

A CONTRIBUTION TO THE SYSTEMATICS OF THE COPAXA SEMIOCULATA SPECIES-GROUP  
(SATURNIIDAE), WITH NOTES ON THE EARLY STAGES, AND A DESCRIPTION OF  
COPAXA LUNULA, NEW SPECIES

KIRBY L. WOLFE<sup>1</sup>

3090 Cordrey Drive, Escondido, California 92029, USA, email: kirwolfe@pacbell.net

CLAUDE LEMAIRE<sup>2</sup>

La Croix des Baux, F-84220 Gordes, France, email: Lemaire.C@wanadoo.fr

ANGELA AMARILLO S.

Department of Entomology, University of Kentucky, S225 Agricultural Sciences Central North,  
Lexington, Kentucky 40546-0091, USA, email: aamarill@hotmail.com

AND

CHRISTOPHER A. CONLAN<sup>1</sup>

11513 Hadar Drive, San Diego, California 92126, USA; email: conlan@adnc.com

**ABSTRACT.** *Copaxa semioculata* is re-described. Recent collecting has demonstrated that a population from western Ecuador was misidentified as *C. semioculata semioculata* by Lemaire (1975, 1978), and that this population plus *C. semioculata orientalis*, of eastern and western Ecuador and central and western Colombia, are actually conspecific and specifically distinct from *C. semioculata*, which occurs only in the eastern Andes of South America from Venezuela to Peru. The male of *C. semioculata* differs noticeably from ***C. orientalis, new status*** by its smaller size, narrower forewings, variable color, dark antennae, differences in the genitalia and especially hours of nuptial flight. Males are diurnal and have rarely been collected at lights. Male and female genitalia are figured and immature stages are described and illustrated in color. Larvae fed in the laboratory on *Persea americana* (Lauraceae). *Copaxa orientalis* is hereby elevated to full specific rank. Additionally, a new species closely related to *C. semioculata* is described from Bolivia and Peru.

**RESUMEN.** Se describe *Copaxa semioculata* de nuevo. Mediante muestreo realizado recientemente se ha demostrado que una población del oeste del Ecuador fue malidentificada como *C. semioculata semioculata* por Lemaire (1975, 1978), y que esta población más *C. semioculata orientalis*, del este y el oeste del Ecuador y el centro y el oeste de Colombia, en realidad son de la misma especie y son distintas a *C. semioculata*, la cual se encuentra en los Andes orientales de Venezuela al Perú. El macho de *C. semioculata* difiere notablemente de ***C. orientalis, estatus nuevo*** por su tamaño menor, alas delanteras más delgadas, color variable, antenas más oscuras, diferencias en los genitales y en especial las horas de su vuelo nupcial. Los machos son diurnos y rara vez se han colectado con luces. Se ilustran los genitales del macho y de la hembra y se describen y presentan fotografías en colores de los estadios inmaduros. En el laboratorio las larvas se alimentaron con *Persea americana* (Lauraceae). Se eleva *Copaxa orientalis* a pleno rango específico. Adicionalmente se describe una especie nueva de Bolivia y el Perú, de próxima afinidad con *C. semioculata*.

**Additional key words:** Bolivia, Colombia, Ecuador, immature stages, lunula, Neotropical, *orientalis*, *Persea*, Peru, Venezuela.

The genus *Copaxa* (Walker 1855) comprises more than 36 species of often large and colorful moths, distributed from Mexico to Argentina. These were divided by early authors into three genera, with *Copaxa* containing the majority of species. Among the high altitude Andean species, some were placed in *Sagana* Walker (1855) and others, along with several Mexican species, in *Saturniodes* Jordan (1911). The Andean species are a poorly-studied group generally restricted to often cold, wet and steep habitats between 2000–4000 m, from Venezuela to Bolivia.

The genus *Sagana* was proposed for *Sagana sapatoza* (Westwood 1853) from Colombia, and was subsequently used to harbor the closely related but slightly larger *Sagana semioculata* R. Felder & Rogenhofer (1874) from Venezuela. This arrangement

was retained by Packard (1914) and Bouvier (1936). Curiously, Draudt (1929) separated *semioculata* from *sapatoza* and placed *semioculata* in *Saturniodes* where it remained for some years. Michener (1952) unified *Saturniodes* and *Sagana* under *Copaxa* but retained the three names as subgenera. Lemaire (1978) demonstrated problems with Michener's model and discarded the subgenera, synonymizing all in *Copaxa*.

Most of the high altitude Andean *Copaxa* species are characterized by lunate or modified lunate hyaline discal spots on all four wings. Until now, only three easily distinguishable species of the *Copaxa semioculata* complex were recognized: *C. sapatoza*, *C. semioculata* and *C. herbuloti*. *C. sapatoza* has wide, squared lunate discal spots, *C. semioculata*, a variable moth encompassing several hidden species, has lunate spots. *Copaxa herbuloti* Lemaire (1971), described from a single male from northwestern Peru and obviously dis-

<sup>1</sup> Research Associate, Natural History Museum of Los Angeles County, California, USA.

