Revision of the *Copaxa semioculata* and *Copaxa medea* groups, with corrigenda of Wolfe et al. (2003a), descriptions of three new species, and notes on their early stages (Lepidoptera: Saturniidae)

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Abstract: The group of *Copaxa semioculata* ([C. &] R. Felder, 1874) is revised, notes on distribution and natural history are presented accompanied by photographs of adults, genitalia, immature stages and habitat. *Copaxa semioculata* is re-redescribed to correct an error in Wolfe et al. (2003a). Three new species are described, increasing the group to eight high altitude species: *Copaxa **intermediata*** **sp. n.** (holotype ♂ and allotype ♀ will be deposited in LACM, Los Angeles), *Copaxa **bella*** Wolfe, Naumann, Brosch, Wenczel & Nässig **sp. n.** (holotype ♂, will be deposited in ZMHU, Berlin), and *Copaxa **bachuea*** **sp. n.** (holotype ♂, in MNHN, Paris) from Ecuador, Peru and Venezuela + Colombia + Ecuador, respectively. *Copaxa medea* (Maassen, 1890) is removed from the group and placed in a separate, although probably related, monotypic group of its own caused by many morphological differences.

Una revisión de los grupos de *Copaxa semioculata* y *Copaxa medea*, con enmienda de Wolfe et al. (2003a), descripciones de tres especies nuevas y notas sobre sus estadios inmaduros (Lepidoptera: Saturniidae)

Resumen: Se revisa el grupo de *Copaxa semioculata* ([C. &] R. Felder, 1874) y se presenta notas sobre la distribución y la historia natural acompañadas por fotografías de adultos, sus genitales, estadios inmaduros y habitat. La *Copaxa semioculata* se vuelve a redescribir para corregir un error en Wolfe et al. (2003a). Se describen tres especies nuevas, aumentando el grupo a ocho especies de grandes altitudes: *Copaxa **intermediata*** **sp. n.** (el holotipo ♂ y alotipo ♀ se depositarán en LACM, Los Angeles), *Copaxa **bella*** Wolfe, Naumann, Brosch, Wenczel & Nässig **sp. n.** (el holotype ♂ se depositará en ZMHU, Berlin) y *Copaxa **bachuea*** **sp. n.** (el holotipo ♂ en MNHN, Paris) del Ecuador, del Peru y de Venezuela + Colombia + Ecuador, respectivamente. La *Copaxa medea* (Maassen, 1890) se separa del grupo y se pone en su propio grupo probablemente cercano pero monotípico, basado en muchas diferencias morfológicas.

Revision der Artengruppen von *Copaxa semioculata* und *Copaxa medea*, mit Korrekturen zu Wolfe et al. (2003a), Beschreibung von drei neuen Arten und Anmerkungen zu den Präimaginalstadien (Lepidoptera: Saturniidae)

Zusammenfassung: Die Artengruppe von *Copaxa semioculata* ([C. &] R. Felder, 1874) wird revidiert. Neben Anmerkungen zur Verbreitung und Biologie werden Abbildungen der Imagines, der Genitalien, der Präimaginalstadien und der Biotope gegeben. *Copaxa semioculata* wird ein zweites Mal nachbeschrieben, um einen Fehler bei Wolfe et al. (2003a) zu beheben. Drei neue Arten werden beschrieben, wodurch die Gruppe auf insgesamt acht Hochgebirgsarten anwächst: *Copaxa **intermediata*** **sp. n.** (Holotypus ♂ und Allotypus ♀, werden ins LACM, Los Angeles, gelangen) aus Ecuador, *Copaxa **bella*** Wolfe, Naumann, Brosch, Wenczel & Nässig **sp. n.** (Holotypus ♂, wird später ins ZMHU, Berlin, gelangen) aus Peru und *Copaxa **bachuea*** **sp. n.** (Holotypus ♂, in MNHN, Paris) aus Venezuela, Kolumbien und Ecuador. *Copaxa medea* (Maassen, 1890) wird aus der *semioculata*-Artengruppe ausgeschlossen und in eine separate, wenn auch wahrscheinlich noch damit verwandte, monotypische solche Gruppe gestellt, da sie in vielen morphologischen Aspekten von der *semioculata*-Gruppe abweicht.

Introduction

The group of *Copaxa semioculata* ([C. &] R. Felder, 1874) presently encompasses eight species of high to very high altitude distribution in the Andes of South America, from Venezuela south to central Bolivia (see distribution map). The group has usually included *Copaxa medea* (Maassen, 1890), very distinct morphologically in the adult and larva from all the others, for which it should best be considered as the sole member of its own group.

Members of both groups have historically been placed in genus or subgenus *Saturniodes* (Jordan, 1911) and/or *Sagana* Walker, 1855. Michener (1952) combined *Saturniodes* and *Sagana* with *Copaxa* Walker, 1855, but inexplicably preserved their status as subgenera. Presenting a detailed general anatomical description of genus *Copaxa*, Michener included a key to separating the three subgenera, but apparently ignored or did not examine the species *semioculata*. It is not clear which species he included in the subgenera except for *Sagana* which he invested with a single species, *sapatoza* (Westwood, [1854]). Lemaire (1978) discarded Michener's model and synomymized the three subgenera with *Copaxa*.

Several other species of the *C. semioculata* group were recently described or reclassified (Wolfe et al. 2003a), but a flurry of findings since then require a revision of our former conclusions and the systematics of this group. It should also be pointed out that an important obstacle to our previous effort was the impossibility of sharing the scarce specimens between the various authors due to governmental restrictions.

Adults of the *C. semioculata* group appear to be most closely related to the *Copaxa canella* Walker, 1855 group, whose species possess a single, rounded translucent discal spot narrowly surrounded by yellow and black. In the present group, this single discal spot on each wing is crescent- or modified crescent-shaped, thus differing from all other *Copaxa* species.

Adults of *C. medea* possess a rounded discal spot on each wing, but differ from all other *Copaxa* by possessing

bold white markings including a white outer border of the postmedial line of the wings.

Larvae of the *C. semioculata* group are distinguished by having the dorsal scoli of the second and third thoracic segments fused together on each segment to collectively form a narrow dorsal thoracic peak (Fig. 61), unique among *Copaxa* larvae. Additionally, the dorsal, forward-arching spines typical of *Copaxa* larvae are prominent, broadly flattened and somewhat rounded in this group, colored red, pink or white. Otherwise, larvae closely resemble those of the *C. canella* group, with the central bristle on many scoli consisting of a long black club-tipped whip.

Larvae of the *medea* group have the dorsal scoli of the 2nd and 3rd thoracic segments widely separated atop short, stout tubercles (Fig. 62). The forward-arching dorsal spines are narrow, white, and typical of *Copaxa*.

Previous lack of specimens, especially of day-flying ♂♂, led to Lemaire's (1978: 194) assertion of no sexual difference in coloration in this group. There is actually strong sexual dimorphism in shape and coloring in the day-flying species cluster of the *C. semioculata* group. In *Copaxa medea* there is a pale tan ♀ form (Fig. 19) almost totally lacking the ♂ markings.

The *C. semioculata* group appears to be divided into two major lines, based on adult morphology (Table 1):

- In the first line, which is mainly nocturnal and includes *Copaxa semioculata, C. intermediata* sp. n., *C. orientalis* Lemaire, 1975 and *C. sapatoza*, the ante- and postmedial lines of the hindwing reach the costa usually without meeting. The darker median area between often extends to the costa also. On the abdomen, the stigmata are widely surrounded by dark scales (Fig. 58). ♂♂ fly soon after dark, except in *C. semioculata,* whose ♂♂ are diurnal. There is very little sexual dimorphism.
- The second line, mostly of species known to have diurnal ♂♂, with *Copaxa lunula* Wolfe & Conlan, 2003, *C. bella* sp. n., *C. bachuea* sp. n., and *C. herbuloti* Lemaire, 1971 can easily be distinguished by the trajectory of the ante- and postmedial lines of the hindwing, which meet just distad of the discal spot, forming a dark median area that does not nearly reach the costa. Sexual dimorphism is strong. ♂♂ fly at midday, except in *C. herbuloti*, whose hour of nuptial flight is uncertain.

Table 1: Diurnal flight activity of the sexes of the *Copaxa* species of the *semioculata* and *medea* groups.

***Copaxa semioculata* group**		
Line of nocturnal ♂♂	**Male**	**Female**
C. intermediata	nocturnal	nocturnal
C. orientalis	nocturnal	nocturnal
C. semioculata	diurnal	nocturnal
C. sapatoza	nocturnal	nocturnal
Line of diurnal ♂♂		
C. bella	diurnal	nocturnal
C. lunula	diurnal	nocturnal
C. bachuea	diurnal	nocturnal
C. herbuloti	nocturnal?	nocturnal
***Copaxa medea* group**		
C. medea	nocturnal	nocturnal

Collections cited:

BMNH The Natural History Museum (formerly British Museum [Natural History]), London, U.K.

CAAB collection Angela Amarillo, Bogotá, Colombia

CBH collection Brosch, Hille, Germany

CBWK collection Bernhard Wenczel, Kloten, Switzerland

CCCE collection Christopher Conlan, Escondido, California, U.S.A.

CCMC collection Carlos Mielke, Curitiba, Brazil

CDHP collection Daniel Herbin, Péchabou, France

CFMP collection Frank Meister, Prenzlau, Germany

CJLC collection J. F. LeCrom, Bogotá, Colombia

CKWE collection Kirby Wolfe, Escondido, California, U.S.A.

CSNB collection Stefan Naumann, Berlin, Germany

CTDR collection Thibaud Decaëns, Rouen, France

CTFL collection Thomas Frankenbach, Lindenberg, Germany

ICNM Instituto Colombiano Nacional Museo de Historia Natural, Bogotá, Colombia

IZAA Instituto Zoología Agrícola, Fac. Agronomía, Maracay, Venezuela

LACM Natural History Museum of Los Angeles County (formerly Los Angeles County Museum), Los Angeles, California, U.S.A.

MHNL Museo de Historia Natural, Lima, Peru

MNHN Muséum national d'histoire naturelle, Paris, France

NHMS Natural History Museum, Santa Cruz, Bolivia

ZMHU Museum für Naturkunde der Humboldt-Universität zu Berlin (formerly Zoologisches Museum der Humboldt-Universität), Germany

Copaxa semioculata group

Line 1 with mainly nocturnal males

Copaxa semioculata ([C. &] R. Felder, 1874)

Sagana semioculata [C. &] R. Felder (1874: 8, pl. 87, fig. 4).

