhat narrower than the vinculum, sclerotized, with the anterior margin shaped as an inverted "U", somewhat more open towards the anterior margin; posterior margin slightly convex towards the central part. Joining of the tegumen and uncus, membranous. Uncus sclerotized; the base bipartite, narrower than the posterior margin of tegumen; setae present on the dorsal and lateral surface of the lobe; fusiform in lateral view. Juxta sclerotized. Transtilla membranous. Valva sclerotized, wide in the proximal half, narrow in its central part; the distal half digitiform and very sclerotized, with setae present in the ventral area; in ventral view, valvae are concave. Aedeagus elongated, narrow, somewhat sinusoidal and smaller than the genital capsule; slightly sclerotized at the proximal two thirds and sclerotized at the distal one; presence of carina penis.

Female. With the same traits as the male, except for shorter rami.

Examined material. SYNTYPES: 1 female, with labels: Calonotos / flavicornis / Type Druce; Type / HT; Type / Sp. figured.; Antioquia / Salmon; Presented by / J.J. Joicey Esq. / Brit. Mum. 1931-444; KB-Dia-Nr. / 432 / B. Kreusel dok.; BMNH (E) 1378941. [Colombia] (Figs. 11-12). (NHMUK) [examined]. Lectotype designated here. 1 female: Antioquia / L. Salmon; Joicey / Bequest. / Brit. Mus. / 1934-120.; BMNH (E) 1378942. [Colombia]. (NHMUK) [examined]. **Examined additional material: ECUADOR.** ZAMORA-CHINCHIPE: 1 male, Zamora, 04°04'N, 78°58'W, 1500 m, ii.1996, M. Büche (diurnal collection) (MUSM); 1 male: Trichela / flavicornis / Ecuador; Mssn. / C.; 395. (ZMHU) [examined]. **PERU: AMAZONAS:** 3 males, Alto río Nieva, 05°41'S, 77°47'W, 2000 m, 20.xi.1996, M. Jorón (Diurnal Collection).

Distribution. Known from the type locality (Colombia), Ecuador and Peru.

Comments. Like *Apu mooreorum*, the species is diurnal. All specimens were collected in the northern montane forests of Peru with entomological net. For now, both species have an allopatric distribution.

Figures 9-10. *Apu flavicornis* (Druce, 1893) **comb. nov.** (Nieva river). 9-10. 9. Vista dorsal. 10. Vista ventral. Scale: 5 mm. / *Apu flavicornis* (Druce, 1893) **comb. nov.** (río Nieva). 9-10. 9. Vista dorsal. 10. Vista ventral. Escala: 5 mm.

Figures 11-12. *Apu flavicornis* (Druce, 1893) **comb. nov.** Syntype female in NHMUK. 11-12. 11. Dorsal view. 12. Ventral view. / *Apu flavicornis* (Druce, 1893) **comb. nov.** Sintipo hembra en NHMUK. 11-12. 11. Vista dorsal. 12. Vista ventral.

Figures 13-14. *Apu flavicornis* (Druce, 1893) **comb. nov.** (Genitalia # JGA-710, MUSM). 13. Dorsal view. 14. Ventral view. 15. Lateral view. 16. Aedeagus. Scale: 1 mm. / *Apu flavicornis* (Druce, 1893) **comb. nov.** (Genitalia # JGA-710, MUSM). 13-15. 13. Vista dorsal. 14. Vista ventral. 15. Vista lateral. 16. Edeago. Escala: 1 mm.

Discussion

The genus *Cosmosoma* was proposed by Hübner (1823) with the type species *Cosmosoma omphale* Hübner, 1823 (pl. 156, figs. 1-4). Butler (1876) considered *C. omphale* synonymous with *Sphinx auge* Linnaeus, 1767 (=*Cosmosoma auge*). Hampson (1898) followed what was proposed by Butler (1876), but added *Cosmosoma melitta* Möschler as a new synonym.

The holotype of *C. omphale* is presumably missing and the holotype of *Cosmosoma auge* is in The Linnean Society (London, United Kingdom). The available description of *C. auge* is provided by Travassos Filho (1938), who based it on Hampson's (1898) diagnosis. When analyzing the drawings on *C. omphale* description, the color pattern coincides with the concept of *C. auge* from Travassos Filho (1938), moreover, a white spot is visible in lateral view (Hübner 1823), a trait representing the presence of the androconial organs (double pouch) in the ventral part of the first abdominal segments, a characteristic present in both species. Both of them are subjective synonyms, but the name *auge* takes precedence over *omphale* (ICZN 1999: Art. 23.1), the former being a senior synonym. However, the type species for the genus *Cosmosoma* is *C. omphale* and not *C. auge* (*Sphinx auge*) as Travassos Filho (1938) mentioned (ICZN 1999: Art. 67.1.2). Finally, the type specimen for *Cosmosoma melitta* Möschler, is a female from Paramaribo [Suriname] and it is found at the ZMHU. In the original description, Möschler (1878) indicated that the species would be related to *"auge"*. According to the analysis of the morphological characters and the color pattern, there is a certain difference at the level of the first abdominal tergite, which is orange. This specimen could represent part of the chromatic variability of the species.

Very few genera of Euchrommina have been revised (Dietz 1994; Simmons 2006; Simmons & Weller 2006; Pinheiro & Duarte 2010). *Cosmosoma* is one of many in need of revision. The genus is polyphyletic. It has been considered a basket genus. The revision

work will be arduous and long-lasting, due to the high number of species and how difficult it is to obtain specimens, some species being known only from the holotype.

Apu gen. nov. has very different traits from *Cosmosoma*. They differ at the level of color pattern and external and genital morphology. One of the most important differences is at the abdomen. *Cosmosoma* has the first three tergites of the abdomen modified forming an androconial organ (Barth 1953) known as valva (Hampson 1898) or double pouch (Weller *et al*. 2000). *Apu* gen. nov. doesn't have the tergites modified. The presence of this type of androconial organ is at the moment known in several species considered within the subtribe Euchromiina. However, the monophyly of the subtribe remains to be demonstrated. *Apu mooreorum* sp. nov. and *A. flavicornis* are allopatric species but both occur in the montane forests of the Andes. *A. mooreorum* in Colombia, Ecuador and northern Peru, while *A. flavicornis* in southeastern Peru and almost certainly in Bolivia.

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