<sup>2</sup> Correspondant du Muséum national d'Histoire naturelle, Paris.

tinct in the genitalia, has widely distorted hyaline discal spots on the forewing. *C. orientalis* Lemaire (1975), a large, dark species, was described from the eastern Andes of Ecuador as a subspecies of *C. semioculata*. Recent collecting has yielded additional phenotypes of the *C. semioculata* species group, calling into question the previous identification of the nominotypical taxon of *C. semioculata*.

A taxonomic problem began with Felders' and Rogenhofer's description of *Copaxa semioculata* from an unspecified number of female specimens from "Venezuela." Lemaire (1978:197) designated as lectotype a specimen preserved in The Natural History Museum (BMNH, London) (by way of the Felder and W. Rothschild collections). Examined by KLW and CL, it provides no precise locality data on the label. Sonthonax's (1901) citation of a male and female with wingspan of 12 cm, from "Bogota, Venezuela" is erroneous on two counts, as Bogota is in Colombia and the size is much too large for *C. semioculata*. When Lemaire described *C. semioculata orientalis* no male specimens of *C. semioculata* were known from Venezuela or Colombia. A large series of male and female specimens from western Ecuador, collected at lights and preserved in the BMNH, appeared to CL to match the original description and illustrations and he erroneously assigned the specimens to the nominotypical subspecies in the description of the new subspecies *orientalis* and in the revision of the genus (Lemaire 1978).

The preponderance of small females of *C. semioculata* attracted to lights in eastern Ecuador aroused our suspicion that the true male of this species might be diurnal, and that Lemaire's "*semioculata*" of western Ecuador were misidentified. Evidence of this began to emerge with the net capture by Amarillo of a small orange male flying slowly and low to the ground in full sunlight at 1630 h in January, 1992 at 2850 m in Iguaque National Wildlife Sanctuary in Boyacá Department, northeast of Bogota, Colombia. A female was later collected at lights. Returning to Iguaque in April 1998, and April 2000, KLW and AAS captured seven additional females.

While examining public and private collections in Venezuela and Colombia, KLW found a female specimen of *C. semioculata* from Tachira, western Venezuela (2425 m) and two male specimens of the same species from Colombia. Both males were captured flying at noon above 2000 m, one on the Venezuelan-Colombian border and the other near Bogota, by J. F. Le Crom (pers. com.), who regularly sees it flying high above the ridges east of the city.

In spite of the vagueness of the type locality "Venezuela," it can be assumed, based on the biogeographic

data, especially elevation, that the lectotype of *C. semioculata* originates from the Mérida Cordillera or from the Province of Tachira in western Venezuela near Colombia. Thus, this lectotype and the two above specimens from Bogota and from the Venezuelan/Colombian border can be considered as conspecific, which resolves the long perplexing problem of the identity of *C. semioculata* and of the identification of the corresponding male.

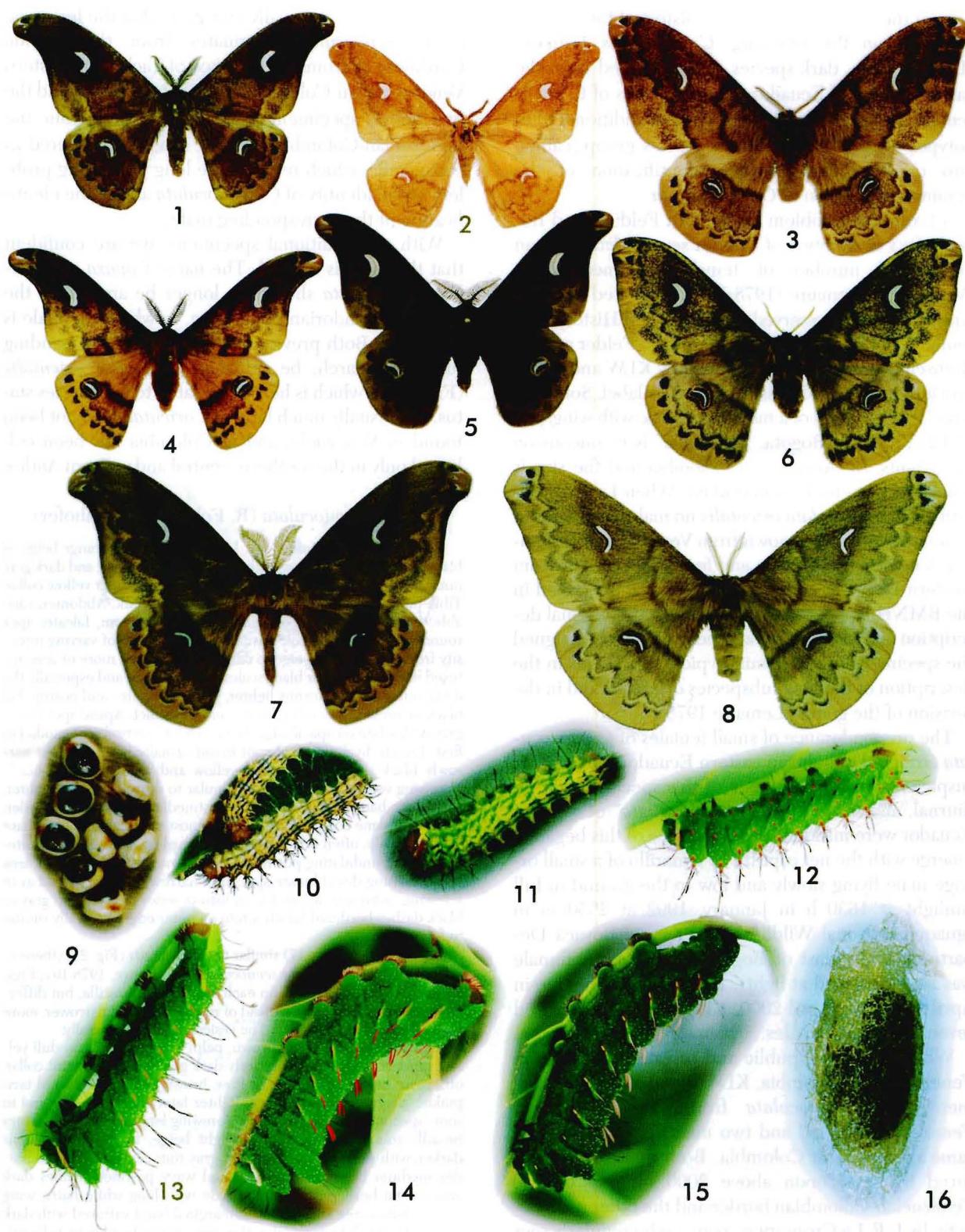
With the additional specimens, we are confident that the male is diurnal. The name *Copaxa semioculata semioculata* should no longer be applied to the western Ecuadorian population, in which the male is nocturnal. Both previous subspecies should, pending further research, be referred to *Copaxa orientalis* (Figs. 7, 8), which is hereby elevated to full species status. The usually much larger *C. orientalis* has not been found in Venezuela, and in Colombia has been collected only in the southern, central and western Andes.