Saturniodes semioculata (Felder): Draudt (1929: 723, pl. 104, a); Schüssler (1933b: 152).

Copaxa semioculata (Felder): Bouvier (1936: 186).

Copaxa semioculata (R. Felder & Rogenhofer), *partim:* Wolfe et al. (2003a: 54–61, figs. 1, 3, 17, 18, 22 [re-description]).

Specimens examined: Venezuela. Lectotype ♀, (BMNH), [identity and origin inconclusive]. — **Colombia.** 1 ♂, (near Venezuela border), 22. xii. 1993, J. F. LeCrom (CJLC); 1 ♂, Cundinamarca, Represa El Sisga, 4. i. 1968, J. Cayon, ICNL 7754 (ICNM); 1 ♂, Cundinamarca, 3300 m, 12. xi. 1995, J. F. LeCrom (CAAB); 1 ♀, Cundinamarca, Bogotá, Rd. Bogotá–Tunja, Villa Pinzón, 3100 m, ix. 1999, D. Bonilla (CTDR); 2 ♂♂, Cundinamarca, Rd. Bogotá–

Tunja, Chacontá, 2600 m, VII. 2001, at UV light + virgin ♀ of *sapatoza,* Decaëns & Bonilla (CKWE & CTDR); 1 ♂, Boyacá, Santuario Nacional de Flora y Fauna de Iguaque, 2990 m, 22.–24. IV. 2000, K. & S. Wolfe (CKWE); 2 ♀♀, Cundinamarca, 49 km N of Bogotá, 1.6 km S of Represa El Sisga, 2750 m, K. Wolfe, D. Bonilla, T. Decaëns & L. D. Ramírez (CKWE & CTDR).

Copaxa semioculata was described from one or more ♀ specimens from "Venezuela" whose history is murky. A ♀ specimen from the Felder and W. Rothschild collections in The Natural History Museum (BMNH, London) was designated lectotype by Lemaire (1978). Wolfe et al. (2003a) argued that if the original specimen had indeed been collected in Venezuela, it would have doubtfully been conspecific with the larger Ecuadorean taxon specified as *C. semioculata* by Lemaire (1975), as the Ecuadorean taxon has not been found in Venezuela nor even Colombia. Rather, a smaller taxon found on the Colombian highland plateau, in which the ♂ is apparently diurnal, has been collected near the border with Venezuela, and could reasonably be expected to be found in Venezuela.

In transferring the name *semioculata* from the Ecuadorean to the Colombian taxon in 2003, we inadvertently combined two species, which later became apparent as various new specimens of the *semioculata* group were collected and reared and genitalia were compared. One of the two species, *C. semioculata*, belongs to the nocturnal line of the group, judging by its original illustration, while the other, *Copaxa bachuea* sp. n., belongs to the line with diurnal ♂♂. However, both of these species are diurnal. Careful examination of the specimens reveals that those captured flying at midday by J. F. LeCrom (pers comm.) belong to the newly redescribed *C. semioculata* while the single orange male captured by Angela Amarillo at 16:00 h will be named *C. bachuea*. In Wolfe et al. (2003*a*), Figs. 1 and 3 are photographs of the ♂ and ♀ of *C. semioculata*, whereas the eggs and larvae identified as those of *semioculata* actually belong to *C. bachuea*. In the present study, the ♂ and ♀ of *C. semioculata* are illustrated in Fig. 5 and Fig. 6, respectively.

Re-redescription

♂ (Figs. 5, 29): Head dark brown, eyes large. Antennae with brownish yellow shaft and dark brown rami, quadripectinate. Thorax dark brown or reddish brown, with indistinct yellow collar. Tibia brownish pink with long beige hairs, tarsi brighter pink. Abdomen dark reddish brown, lighter ventrally, with darker-ringed stigmata. Forewing length 35–51 mm, falcate; apex rounded. Dorsal background color dark orange brown, pink basally and along border of costa of hindwing; dark gray or black scales shade the median and especially the distal outer border; tornus lighter, yellowish; ante- and postmedial dark lines indistinct, and on hindwing do not connect distad of discal spot, proceeding separately to the costa; submarginal band of hindwing a series of U-shaped black dashes edged faintly white on outer edge. Apical spot small, gray with white on apical edge; trace of white second spot caudad to first. Lunate hyaline discal spot narrow, obscurely bordered first narrowly black then broader dark yellow and again narrowly black. Underside mostly dark, similar to dorsal color, with a beige band over the zigzag post-medial line; discal lunate spots bordered black; dashes of submarginal band beige.

♂ **genitalia** (Fig. 67) similar to *C. orientalis* (Fig. 69) (these illustrated as *C. semioculata semioculata* by Lemaire 1978: 197, fig. 156), 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.

♀ (Figs. 6, 30). Head dark brown with some yellow hairs, palpi dark brown. Antennae dull yellow, bipectinate. Thorax pale brown with long yellow hairs and yellow tuft collar. Tibia dark brown, tarsi pinkish. Abdomen gray with yellow hairs. Forewing length 44–51 mm, wings broadly rounded; ground color grayish beige finely speckled with black and yellow scales, brigher yellow on the tornus without black scales; antemedial and wavy postmedial lines dark gray; costal border dark gray; single apical spots as in ♂. Hindwing like forewing but paler, with darker area between ante- and postmedials; pattern as in ♂; rest of wing 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 ♂; forward area of wing pale, pink in some specimens. Discal spots as in ♂, surrounded by yellow and gray or black. Underside of wings, base to median and narrow border, medium brown with outer half pale brown, all finely speckled yellow and black.

♀ **genitalia** (Fig. 76) similar to *C. intermediata*, but smaller and without sclerotization of the prevaginal lamella.

I have examined five male and two female specimens and the photographs of one ♂ and one ♀, collected at points ranging from the Venezuelan border with Colombia southwest to the Bogotá area. Two of the above ♂♂ were apparently attracted to pheromone of a virgin ♀ *Copaxa sapatoza* at bright lights (D. Bonilla & T. Decaëns, pers. comm.), one of which copulated with her (with unproductive results); two ♂♂ were captured flying at midday; one came to lights at dusk; and the history of one was unknown.

Attempts to gather eggs for rearing were not successful, and immature stages are not known.

Copaxa intermediata sp. n.

Copaxa (*Saturniodes*) *semioculata* (C. & R. Felder): Lemaire (1975a: 94).

Copaxa semioculata semioculata (C. & R. Felder): Lemaire (1978: 197, pl. 44, fig. 1 ♂).

Copaxa semioculata semioculata (C. Felder & Rogenhofer): Lemaire (1996: 48).

Copaxa orientalis Lemaire, *partim:* Wolfe et al. (2003a: 55) [misidentification].

Holotype: ♂, Ecuador, Azuay Prov., 22 km W. of Cuenca,

2°47.06′ S, 79°10.07′ W, 3474 m, 30. XII. 2002, K. & S. WOLFE, Wm. KELLY, (CKWE, finally LACM).

Paratypes (2 ♂♂, 4 ♀♀ in total): All **Ecuador.** Allotype ♀, Cotopaxi Dept., ca. NE Latacunga, 0°41.62′ S, 78°33.25′ W, 3328 m, 5. I. 2003, K. & S. WOLFE, Wm. KELLY, (CKWE, finally LACM). 1 ♀, Cotopaxi Dept., ca NE Latacunga, 3151 m, 10. III. 1995, K. & S. WOLFE, (CKWE, finally LACM). 2 ♂♂, 2 ♀♀, Azuay Dept., W of Cuenca, 3385–3700 m, O. T. BARONI (BMNH).

Further specimens, not included in paratype series: All **Peru:** 1 ♂, Amazonas, Achupas, 3100 m, 10. v. 1999, (MNHN). 1 ♂, Amazonas, Achupas, 3200 m, 12.–14. VIII. 2000, genitalia no. 908/03 NAUMANN, (CTFL).

Etymology: The new species' name is *Copaxa intermediata* because of its intermediate size and color between *C. semioculata* and *C. orientalis*.

When WOLFE et al. (2003a) removed this taxon from *C. semioculata semioculata,* they placed it provisionally with *C. semioculata orientalis* while they raised *C. orientalis* to species level. Both this taxon and *C. orientalis* have now been reared and studied at greater depth, and based on larval and adult morphology, habitat and habits, should be separated.

This species is very similar to *C. orientalis* but can be identified by its smaller size, rounded forewing tips, larval color and spination, and distribution. ♀♀ of this species come to the lights as often as ♂♂, whereas ♀♀ of *C. orientalis* rarely come to lights. In three nights we captured one ♂ and two ♀♀ of *C. intermediata* in Ecuador. In the BMNH (London) a series of specimens from west of Cuenca contains a number of ♀♀. *Copaxa intermediata* is found mainly in the Andean Corridor of Ecuador and adjacent Peru, from 3000 to 4000 m on the more sheltered central valley side of the mountains in slight rain shadow. It is reported to feed on *Brachiotum ledifolium* (GARA & ONORE 1989), a member of the Melastomataceae family, unlike *C. orientalis*. Captive larvae fed well on avocado but also accepted *Tibouchina semidecandra* (Melastomataceae) on which they did not thrive. Immature stages are very similar to other members of the *C. semioculata* group and cocoon is partially sealed open mesh (Fig. 39). Last instar larva (Fig. 52) differed from that of *C. orientalis* by color and spination. Larva is bluish with narrow, white, forward-arching dorsal spines, while the larva of *C. orientalis* is green with broad, white, paddle-shaped arching spines. Reared adult ♂♂ flew soon after dark as did the single wild ♂ I collected at lights.