#### *Copaxa semioculata* (R. Felder & Rogenhofer)

**Redescription. Male** (Figs. 1, 2). Head brown, orange beige or black, eyes large. Antennae with brownish yellow shaft and dark gray rami, quadripectinate. Thorax variable, with indistinct yellow collar. Tibia pink with long beige hairs, tarsi bright pink. Abdomen variable, lighter ventrally. Forewing length 35–50 mm, falcate; apex rounded. Background color usually orange brown of varying intensity from light orange beige to dark brown or gray, more or less suffused with dark gray or black scales in the median and especially the distal outer border; tornus lighter, yellowish; ante- and postmedial black or brown lines often blurry and indistinct. Apical spot small, gray with white on apical edge; trace of white second spot caudad to first. Lunate hyaline discal spot broad, usually bordered first narrowly black then broader dark yellow and again narrowly black. Forewing ventrally dark or light, similar to dorsal color but lighter, with dark band along indistinct postmedial line and on border. Hindwing same color as forewing but most of costal area from base to border pale, often tinged pink on forward basal area; brown antemedial and undulating postmedial lines enclose broad darker area encompassing discal lunate spot; spot narrower but bordered as in forewing; submarginal band an indistinct series of U-shaped gray or black dashes bordered faintly white on outer edge. Ventrally similar to forewing.

Male genitalia (Fig. 17) similar to *C. orientalis* (Fig. 21) (these illustrated as *C. semioculata semioculata* by Lemaire, 1978:197, Figs. 156, 157), with long hooks on each arm of the transtilla, but different in having a triangular, instead of round, juxta and narrower, more pointed apices of the valves. The vesica evaginates dorsally.

**Female** (Fig. 3). Head brown, palpi brown. Antennae dull yellow, bipectinate. Thorax anteriorly dark gray with yellow tuft collar, otherwise beige, tinted rose, yellow, brown or gray. Tibia and tarsi pinkish beige. Abdomen beige, lighter laterally and darker and in some specimens pinker ventrally. Forewing length 41–55 mm, wings broadly rounded; ground color light beige, in some specimens darker, with pink, yellow, brown or gray tint; central band and border medium brown; antemedial and wavy postmedial lines dark gray; costal border dark gray at base with long white hairs; wing base, median area and vague submarginal band suffused with dark gray and reddish brown scales, the submarginal band outwardly suffused with white; single apical spot dark gray bordered outwardly white. Hindwing colored similarly to forewing but with lighter margins, submarginal band of dark gray, outwardly white U-shaped dashes; irregular area between antemedial and postmedial lines as in



Figs. 1–16. Adults of *Copaxa semioculata*, *Copaxa lunula*, new species, *Copaxa orientalis*, new status; immature stages of *C. semioculata* and larva of *C. lunula*. 1. *Copaxa semioculata*, male, brown phenotype, COLOMBIA, Boyacá, Santuario Nacional de Flora y Fauna de Iguaque, 2990 m, 22–24 April 2000, leg K. & S. Wolfe. 2. *C. semioculata*, male pale phenotype, COLOMBIA, Boyacá, Iguaque National Wildlife Refuge,

male; forward area of wing pale, pink in some specimens. Discal spots as in male, surrounded by yellow and gray or black. Ventrally similar, but suffused with white scales except on margin; antemedial and postmedial lines medium brown.

Female genitalia (Fig. 18) similar to *C. orientalis*.