Adults have been previously described by LEMAIRE and others as *C. semioculata*, and are colored much like *C. orientalis.*

♂ (Figs. 3, 26). Head dark brown, eyes large. Antennae with yellowish shaft and light brown rami, quadripectinate. Thorax dark brown with some yellow hairs; indistinct yellow collar. Tibia dark brown, tarsi pinkish. Abdomen dark brown, lighter ventrally, with darker-ringed lateral stigmata. Forewing length 54–58 mm, falcate; apex rounded. Dorsal background color brown with a darker median band, the whole suffused with black and yellow, appearing greenish in fresh specimens. Tornus and adjoining submarginal area honey-colored without black scales; ante- and postmedial black wavy lines clearly distinct, and on hindwing do not connect distad of discal spot, proceeding separately to the costa; submarginal band of hindwing a series of U-shaped black dashes edged faintly white on outer edge. Two apical spots large, black with white on apical edge. Lunate hyaline discal spot narrow, obscurely bordered first narrowly black then broader dark yellow and again narrowly black. Underside dark, purplish brown from base to median; a broad pinkish beige band over the zigzag postmedial line; dark orange-brown marginal area. Discal lunate spot bordered black; dashes of submarginal band pinkish beige.

♂ **genitalia** (Fig. 68) similar to *C. orientalis* (Fig. 69) (these illustrated as *C. semioculata semioculata* by LEMAIRE 1978: 197, figs. 156, 157), with long hooks on each arm of the transtilla. The vesica evaginates dorsally.

♀ (Figs. 4, 27, 28). Similar to ♂ but paler, more tan. Antennae dull yellow, bipectinate. Wings broad, not falcate. Forewing length 54–60 mm, pattern as in ♂. Underside of wings variable, usually dark brown at the base gradually fading to pinkish beige near the margin, with most displaying strong broad antemedial and narrow wavy postmedial lines with a narrow medial band and margin, all dark brown. U-shaped submarginal dashes pinkish beige.

♀ **genitalia** (Fig. 77) similar to *C. orientalis*, but prevaginal lamella not as elaborate nor as sclerotized.

Figs. 1–17: *Copaxa* specimens of the group of *Copaxa semioculata*, uppersides. — **Figs. 1–2:** *C. orientalis.* **Fig. 1:** ♂, Colombia, Caldas, ca. Nevado del Ruiz, 3550 m, 10. VII. 2002. **Fig. 2:** ♀, Colombia, Tolima, Municipio Cajamarca, Anaime Reserve, 3310 m, 28. III. 1995. — **Figs. 3–4:** *C. intermediata.* **Fig. 3:** holotype ♂, Ecuador, Azuay Dept. Hotel, 22 km W. of Cuenca, 3474 m, 30. XII. 2002. **Fig. 4:** allotype ♀, Ecuador, Cotopaxi Dept., ca. NE Latacunga, 3328 m, 5. I. 2003. — **Figs. 5–6:** *C. semioculata.* **Fig. 5:** holotype ♂, Colombia, Cundinamarca, Villa Punzón, 2900 m, v. 2001, D. BONILLA, genitalia no. 84/01 WOLFE (LACM). **Fig. 6:** allotype ♀, Colombia, Boyacá Dept., 49 km N of Bogotá, 1.6 km S of Represa del Sisga, ca. Chocontá, 2750 m, 9. VII. 2002, K. WOLFE, D. BONILLA, T. DECAËNS, L. D. RÁMIREZ, genitalia no. 107/05 WOLFE (LACM). — **Figs. 7–8:** *C. sapatoza.* **Fig. 7:** ♂, Colombia, Cundinamarca, Bogotá, Barrio Soacha, 2900 m, ex larva on *Alnus* sp., v./VI. 2001, D. BONILLA. **Fig. 8:** ♀, Colombia, Cundinamarca, Bogotá, Barrio Cajika, 2700 m, ex larva on *Alnus* sp., Autopista Norte (to Tunja) center divide, v./VI. 2001, D. BONILLA. — **Figs. 9–10:** *C. herbuloti* **Fig. 9:** ♂, Peru, Pasco, Oxapampa, ca. 22 km E of town, 2600 m, 23. v. 2003, leg. K. L. WOLFE, C. CONLAN & J. CISEKI. **Fig. 10:** ♀, reared ex ♀ with same data, K. WOLFE. — **Figs. 11–12:** *C. lunula.* **Fig. 11:** paratype ♂, Bolivia, Cochabamba Prov., 1 km E of La Siberia, 12. XI. 1999, K. WOLFE & C. CONLAN, reared ex ♀ by C. CONLAN. **Fig. 12:** paratype ♀, same data as ♂, wild caught. — **Figs. 13–15:** *C. bella.* **Fig. 13:** paratype ♂, Peru, Pasco, Oxapampa, ca. 22 km E of town, 2600 m, 27. v. 2003, leg. K. L. WOLFE, C. CONLAN & J. CISEKI. **Fig. 14:** paratype ♂, reared ex ♀, same locality. **Fig. 15:** paratype ♀, reared ex ♀, same locality. — **Figs. 16–17:** *C. bachuea*. **Fig. 16:** holotype ♂, Colombia, Boyacá, Santuario Nacional de Flora y Fauna de Iguaque, 2900 m, 5. I. 1992, A. AMARILLO, genitalia no. 65/00 WOLFE (MNHN). **Fig. 17:** paratype ♀, same locality, 24.–26. IV. 1998. — All specimens except holotypes and allotypes are in CKWE.

Copaxa orientalis Lemaire, 1975

Copaxa (Saturniodes) semioculata orientalis Lemaire, (1975b: 55, fig. 1 ♂).

Copaxa semioculata orientalis Lemaire: Lemaire (1978: 198, pl. 44, fig. 2 ♂), (1996: 48).

Copaxa orientalis Lemaire, *partim:* Wolfe et al. (2003a: 55).

Specimens examined: Holotype ♂, **Ecuador,** Oriente, Cotopaxi, route de Salcedo napo, km 49, 3500 m, 5.–7. i. 1975, (MNHN). – **Ecuador:** 27 ♂♂, Napo Prov., 49 km on Rd. Salcedo–Tena, 3450 m, 7./8. v. 2000, GPS 0°59.65′ S, 78°18.80′ W, K. & S. Wolfe, C. & M. Conlan, (CKWE, CCCE). – **Colombia:** 17 ♂♂, 1 ♀, Tolima, Municipio Cajamarca, Anaime Reserve, 3310 m, 29. iii. 1995, K. & S. Wolfe, A. Amarillo & C. Sarmiento, (CAAB, CKWE, ICNM; LACM). 15 ♂♂, Caldas, ca. Nevado del Ruíz, 3550 m, 10. vii. 2002, K. Wolfe, T. Decaëns & D. Bonilla, (CKWE, CTDR)

This large *Copaxa* is found at high altitude to at least 4200 m above sea level, from the western cordillera of Colombia south, in Ecuador mostly in the eastern Andes at the upper tree limit in humid chaparral to south central Ecuador. Adults (Figs. 1, 2, 22, 23) are almost identical to *Copaxa intermediata* of Ecuador but are much larger and occupy a different habitat. Other morphological differences include the more squared forewing tips of *orientalis*, almost as if cut off with scissors, especially in the ♀. It is notable that ♀♀ of *orientalis* rarely come to lights whereas in *intermediata* as many ♀♀ as ♂♂ are attracted to lights.

Adults begin to fly about a half hour after dark, and continue for about one and a half hours. We caught 27 ♂♂ and no ♀♀ in two nights in Ecuador. In Colombia, we caught 17 ♂♂ and 1 ♀ in two nights. At another location in Colombia, a restaurant worker at a mountain hot spring caught dozens of ♂♂ at the lights over several months, but only two ♀♀.

Immature stages are typical of the group (Figs. 46–51) and cocoon is similar to that of *C. intermediata*. Larvae fed well on avocado. Last instar larva (Fig. 51) is mostly green with broad, white paddle-shaped forward arching dorsal spines. A wild-caught fourth instar larva was more brightly colored, with large triangular deep red patches bordered yellow just cephalad of spiracles. It was feeding on an unidentified common bush at that altitude with pink and white berries similar to blueberries in size and shape.

Genitalia (Figs. 69, 78) similar to *C. intermediata*, but larger, more sclerotized. In ♂, vesica evaginates dorsally and in ♀, prevaginal lamella very large, sclerotized.

Copaxa sapatoza (Westwood, [1854])

Saturnia sapatoza Westwood, (1853: 163, pl. 33, fig. 1 ♂).

Sagana sapatoza (Westwood): Draudt (1929: 722, pl. 103, c, ♂, ♀); Schüssler (1933b: 150).

Copaxa (*Sagana*) *sapatoza* (Walker) [sic]: Michener (1952: 485, figs. 91 & 394–397).

Copaxa sapatoza (Westwood): Lemaire (1978: 195, pl. 43, fig. 2 ♂), (1996: 48).

Specimens examined: Dozens of specimens of this uncontested species were examined in major museums, all from 2600–3000 m in Cundinamarca and Boyocá provinces of Colombia.

Copaxa sapatoza was recently rediscovered in Colombia (Wolfe et al. 2003b), where it is endemic but had not been seen by saturniid specialists for about 50 years. Diego Bonilla and Luz Dary Ramírez found eggs, cocoons and larvae on the ubiquitous alder tree of the extensive Sabana of Bogotá, the remains of a huge prehistoric lake, where alder trees (*Alnus acuminata*) dominate. Later when I joined them we even found larvae feeding on alder in the median of a freeway in the outskirts of Bogotá. Further northeast, with Thibaud Decaëns joining us, we found many eggs on sprouting branches at the base of fence posts of alder wood surrounding potato fields and pastures. On a tree by our roadside restaurant I found a perfect newly emerged ♂ hanging from its cocoon and extending its wings. This is a very common species inhabiting open spaces where collectors would not normally expect to find anything of interest, in riparian remnants and developed agricultural areas of the central Andean valley from Bogotá northeast at least ca. 100 km to Duitama, from 2600–3000 m elevation. Although its hostplant occurs commonly at higher and lower elevations, *C. sapatoza* has not been found there.

Most large alder trees are too poisonous for the larvae and their leaves are usually fatal when eaten by them, but certain large and most small trees are tolerated and are chosen by the ♀♀ for egg deposition. Adults fly soon after dark for about an hour and a half.

Larvae in captivity fed well on sapling leaves of *Alnus rhombifolia* and on *Persea americana* and grew normally. Eggs were atypically solid white. Last instar larva (Fig. 53) was typical for the *C. semioculata* group. Forward-arching dorsal spines are broad, pointed and pink. Cocoon with sealed mesh (Fig. 41), fastened mostly horizontally on small branch, wrapped in a leaf.

There are many specimens of *C. sapatoza* in the museums of the world, and identity of this taxon is unquestioned. Adult coloration (Figs. 7, 8, 20, 21) varies from bright yellow to dark green-appearing, due to the proportion of black to yellow scales present. Reared specimens or specimens obtained from wild-collected cocoons kept at higher than normal temperatures are brighter yellow than wild-caught specimens, which are much darker and greenish. There is also variable intensity and distribution of pink along the base and tornus of the forewing and the costa and angle of the hindwing and other parts. *C. sapatoza* belongs to the nocturnal line of the species group, and possesses dark stigmata on the abdomen.

Genitalia (Figs. 73, 80) are typical for the group, ♂ without hooked projections on arms of the transtilla, aedeagus evaginates ventrally.

Line 2 with diurnal males

Copaxa herbuloti Lemaire, 1971

Copaxa (*Sagana*) *herbuloti* Lemaire, (1971: 144, fig. 4 & pl. 3, fig. 6 ♂).

Copaxa (*Sagana*) *herbuloti* Lemaire: Lemaire (1975a: 94).

Copaxa herbuloti Lemaire: Lemaire (1978: 196, pl. 43, fig. 3 ♂), (1996: 48); Wenczel & Nässig (2003: 205, figs. 1–3 ♀).

Specimens examined: All **Peru:** holotype ♂, "Huancabamba", (MNHN). – 3 ♂♂, 1 ♀, Pasco, Oxapampa, ca. 22 km E of town, 2600 m, "La Antena", 10°38.23′ S, 75°17.25′ W, 25.–31. v. 2003, leg. K. L. Wolfe, C. Conlan & J. Ciseski, (CKWE, CCCE).

Since its description in 1971, this species has been known from a single ♂ specimen, labeled "Huancabamba, Peru", which Lemaire erroneously assigned to Piura Department because it was the only Huancabamba he could find in his atlas (pers. comm.). It was more than likely collected in Huancabamba, Pasco Department, where three Swiss immigrant brothers named Böttger collected thousands of lepidoptera specimens for European collectors in the late 1880's. The grandson of one, José Bottger, living in Oxapampa very near Huancabamba, and B. Wenczel (Switzerland) recently collected the first ♀ specimens of this species, three of which are illustrated in Wenczel & Nässig (2003).

With J. Bottger we collected three ♂♂ of *C. herbuloti* at our lights the first night, while using a reared virgin ♀ of *Copaxa bella* sp. n. that had emitted pheromone throughout the afternoon too late to attract a noon-flying ♂ of her own species. These were the first ♂♂ of C. *herbuloti* seen by Bottger during five years of moth lighting there, and he was astonished. He had captured eight ♀♀ during that time.

Larvae obtained from the eggs of one wild-caught ♀ reluctantly accepted *Persea americana* and no adult ♂♂ emerged correctly. Larvae from another ♀ refused to feed normally on *Persea* and quickly perished. Last instar larva (Fig. 54) with forward arching spines very broad, slightly pointed, white; cocoon (Fig. 40) dark reddish brown, very open stiff mesh.

♂ (Figs. 9, 31). Head purplish brown, eyes large. Antennae dark yellowish brown, quadripectinate. Thorax dark purplish brown, with narrow yellow collar. Tibia and tarsi purple. Abdomen dark purple, lighter ventrally, without darker-ringed stigmata. Forewing length 42 mm, falcate; apex rounded. Dorsally orange brown on forewing, with yellow on tornus and antemedial area; median area darker, more purplish, submarginal band subtle bluish gray; postmedial line indistinct. Discal spot is unique for the group, wider and more distorted than in any other species, without obvious border. Hindwing dull dark pink, brighter at base and along costa; dark brown ante- and post-median lines connect distad to discal spot with kidney-shaped area between darker purplish; marginal area orange; U-shaped dashes blurred, dark brown. Underside is unique among *Copaxa*. Most of entire underwing dull purplish red, changing to orange-brown on the hindwing border area; submarginal band on the forewing bluish, lines bluish, dashes bluish.

♂ **genitalia** (Fig. 74): Only short, rudimentary projection from arms of the transtilla, unlike most members of the group; uncus broad and short, with short, widely spaced projections; aedeagus typical but vesica evaginates ventrally, unlike all other members of the group.

♀ (Figs. 10, 32). Antennae dull yellow, bipectinate. Forewing length 44–52 mm. Dorsal pattern as in ♂, with no obvious ante- and postmedial lines, but color much paler, ranging from dull beige to dull purplish brown, pale dull pink on base with light gray on postmedial area, especially ventrally. Wings thinly scaled and translucent.

♀ **genitalia** (Fig.78): Typical, but prevaginal lamella not sclerotized.

This species belongs to the line of diurnal ♂♂, although we do not know whether *C. herbuloti* ♂♂ are diurnal or nocturnal. They may be crespuscular. Adults are very thinly-scaled on the wings and have little scaling on the legs, probably an adaptation to the extremely wet cloud forest habitat in which they live. All specimens we know of were taken in a small area near Oxapampa, on the wettest mountaintop areas at 2600 m.

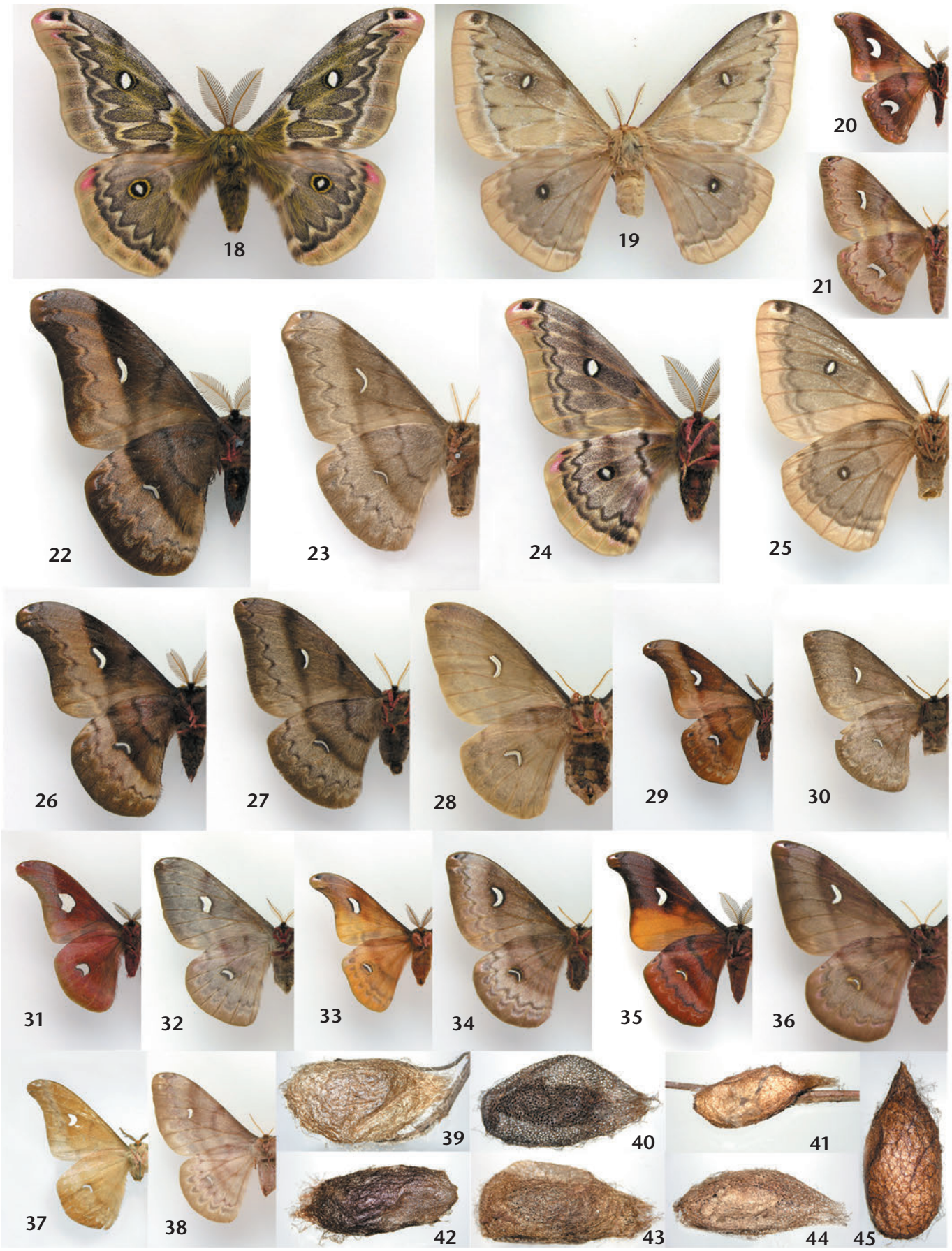
Copaxa bella Wolfe, Naumann, Brosch, Wenczel & Nässig sp. n.

Copaxa lunula Wolfe & Conlan, 2003 *in* Wolfe et al. (2003a: 59–60, fig. 22, map), *partim* [misidentification].