**Diagnosis.** Males of *C. semioculata* can be distinguished from *C. orientalis* (Fig. 7) by smaller size, much narrower forewings and dark antennae. Males of *C. semioculata* apparently search for females for about one hour at midday and remain in copula until late afternoon or evening. KLW noted three males flying from 1120 h to 1205 h (Iguaque, April 2000, unpublished obs.). In all known cases, males were collected either during daytime with nets or at lights just at dusk. In two cases, males were attracted to lights with a virgin female of *C. sapatoza*, with which one copulated, resulting in infertile eggs (Diego Bonilla P. pers. com.). Females of *C. semioculata* are smaller than *C. orientalis* (Fig. 8) and are strictly nocturnal, arriving at lights throughout the night. In *C. orientalis*, in which the antennae are yellow in both sexes, flight is nocturnal, with males attracted to lights between 1930 h and 2115 h (KLW, CL, AAS, CAC, pers. observ.).

**Distribution.** All known specimens of *C. semioculata* originated in the eastern Andes between 2150–3430 m, in forest on both slopes, from western Venezuela, Colombia, Ecuador and northern Peru. Localities where it has been collected include: VENEZUELA, Táchira, Páramo Tama, Betanía, 2425 m, 16–10 Mar 1983, Exp. Instituto Zoología Agrícola, Fac. Agronomía; COLOMBIA, (near Venezuelan border), 22 Dec. 1993, leg. LeCrom (netted at noon); COLOMBIA, Boyacá, Santuario Nacional de Flora y Fauna de Iguaque, El. 2990 m, 24–26 Apr 1998, at MV & UV lights, leg K. Wolfe, A. Amarillo, C. Sarmiento; COLOMBIA, Cundinamarca, Represa El Sisga, 4 Jan 1968, J. Cayon; COLOMBIA, Cundinamarca, 3300 m, 12 Nov 1995, leg LeCrom; COLOMBIA, Cundinamarca, Villa Punzón, 2900 m, May 2001, leg D. Bonilla; COLOMBIA, Cundinamarca, Bogota, Rd. Bogotá—Tunja, Villa Pinzón, 3100 m, Sep 1999, leg D. Bonilla; COLOMBIA, Cundinamarca, Rd. Bogotá—Tunja, Chacanta, 2600 m, Jul 2001, leg T. Decaëns & D. Bonilla; ECUADOR, Cotopaxi, ca. 25 km NE of Latacunga, MV light 1930 h, el. 3151 m, 10 Mar 1995, K.

Wolfe & S. Smoot; ECUADOR, Napo, Papallacta, 2800 m, 2 Mar 1992, Wm. Kelly; ECUADOR, Napo, rd. Baeza to Tena, S. of Cosanga, 2150 m, N. Veneditoff, 23 Mar 1976; ECUADOR, Napo, Cosanga to Tena km 7, 2350 m, 19 Jul 1990, leg. D. Herbin & J. Haxaire; ECUADOR, Morona Santiago, 44 km on Rd. Gualaceo-Limon, El. 2300 m, 4 May 2000, GPS = 03°01.00S × 078°34.83W, K. & S. Wolfe, C. & M. Conlan; PERU, Amazonas, Achuras 3100 m, 10 May 1999.

*Copaxa orientalis* and *C. semioculata* are probably sympatric in parts of their range, but *semioculata* prefers dense humid forest below the treeline whereas *orientalis* ranges at higher altitudes, near the tree line and in alpine shrubbery. *Copaxa orientalis* has been collected in COLOMBIA in the following locations: eastern slope of Central Cordillera in departments of Caldas (Parque Nevado) and Tolima (Anaime Reserve); Western Cordillera in Valle (Anchicayá Alto) and Nariño (Cumbal, Chachaguí, La Laguna, Ipiales, 86 km S of Pasto). In ECUADOR, specimens of *C. orientalis* exist from Carchi, near Tucán; the eastern Cordillera in Napo near Cotopaxi border, Rd. Salcedo to Napo, km 49, 3500 m (type locality); western Cordillera in Pichincha, old Rd. Quito to Santo Domingo de los Colorados, km 26, 3200 m; and Tungurahua (west of Ambato). Both *C. semioculata* and *C. orientalis* fly during much of the year. However, males of *C. semioculata* do not seem to be active during periods of heavy, all-day cloudiness, and females are not usually found during the following nights.