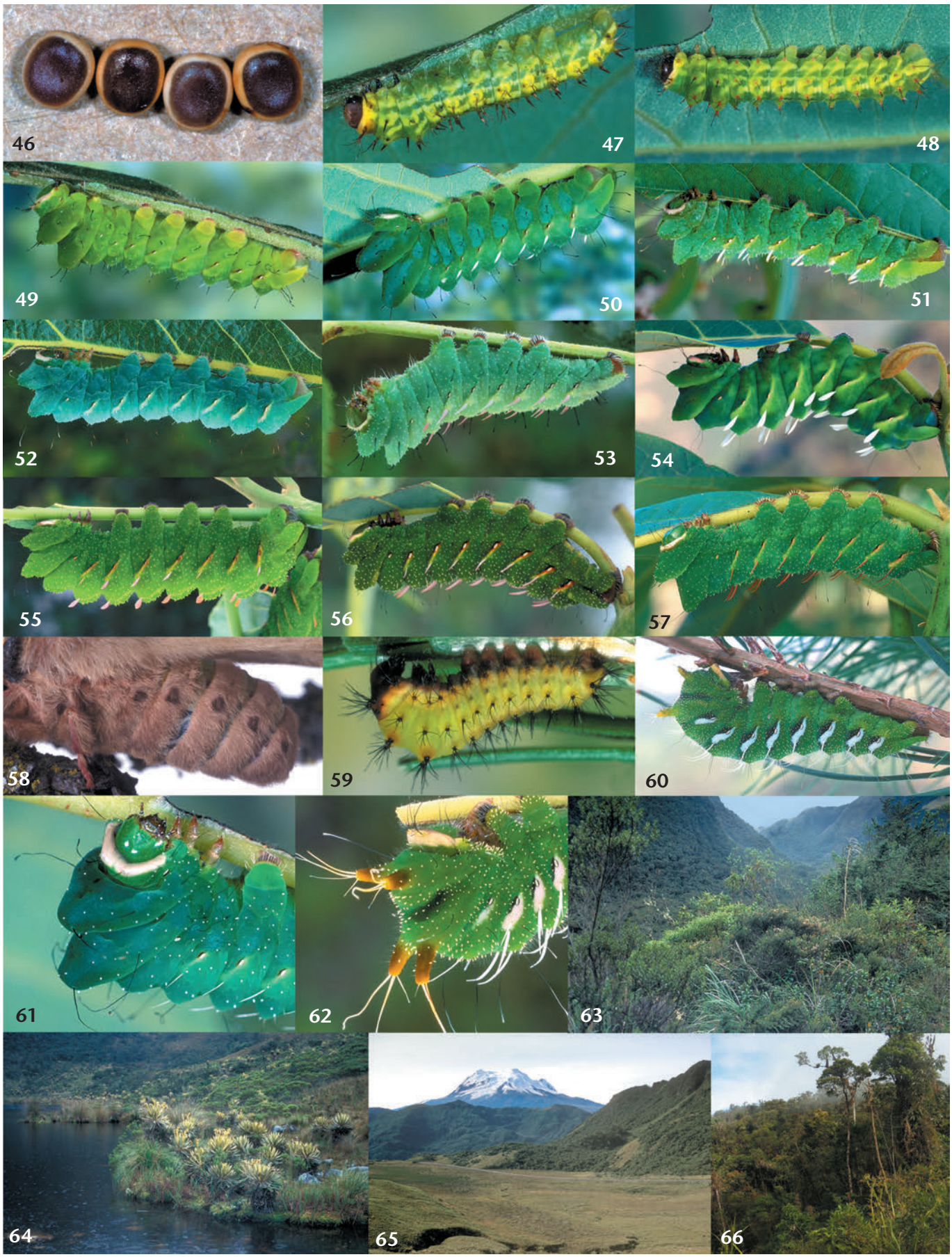
Holotype: ♂ (Figs. 85–87), Peru, Junin province, Satipo, Calabaza, 2000 m, 12. vii. 2001, leg. Bernhard Wenczel, genitalia prep. no. 602/01 Naumann, ex CBWK. The holotype will be deposited in ZMHU, Berlin, when further work on the genus is finished.

Paratypes (5 ♂♂, 10 ♀♀ in total): All **Peru:** 1 ♀, allotype (Figs. 88–90), Pasco province, Oxapampa env., 2511 m, 10°38′15.1″ S, 75°17′14.2″ W, humid forest, ix. 2002, José Bottger, received via B. Wenczel, genitalia no. 0356 CBH = 880/03 Naumann, ex CBH, (will be deposited in ZMHU). – 3 ♂♂, Pasco, Oxapampa, ca. 22 km E of town, 2600 m, "La Antena", 10°38.23′ S, 75°17.25′ W. Came to virgin ♀ 11:35 h, 27. v. 2003, leg. K. L. Wolfe, C. Conlan & J. Ciseski, (MNHL, CKWE). 1 ♀, same locality as previous, 2. vi. 2003, (CKWE). 1 ♂, 3 ♀♀, Pasco, ca. Oxapampa, 2500 m, José Bottger eggs, ex-♀ at lights, reared on *Persea americana*, (CKWE, CCCE). 1 ♀, Pasco, Oxapampa env., high altitude humid forest, 2511 m, 10°38′15.1″ S, 75°17′14.2″ W, 6.–13. vi. 2002, leg. B. Wenczel & J. Bottger, (CBWK). 1 ♂, Pasco, Oxapampa env., 2500 m, vii. 2004, collection no. 16.420 (CCMC). 1 ♀, Pasco, Oxapampa env., 2180 m, vii. 2002, colection no. 16.031 (CCMC). 1 ♀, San Martin Dept., Río Abiseo, Puerta del Monte, 3200 m, vii. 1998, G. Lamas, (MHNL). 1 ♀, Puno Departamento, Sandia Provincia, Limbani Distrito, Carcel Punko, 2593 m, humid rain forest, 14°5′57.4″ S, 69°41′10.2″ W, iv. 2005, leg. José Bottger (CSNB). 1 ♀, Cuzco Province, Valle Marcapata, Pont Amacho, 2740 m, 2004 (CFMP); forewing length 54 mm.

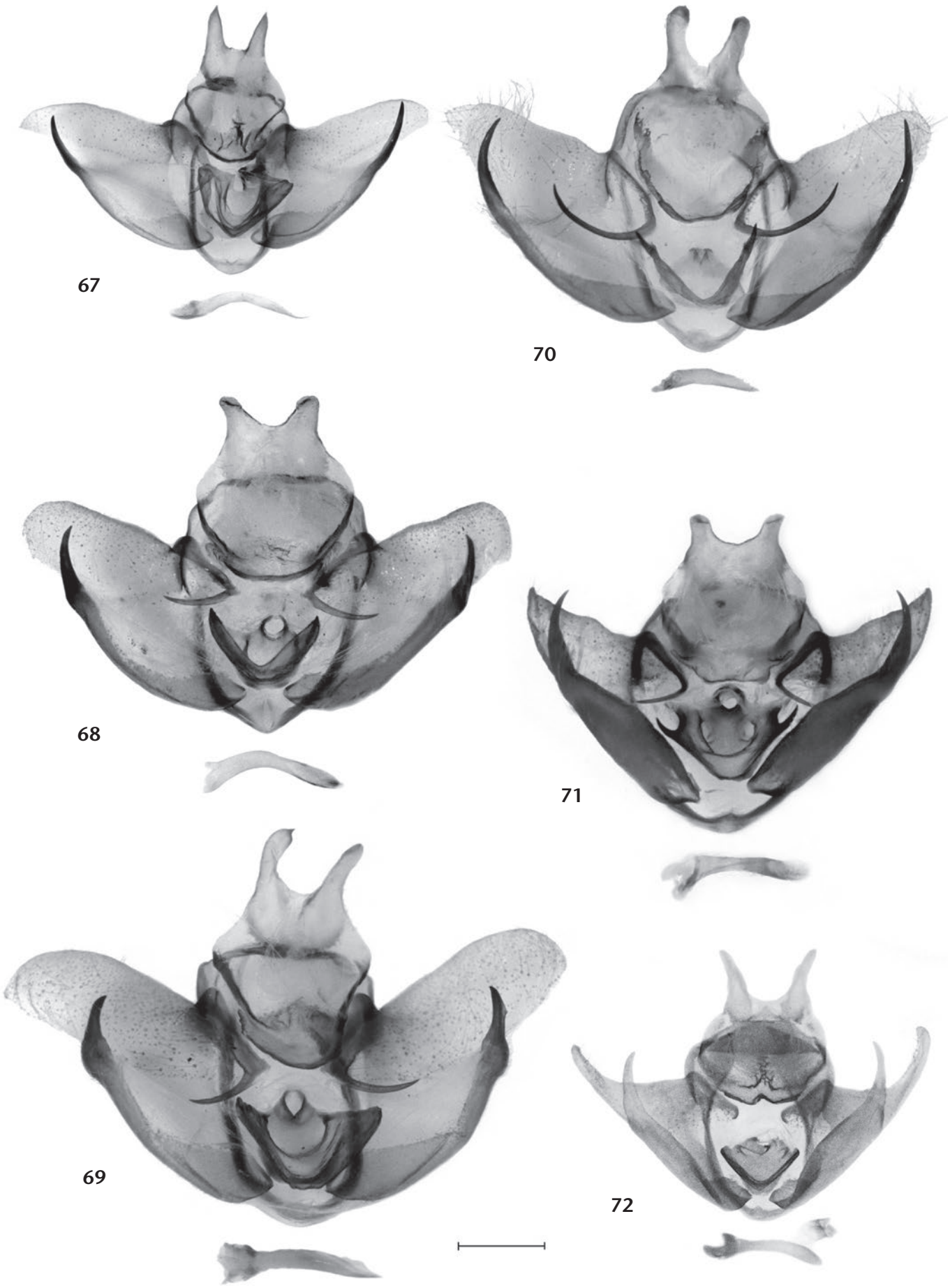
Etymology: I am grateful to B. Wenczel, S. Naumann, and W. A. Nässig for suggesting the name *bella*, referring to the beauty of this species.