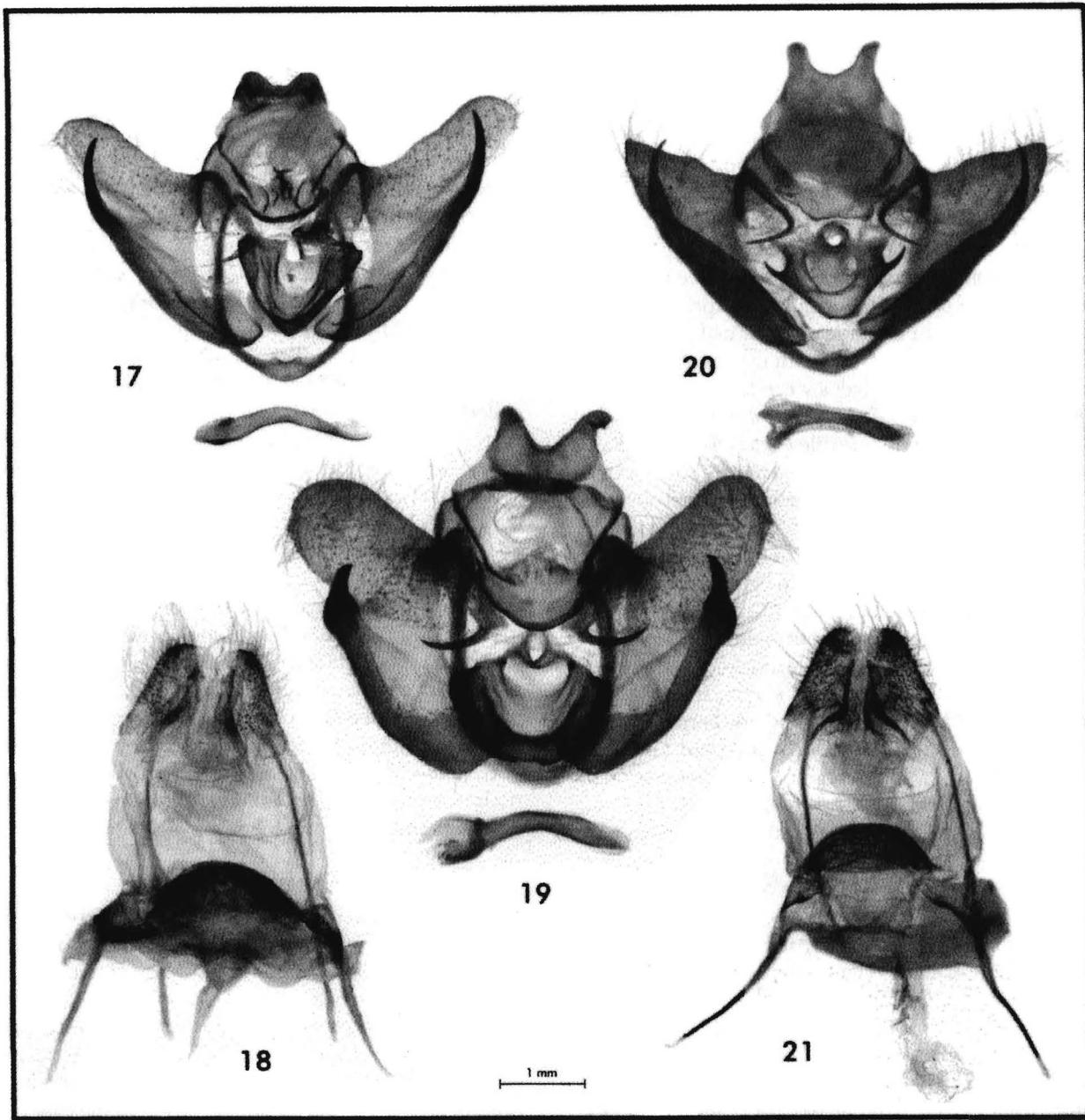
#### IMMATURE STAGES

Females captured at lights in Colombia oviposited in paper bags. Larvae were subsequently reared in the laboratory on *Persea americana* Mill. (Lauraceae). Some larvae initially accepted *Quercus* sp. (Fagaceae), the only other hostplant accepted among several offered, but were later moved to *Persea*. Larvae were consistent in color, pattern and spination with other *Copaxa* species, most resembling larvae of the canela-lavendera group (Wolfe 1993). More than 20 cocoons with pupae were obtained but only one female emerged. Remaining pupae died within a year.

**Egg** (Fig. 9): 1.9 mm long × 1.6 mm wide × 1.3 mm

←

2900 m, 5 January 1992, leg A. Amarillo. **3.** *C. semioculata*, female, COLOMBIA, Cundinamarca, Bogota, Rd. Bogotá - Tunja, Villa Pinzón, 3100 m, September 1999, leg T. Decaëns & D. Bonilla. **4.** *Copaxa lunula*, paratype male, orange phenotype, BOLIVIA, Cochabamba Prov., dwarf cloud forest 1 km E La Siberia, 3050 m, 17°47.63S × 064°44.70W, 12 November 1999; ex-♀ at lights; leg. K. Wolfe & C. Conlan, reared on *Persea* by C. Conlan. **5.** *C. lunula*, paratype male, dark phenotype, ibid. **6.** *C. lunula*, paratype female, ibid. **7.** *Copaxa orientalis*, male, COLOMBIA, Tolima, Municipio Cajamarca, Anaime Reserve, el. 3310 m, 29 March 1995, K. Wolfe, S. Smoot, A. Amarillo, C. Sarmiento. **8.** *C. orientalis*, female, ibid. **9.** *C. semioculata* eggs. **10.** *C. semioculata* 1st instar larva. **11.** *C. semioculata* 2nd instar larva. **12.** *C. semioculata* 3rd instar larva. **13.** *C. semioculata* 4th instar larva. **14.** *C. semioculata* 5th instar larva. **15.** *Copaxa lunula* 5th instar larva. **16.** *C. semioculata* cocoon with pupa. Illustrations by KLW.