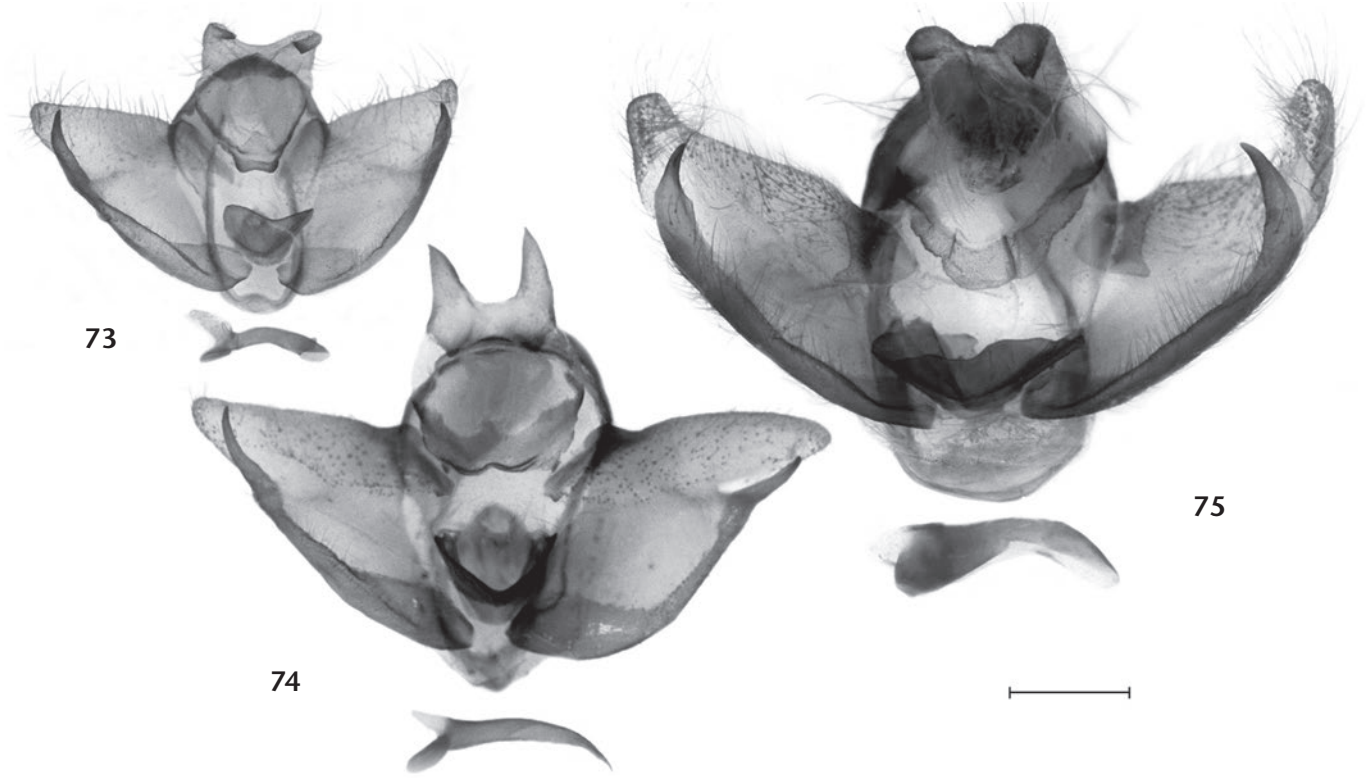
Figs. 18–19: *Copaxa medea*, uppersides. **Fig. 18:** ♂, reared ex ♀, Ecuador, Azuay Dept., 47 km W of Cuenca, 3615 m, 29. XII. 2002, K. & S. WOLFE, Wm. KELLY. **Fig. 19:** ♀, same data, genitalia no. 112/05 WOLFE. — **Figs. 20–38:** *C. semioculata* group and *C. medea*, undersides. **Fig. 20:** ♂, *C. sapatoza*. **Fig. 21:** ♀, *C. sapatoza*. **Fig. 22:** ♂, *C. orientalis*. **Fig. 23:** ♀, *C. orientalis*. **Fig. 24:** ♂, *C. medea*. **Fig. 25:** ♀, *C. medea*. **Fig. 26:** ♂, *C. intermediata*. **Fig. 27:** ♀, *C. intermediata*. **Fig. 28:** ♀, *C. intermediata*. **Fig. 29:** ♂, *C. semioculata*. **Fig. 30:** ♀, *C. semioculata*. **Fig. 31:** ♂, *C. herbuloti*. **Fig. 32:** ♀, *C. herbuloti*. **Fig. 33:** ♂, *C. lunula*. **Fig. 34:** ♀, *C. lunula*. **Fig. 35:** ♂, *C. bella*. **Fig. 36:** ♀, *C. bella*. **Fig. 37:** ♂, *C. bachuea*. **Fig. 38:** ♀, *C. bachuea*. — **Figs. 39–45:** Cocoons. **Fig. 39:** *C. intermediata*. **Fig. 40:** *C. herbuloti*. **Fig. 41:** *C. sapatoza*. **Fig. 42:** *C. lunula*. **Fig. 43:** *C. bella*. **Fig. 44:** *C. bachuea*. **Fig. 45:** *C. medea*.. **Figs. 46–51:** Early stages of *Copaxa orientalis*. **Fig. 46:** Eggs. **Fig. 47:** 1st instar. **Fig. 48:** 2nd instar. **Fig. 49:** 3rd instar. **Fig. 50:** 4th instar. **Fig. 51:** 5th instar. — **Figs. 52–57:**



C. semioculata group 5th (last) instar larvae. **Fig. 52:** *C. intermediata*. **Fig. 53:** *C. sapatoza*. **Fig. 54:** *C. herbuloti*. **Fig. 55:** *C. bella*. **Fig. 56:** *C. lunula*. **Fig. 57:** *C. bachuea*. — **Fig. 58:** Abdomen of *C. intermediata* with large, dark lateral stigmata of nocturnal line of the species group. — **Fig. 59:** 1st instar, *C. medea*. **Fig. 60:** 5th (last) instar, *C. medea*. — **Fig. 61:** Thoracic peak, 4th instar, *C. intermediata*. **Fig. 62:** Thoracic horns, 4th instar, *C. medea*. — **Figs. 63–66:** High Andine *Copaxa* habitats. **Fig. 63:** Home of *C. orientalis*, Ecuador, Napo Prov., 3450 m. **Fig. 64:** Home of *C. bachuea*, Colombia, Boyocá Dept., Laguna de Iguaque, at the upper limit for this species at 3500 m elevation. **Fig. 65:** Home of *C. medea* and *C. intermediata*, east of Quito, Ecuador, ca. 3500 m. **Fig. 66:** Home of *C. herbuloti* and *C. bella*, in Peru, Pasco Dept., near Oxapampa, 2600 m (photo by José Bottger).



Figs. 67–72: Male genitalia, *Copaxa*. **Fig. 67:** *C. semioculata,* holotype genitalia no. 84/01 Wolfe. **Fig. 68:** *C. intermediata,* progeny of allotype ♀, 98/04 Wolfe. **Fig. 69:** *C. orientalis,* locality as Fig. 2, 99/04 Wolfe. **Fig. 70:** *C. bella,* sibling of Fig. 14, 100/05 Wolfe. **Fig. 71:** *C. lunula,* sibling of Fig. 11, 86/01 Wolfe. **Fig. 72:** *C. bachuea,* holotype (Fig. 16), 65/00 Wolfe.



Figs. 73–75: Male genitalia, *Copaxa*. **Fig. 73:** *C. sapatoza,* locality as Fig. 7, genitalia no. 104/04 Wolfe. **Fig. 74:** *C. herbuloti,* locality as Fig. 9, 103/04 Wolfe. **Fig. 75:** *C. medea,* progeny of Fig. 84, 105/04 Wolfe. — **Figs. 76–84:** Female genitalia, *Copaxa*. **Fig. 76:** *C. semioculata,* paratype (Fig. 6), 107/05 Wolfe. **Fig. 77:** *C. intermediata,* progeny of allotype, 110/05 Wolfe. **Fig. 78:** *C. orientalis,* Fig. 2, 108/05 Wolfe. **Fig. 79:** *C. herbuloti,* same locality as Fig. 9, 111/05 Wolfe. **Fig. 80:** *C. sapatoza,* same locality as Fig. 7, 106/05 Wolfe. **Fig. 81:** *C. bella,* sibling of Fig. 14, 109/05 Wolfe. **Fig. 82:** *C. lunula,* same data as Fig. 11, 87/01 Wolfe. **Fig. 83:** *C. bachuea,* paratype, same locality as holotype, 66/00 Wolfe. **Fig. 84:** *C. medea,* Fig. 19, 112/05 Wolfe.

This species is similar to *C. lunula* but is larger, and is known only from central eastern Peru. Genitalia are slightly different, but immature stages and adult habits are similar. ♂♂ fly at noon for about one and a half hours when the sun shines in its cloud forest habitat. ♂♂ vary from dark brown to orange, with pink wing base and a distinctive yellow bar on underside of forewing.

In Wolfe et al. (2003a), we treated the single known pair of this as *Copaxa lunula* Wolfe & Conlan, 2002. I had photographed the ♀ in the Museo de Historia Natural in Lima collected in San Martin in 1998, and in 2001 Bernhard Wenczel in company with José Bottger collected a ♂ at lights in Satipo. Based on this single ♂ only, Naumann & Nässig intended to describe a new species (called "bella") in 2001, but cancelled this plan after correspondence with the author, who at that time expected the two species to be identical and was preparing the manuscript containing the description of *lunula*.

Subsequent ♀♀ were captured near Oxapampa, Pasco, and eggs were gathered which I reared to full-sized adults on *Persea americana*. Larvae were similar to those of *C. lunula* but with wider forward-curving dorsal pink spines, flat but pointed.

Virgin ♀♀ were taken to Oxapampa to attract ♂♂, four of which arrived one day between 11:45–13:30 h whenever the sun would shine through the clouds for a few minutes. This is not an abundant species.

♂ (Figs. 13, 14, 35, 85, 86). Antennae with brownish yellow shaft and dark brown rami, quadripectinate. Thorax dark brown or orange brown, with indistinct yellow collar. Legs pink. Abdomen dark brown or orange, lighter ventrally. Forewing length 43–47 mm, falcate; apex narrowly rounded. Wings dorsally vary from dark brown to orange brown finely sown with yellow and black scales, more yellow on the tornus. Hindwing dull red basally shading to orange brown or orange on marginal band; ante- and postmedial dark lines meet distad of discal spot, forming a zigzag kidney-shaped area darker with black scales. Lunate hyaline discal spots on hindwings broadly bordered yellow between narrow black rings, unlike forewing in which, as in *C. lunula*, yellow ring is practically indistinguishable. All other markings typical for the group. Underside dark purplish brown or orange brown with all dark lines and dashes clearly marked and separated to the costa on the hindwing; continuous dark purplish brown or orange brown medial band through both wings; forewings with distinguishing broad yellow band across lower $^{3}/_{5}$ of wing, from the tornus to the angle.

♂ **genitalia** (Figs. 70, 87) similar to *C. lunula*, but with longer curved hooks on arms of transtilla; lateral curved spines on juxta also similar; apical projections of uncus longer; aedeagus similar, vesica evaginates dorsally.

♀ (Figs. 15, 36, 89, 90). Very large compared to ♂. Antenna yellow, bipectinate. Overall pale yellowish brown, rosy on base of hindwings and on abdomen; forewings not falcate, upper wing markings as in ♂, hindwing yellow discal ring very obvious. Underside subdued dark mauve, lighter on wide submarginal area.