Figs. 17–21. Genitalia of *Copaxa semioculata*, *C. lunula* and *C. orientalis*. **17.** *C. semioculata*, male genitalia with aedeagus separated. **18.** *C. semioculata*, female genitalia, with damaged corpus bursae. **19.** *C. orientalis*, male genitalia with aedeagus separated. **20.** *C. lunula*, male genitalia with aedeagus separated. **21.** *C. lunula* female genitalia. Genitalia illustrations by KLW.

thick; broad transparent dark brown on both faces with large, dark micropile at one end; deposited flat, singly or in short strings of 2–5. Eggs maintained at  $21^{\circ}\text{C} \pm 3^{\circ}$  required ca. 18 days to hatch.

**Larva:** Most larvae hatched between dawn and noon, the majority midmorning. Larvae fed for ca. 55 days before spinning cocoon.

**First instar** (Fig. 10): Head: 1 mm wide; mahogany

brown with long translucent setae, area of stemmata and mandibles black. Body: 10 mm max. length; lemon yellow, broad notal plate mahogany brown, narrow dorsal stripe and three interrupted and irregular subdorsal and lateral stripes black; scoli with broad base salmon, dorsal setae dark brown, lateral long hairs lighter. Thoracic legs black; abdominal prolegs, paranal lobes and ventral body greenish white.

**Second instar** (Fig. 11): Head: 1.6 mm wide, mahogany brown with white clypeus. Body: 15 mm max. length; yellowish green, dorsum white to greenish white; narrow black middorsal stripe almost disappearing on central area of some segments; single black subdorsal zigzag stripe interrupted by subdorsal scoli; scoli mostly golden orange, except reddish brown dorsal prothoracic scoli and notum. Thoracic legs brown, anal legs greenish white, anal area light reddish brown. Dorsal prothoracic and ninth abdominal segment scoli, subdorsal second thoracic and ninth abdominal segment scoli, and all lateral scoli with central seta consisting of long hair with wide lanceolate tip.

**Third instar** (Fig. 12): Head: 2 mm wide, dull green. Body: 20 mm max. length; green mottled olive, darker ventrally, no dorsal stripes. Bases of dorsal scoli slender, elongated, scarlet with narrow yellow band at base. Central spine of dorsal and lateral (but not most subdorsal) scoli with long, lanceolate tipped shiny black hairs as in second instar; segments 6–11 with wide white forward arching spines originating just anteriorly of each dorsal and subdorsal scoli; numerous tiny white fan-shaped setae scattered over integument. On segments 5–10 a black diagonal slash bordered yellow on upper posterior side hides yellow spiracles. Thoracic legs, abdominal and anal feet brown, rest of paranal lobes yellowish green.

**Fourth instar** (Fig. 13): Head: 3.1 mm, green. Body: 36 mm max. length; color, pattern and spination with central long, lanceolate tipped hairs generally similar to third instar except scoli now submerged, scolic spines tiny, thin; forward arching wide dorsal and narrower subdorsal spines now deep pink; a white prothoracic collar band; spiracles yellow. Feet and paranal area as in third instar.

**Fifth instar** (Fig. 14): Head: 5.2 mm, green. Body: 65 mm long × 12 mm thick after feeding is completed. Color and spination as in fourth instar; curved setae on feet white.

**Cocoon** (Fig. 16): Medium brown, double walled, open mesh, shiny.

**Pupa:** 23–26 mm long × 9 mm–12 mm thick, light brown, smooth, with cremaster of single, short spine.

### *Copaxa lunula* Wolfe & Conlan, new species

**Description. Male** (Figs. 4, 5): Head variable shades of brown, eyes large. Antennae with brownish yellow shaft and dark gray or black rami, quadripectinate. Thorax variable, with indistinct yellow collar. Tibia pink with long beige hairs, tarsi bright pink. Abdomen variable, lighter ventrally. Forewing length 38–40 mm, falcate; apex rounded. Background color orange to dark brown or gray, darker between ante- and postmedial lines and toward apex. Tornus and apex lighter, apical spot black bordered white on outer edge; lunate hyaline discal spot bordered black then faintly yellow. Underside as above but lighter. Hindwing same color as forewing but lighter. Black undulating antemedial and postmedial lines enclose broad darker area and lunate spot notably ringed by yellow bordered with

black. Submarginal band a bold series of black U-shaped dashes. Ventrally similar to forewing.

Male genitalia (Fig. 19) similar to those of *C. semioculata* (Fig. 17) but with bilateral long curved sclerotized spines on the ventral rim of the juxta. Aedeagus is more robust than in *C. semioculata* and vesica evaginates laterally.

**Female** (Fig. 6): Head greenish gray, palpi dark brown. Antennae dull yellow, bipectinate. Thorax anteriorly olive to yellow, remainder olive. Tibia and tarsi pink. Abdomen olive, darker in some individuals. Forewing length 43–54 mm, wings broadly rounded; ground color gray, mostly greenish with yellow on the borders, some specimens almost black. Antemedial and postmedial lines black. Two distinct apical black spots, discal spot as in male. Hindwing color similar to forewing but more rosy or mauve. Discal spot and lines as in male. Ventrally lighter. Female genitalia (Fig. 20) do not differ obviously from *C. semioculata*.