♀ **genitalia** (Figs. 81, 88). Prevaginal lamella large, strongly developed and sclerotized, widely cleft in center.

Immature stages similar to *C. lunula* but larvae larger. Last instar (Fig. 55) with pink forward curved spines, cocoon (Fig. 43) large, pale brown with open mesh.

Copaxa lunula Wolfe & Conlan, 2003

Copaxa lunula Wolfe & Conlan, 2003 *in* Wolfe et al. (2003a: 59–60, figs. 4–6, 15, 20–21).

Specimens examined: All **Bolivia:** Holotype ♂ (MNHN), 2 paratype ♂♂ (CKWE, CCCE), Cochabamba Dept., dwarf cloud forest 1 km E La Siberia, 3050 m, 17°47.63′ S, 64°44.70′ W, 12. xi. 1999, leg. K. Wolfe & C. Conlan, *ab ovo,* ex ♀ at lights. 4 ♀♀, same locality, wild-caught, (MNHN, CKWE, CCCE, NHMS). 1 ♀, Cochabamba Dept., lower cloud forest E of Pojo, 2700 m, 17°46.12′ S, 65°42.04′ W, 1. xi. 1999; at MV & UV lights, leg. K. Wolfe & C. Conlan, (CKWE). 1 ♀, La Paz Dept., Rd. La Paz–Coroico, 2615 m, 7. xii. 1991, leg. G. Lecourt & T. Decaëns, (CKWE).

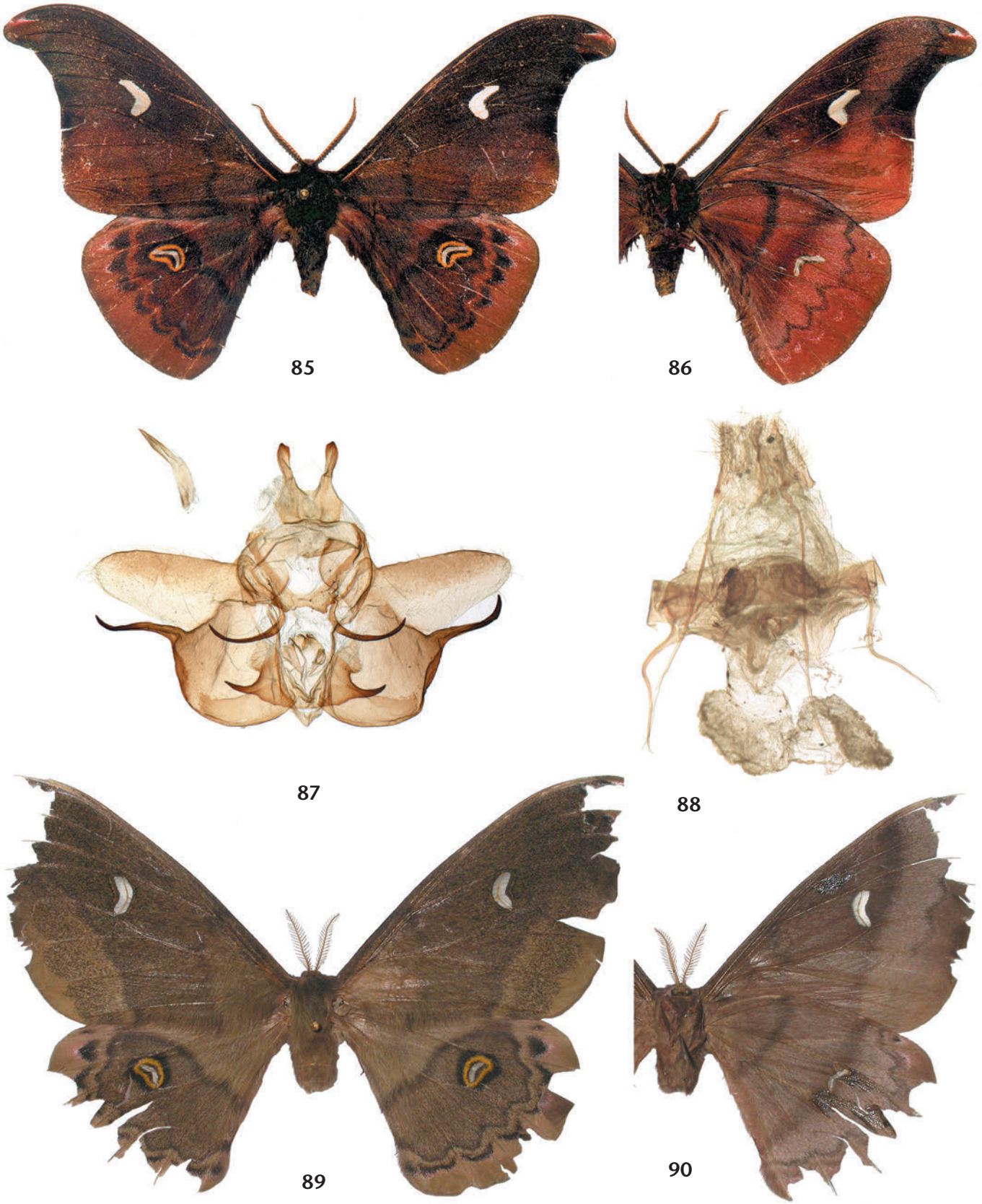
C. Conlan and I first saw ♂♂ of this new species flying just at noon on a sunny day at 3050 m in the eastern Andes of Bolivia. One after another they zigzagged rapidly through the area until we had counted 13, then we saw no more. Four ♀♀ came to the lights that night and eggs were obtained for rearing.

Larvae accepted avocado well and a number of cocoons were obtained, yielding several adult ♂♂ of two color phases; one is illustrated herein and the other is all grayish black on the upper side.

♂ (Figs. 11, 33). Head, antennae, thorax, abdomen and overall as in *C. bella* except color. Forewing length 38–40 mm, falcate; apex narrowly rounded. Dorsal background color orange to dark brown or gray, with typical markings for the group. Hindwing mostly yellow in one morph seen and dark gray in another, without pink; ante- and postmedial lines meet distad of discal spot. Lunate hyaline discal spots as in *C. bella*, with central encircling yellow ring obvious on hindwing, relatively undetectable on forewing. Underside variable.

♂ **genitalia** (Fig. 71). Similar to *C. bella*, but all parts more sclerotized, arm of transtilla much shorter, apical processes of uncus shorter; vesica evaginates dorsally.

♀ (Figs. 12, 34). Antennae yellow, wings broadly rounded, thorax and abdomen mauve with yellow hairs, abdomen lighter. Upperside forewings beige appearing greenish by combination of yellow and black scales overlaying much of surface except margins, which are clear with yellow tint. Hindwing with rosy or mauve tint. Wings rather thinly scaled compared to ♀ of *C. bella*, allowing visibility from above of ante- and post-medial lines to costa of underside, unlike other females of the line of diurnal males.

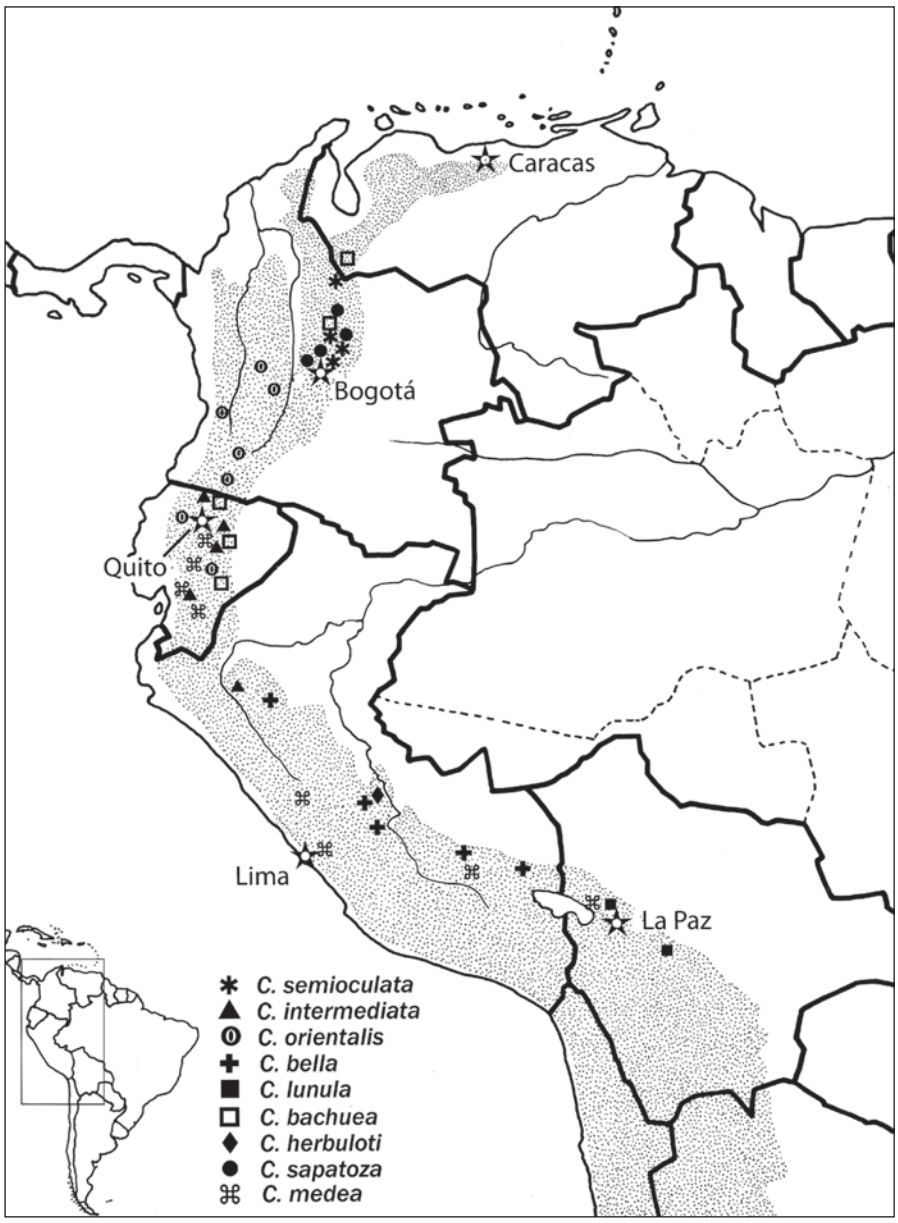


Figs. 85–90: *Copaxa bella,* holo- and allotype. **Figs. 85–87:** holotype ♂. **Fig. 85:** upperside; **Fig. 86:** underside; **Fig. 87:** genitalia (genitalia no. SNB 0602/01). **Figs. 88–90:** allotype ♀. **Fig. 88:** upperside; **Fig. 89:** underside; **Fig. 90:** genitalia (genitalia no. CBH 0356 = SNB 0880/03). — Photos and scans S. Naumann, U. Brosch.