**Types.** Holotype ♂: BOLIVIA, Cochabamba Dept., dwarf cloud forest 1 km E La Siberia, 3050 m, 17°47.63S × 064°44.70W, 12 Nov 1999; leg. K. Wolfe & C. Conlan; ab ovo., ex-♀ at lights, reared in CA on *Persea americana* by C. Conlan; em. 24 Jul 2000. Allotype ♀: Same locality data as holotype, wild-caught. Paratypes (2 ♂ and 3 ♀): 2 ♂, same locality and data as holotype, em. 2 ♀ 24 Jul 2000; 1 ♀, same data as allotype; 1 ♀, BOLIVIA, Cochabamba Dept., lower cloud forest E of Pojo, 2700 m, 17°46.12S × 065°42.04W, 1 Nov 1999; at MV & UV lights, leg. K. Wolfe & C. Conlan; 1 ♀, BOLIVIA, La Paz Dept., Rd. La Paz—Coroico, 2615 m, 07 Dec 1991, leg. G. Lecourt & T. Decaëns.

The holotype and allotype are placed in the collection of the Muséum national d'Histoire naturelle, Paris, France. Paratypes will remain in the following collections: K. Wolfe, 1 ♂, same data as holotype; 1 ♀, same data as holotype; 1 ♀, BOLIVIA, Cochabamba Dept., lower cloud forest E of Pojo, 2700 m, 17°46.12S × 065°42.04W; C. Conlan 1 ♂ same data as holotype; T. Decaëns, 1 ♀, BOLIVIA, La Paz Dept., Rd. La Paz—Coroico, 2615 m.

**Etymology.** This species is named for the translucent lunate discal spots on all four wings.

**Diagnosis.** This new species is closely allied with *C. semioculata*, with which it shares size, shape, markings, similar variable colors, habitat and midday nuptial flight in the male. In the eastern Andes of central Peru it can only be distinguished with certainty from *C. semioculata* by dissection of the genitalia, which present two obvious long spines on the ventral rim of the juxta, completely lacking in *C. semioculata*.

**Distribution.** As in *C. semioculata*, known specimens originate in eastern Andes in forest from 2000–3050 m, from north-central Peru to central Bolivia.

In Cochabamba Department, females we captured at lights in dwarf cloud forest at 3050 m oviposited in paper bags. Larvae were reared and three adult males of two color morphs were obtained. Although close to *C. semioculata*, the genitalia are easily distinguished.

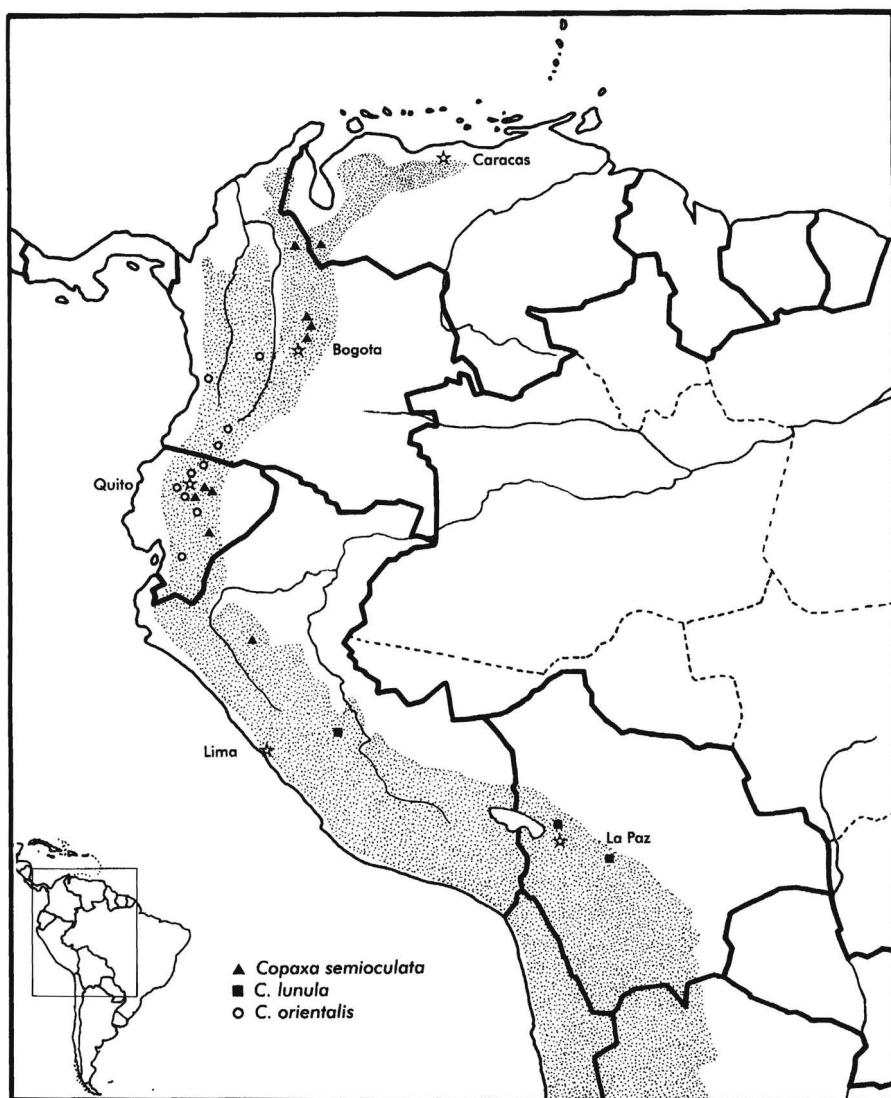


FIG. 22. Distribution map.

Thibaud Decaëns captured the first known female specimen in 1991 at 2615 m in mountains east of La Paz.

**Biology.** We observed more than 15 males flying at midday between 1145 h and 1235 h, but saw no others during several hours before and after this period. Males flew rapidly and erratically over the dwarf forest and would suddenly spiral into the moss-covered trees below when they apparently detected female pheromone. We searched the moss-covered trees and shrubbery for the mating pairs but were unsuccessful. A mercury vapor light placed at the site attracted four females throughout the ensuing night. Eggs were gathered and larvae were reared on *Persea americana*. Larvae reared outdoors fed for five months before pupation and pupal stage lasted about 3 months. Eggs

and all larval instars closely resembled those of *C. semioculata*, but darker with deeper colors, notably in last (fifth) instar (Fig. 15).

We believe midday sunshine is required for emergence and flight of this species. We waited for almost a week while mountains were shrouded in clouds before ascending to the summit on a clear day to search for this species. Colleagues collecting at same site during same dates but during frequently cloudy conditions did not attract females to lights.

#### ACKNOWLEDGMENTS

We thank Professor Gonzalo Andrade-C of the ICN-MHN for help with Colombian permits, Fernando Fernández, Researcher for the Alexander Von Humboldt Institute of Research and Carlos Saenz, Director of Iguaque Wildlife Refuge, for permits and lodging

at Iguaque Wildlife Refuge; José A. Clavijo A. of the Universidad Central de Venezuela for specimen loan; Diego Bonilla P. for information and specimens; Thibaud Decaëns for specimens, information, and photographic scans; Daniel Herbin for information and photographs, Mark Parsons and David Goodger of The Natural History Museum (BMNH, London), for information, photographs and access to the collection; Richard S. Peigler for literature; Brian Harris of the Natural History Museum of Los Angeles County for literature; Carlos Sarmiento, AAS's husband, for general collecting assistance in Colombia; Stefan Naumann, Wolfgang Naessig and Gerardo Lamas for information on Peruvian specimens, Gilbert Hodebert (MNHN) for map preparation.

#### LITERATURE CITED

- BOUVIER, E.-L. 1936. Étude des Saturnioïdes normaux, famille des Saturniides. Mém. Mus. natl. Hist. nat., Paris (n. sér. 3):1–350. 12 pl.
- DRAUDT, M. 1929. 1930. 12 Familie: Saturnidae [sic], pp. 713–827, col. pl. 101–137 and 142. In Seitz, A. Die Gross-Schmetterlinge der Erde, 6 (Die Amerikanischen Spinner und Schwärmer). A. Kernen, Stuttgart.
- FELDER, R. & A. F. ROGENHOFER. 1874. Reise der österreichischen Fregatte Novarra um die Erde in den Jahren 1857, 1858, 1859 unter den Befehlen des Commodore B. von Wüllerstorff-Urbair. Zoologischer Theil. Zweiter Band: Zweiter Abtheilung: Lepidoptera. Vienna. Pt. 4. 10 pp., pl. 75–107.
- LEMAIRE, C. 1971. Descriptions d'Attacidae (=Saturniidae) nouveaux d'Amérique centrale et du Sud (Lepidoptera). Tijdschr. voor Ent. 114, pp. 141–162, 19 fig., 12 phot. pl.
- . 1975. Description de neuf Attacidae sud-américains [Lep.]. Lambillionea, 75. pp. 55–61, 5 fig., 4 phot. pl.
- . 1978. Les Attacidae américains . . . The Attacidae of America (=Saturniidae) Attacinae, C. Lemaire. Neuilly, France. 238 pp. 49 pl.
- MICHENER, C. D. 1952. The Saturniidae (Lepidoptera) of the Western Hemisphere, morphology, phylogeny, and classification. Bull. Amer. Mus. Nat. Hist. 98:335–502, pl. 5.
- PACKARD, A. S. 1914. Monograph of the bombycine moths of North America, part 3 (edited by T. D. A. Cockerell). Mem. Natl. Acad. Sci. 12: IX + 1–516 pp., 113 pl.
- SONTTHONNAX, L. 1901. Essai de classification des Lépidoptères producteurs de soie. 3e fasc. Ann. Lab. Étud. Soie (Lyon) 10:61–132, 29 pl.
- WALKER, F. 1855. List of the specimens of lepidopterous insects in the collection of the British Museum, Part V. pp. 977–1257. By order of the Trustees, London.
- WOLFE, K. L. 1993. The *Copaxa* of Mexico and their immature stages (Lepidoptera: Saturniidae). Trop. Lepid. (Gainesville), 4 (Suppl. 1):1–26.

*Received for publication 22 March 2002; revised and accepted 5 September 2002.*