♀ genitalia (Fig. 82). Much smaller than *C. bella*, prevaginal lamella widely lunate, heavily sclerotized.

Immature stages were typical for the group, last instar larva (Fig. 55) dark green with red forward-arching spines; cocoon (Fig. 42) dark with mostly open mesh.

This species is known only from Bolivia in cloud forests of Cochabamba and La Paz Departments and it probably occurs on the northwest edge of Chuquisaca Department. It is not known how far north it extends nor how far south the range extends of its closest relative, *Copaxa bella* of central Peru.



Distribution map: Distribution (recorded localities) of the species of the *Copaxa semioculata* and *C. medea* groups in the high Andes. Capitals of the countries involved included.

*Copaxa **bachuea*** sp. n.

Copaxa semioculata: Wolfe et al. (2003a: 54–61, figs. 2, 9–14, 16); *partim* (misidentification).

Holotype: ♂, Colombia, Boyacá, Santuario Nacional de Flora y Fauna de Iguaque, 2850 m, 5. i. 1992, leg. A. R. Amarillo & C. E. Sarmiento M. In MNHN, Paris.

Paratypes (8 ♀♀): All **Colombia:** Allotype ♀, same data as holotype, in MNHN. — 3 ♀♀, Boyacá, Santuario Nacional de Flora y Fauna de Iguaque, el. 2990 m, 24.–26. iv. 1998, at MV & UV lights, leg. K. Wolfe, A. Amarillo, C. Sarmiento, (ICNM, CKWE, CAAB). 1 ♀, reared, ex previous paratype ♀, genitalia no. 66/01 Wolfe (CKWE). 3 ♀♀, Boyacá, Santuario Nacional de Flora y Fauna de Iguaque, el. 2990 m, 22.–24. iv. 2000, K. & S. Wolfe, (ICNM, CKWE, CAAB).

Further specimens, not included as paratypes: **Venezuela:** 1 ♀, Táchira, Páramo Tama, Betanía, 2425 m, 16.–10. iii. 1983, Exp. IZAA, (IZAA). — **Ecuador:** 1 ♀, Napo, rd. Baeza–Tena, S. of Cosanga, 2150 m, leg. N. Venedictoff, 23. iii. 1976, (MNHN). 1 ♀, Napo, Cosanga–Tena km 7, 2350 m, 19. vii. 1990, leg. D. Herbin & J. Haxaire, (CDHP). 1 ♀, Morona Santiago, 44 km on Rd. Gualaceo–Limon, el. 2300 m, 4. v. 2000, GPS 3°1.00′ S, 78°34.83′ W, K. & S. Wolfe, C., & M. Conlan, (CKWE).

Etymology: On the paramo below the summit of the Colombian mountain where this moth was first collected, there are several small lakes, the largest named Laguna de Iguaque, or Iguaque Lake (Fig. 64). At the suggestion of A. Amarillo, *Copaxa bachuea* is named after Bachué, mythical mother of humankind, who emerged from this lake with her young son, Huitaca, according to ancient legend. When he matured they married and traveled extensively, peopling the world and teaching how to live in peace. When they grew old, they returned to the lake, turned into serpents, which are symbols of intelligence among the Chibcha tribe living nearby, and submerged themselves in the lake. Since then the natives would throw gold ornaments into the lake as offerings of love. They made gold frogs and tadpoles and aquatic lizards, all symbols of life born of these waters, to wear as necklaces. Frogs became divine symbols of fertility.

Copaxa bachuea is a species with diurnal ♂♂, occupying high altitude cloud forest in western Venezuela and the eastern Andes of Colombia and Ecuador. North of Peru it replaces *C. lunula* and *C. bella* in similar habitat. So far only one ♂ has been captured, by Angela Amarillo, at 16:00 h flying low on a forest trail in Iguaque National

Wildlife Refuge at 2950 m on a somewhat isolated mountain massif in central Colombia, now encompassed by Iguaque wildlife sanctuary. Many ♀♀ have subsequently been captured at lights there, but numerous attempts to rear this species failed due to insufficiently cool temperatures, as we learned from subsequent successful rearings of its close relatives.

Female specimens of *C. bachuea* from high altitude cloud forest in eastern Ecuador are larger, darker and more reddish than those from Colombia and Venezuela, and may eventually prove to be distinct. Female specimens from Iguaque vary considerably in size and color tone, and a ♀ from western Venezuela is well within the size and color variation of the Iguaque specimens. There is likely more than one color morph in the ♂.

♂ (Figs. 16, 37). Head orange beige, eyes large. Antennae with dull yellow shaft and dark brownish rami, quadripectinate. Thorax orange with indistinct yellow collar; legs pink, abdomen orange, lighter ventrally. Forewing length 41 mm, falcate, apex rounded. Wings dorsally orange beige, finely shaded with black scales; pale brown lines broad, distinct but weak; lines on hindwing meet immediately distad of lunate discal spot; submarginal dashes not distinct. Underside pale.

♂ genitalia (Fig. 72). Structures similar to those of *C. semioculata* but differ in longer and curved pair of apical processes on uncus, and in lacking long hooked arms laterally on transtilla, replaced by small triangular lumps. The vesica evaginates dorsally as in *C. semioculata*, but is much larger, square; vesica evaginates dorsally.

♀ (Figs. 17, 38). Head dark brown; antennae dull yellow, bipectinate. Thorax gray brown with yellow tuft collar. Tibia pale brown, parsi pinkish. Abdomen light gray brown. Forewing length 41–55 mm, wings broadly rounded. Above light tan with pale gray on forewing and hindwing median, a pale reddish tan band on forewing median; broad borders greenish golden tan, brown antemedial and zigzag postmedial of forewing strong, lines on hindwing as in male, but more distinct. U-shaped submarginal dashes gray bordered white. Lunate discal spots as in ♂, yellow ring not obvious on fore- or hindwing. Underside pale.

♀ genitalia (Fig. 83). Prevaginal lamella lunate, strongly developed but not heavily sclerotized.

Immature stages are typical. Larvae fed well on *Persea americana* and numerous cocoons were obtained, but pupae died over one year. We subsequently learned from successful rearing of close relatives that ambient temperature should be kept below 22° C during daytime and as low as 12–15° at night. Last instar larva (Fig. 57) typical with bright green integument and bright red forward-arching spines; cocoon (Fig. 44) pale with open-mesh.

Copaxa medea group

Copaxa medea (Maassen, 1890)

Saturnia Medea Maassen, (1890: 50, n° 1, pl. 5, fig. 7 ♂; 65, n° 115; 133, n° 72).

Saturniodes medea medea (Maassen): Draudt (1929: 722, pl. 104, a ♂); Schüssler (1933b: 627); Bouvier (1936: 175).

Copaxa (*Saturniodes*) *medea* (Maassen): Michener (1952: 497, figs. 390–393); Lemaire (1975a: 94) (syn.).

Copaxa medea (Maassen): Lemaire (1978: 199), (1996: 48).

Copaxa (*Saturniodes*) *ockendeni* (Druce, 1906): Lemaire (1975a: 94) (syn.).

Copaxa (*Saturniodes*) *medea carina* Jordan, 1911: Lemaire (1975a: 94) (syn.).

Copaxa (*Saturniodes*) *medea charila* Jordan, 1911: Lemaire (1975a: 94) (syn.).

Copaxa (*Saturniodes*) *medea miles* Jordan, 1911: Lemaire (1975a: 94) (syn.).

Copaxa orios (Dyar, 1913): Lemaire (1978: 199) (syn.).

Specimens examined: Ecuador: 2 ♂♂, 1 ♀, Azuay Dept., 47 km W of Cuenca, 2°48.07′ S, 79°17.45′ W, 3615 m, 29. xii. 2002, leg. K. & S. Wolfe, Wm. Kelly (CKWE). 1 ♂, Cotopaxi Dept., ca. NE Latacunga, 0°41.42′ S, 78°33.25′ W, 3328 m, 5. i. 2003, leg. K. & S. Wolfe, Wm. Kelly (CKWE). Central Plateau Tungurahua, Rt. Almbato–Rio Bamba, km 27.8 E of Chimborazo, 3250 m, 31. i. [19]83, leg. C. Lemaire, P. Thiaucourt, G. & N. Venedictoff (CKWE). — **Peru:** western, Oroya Railway, Rio Blanco, 12,000 ft., A. Miles Moss (BMNH), and other specimens in BMNH, MNHN, MHNL.

Copaxa medea, although probably sharing a not-too-distant ancestor with the *semioculata* group, has diverged greatly enough to form, in my opinion, its own group. A quick glance at the larva reveals great differences beginning with the first instar (Fig. 59), with its swollen head and thoracic segments. Later instars possess dorsal scoli on the 2nd and 3rd thoracic segments which are completely separated and borne on long tubercles (Fig. 62). The round discal spots on the wings of adults also diverge completely from the *semioculata* group, and the genitalia are distinct.

The hostplant of *C. medea* is not known, and although eggs and feeding larvae were found during two consecutive years on imported pine trees by Giovanni Onore near Quito, Ecuador, in the early 1980's, none have been been found on pine since that time. Near that same area I recently found a parasitized cocoon of *medea* hanging on grass growing around a small shrub appearing similar to the hostplant of *C. orientalis.*

C. medea is a variable species in size and color, leading to various synonyms. Although Lemaire describes the ♀ as similar to the ♂ (Figs. 18, 24), a ♀ we captured was practically devoid of ornamentation except for the eyespots on a plain tan background (Figs. 19, 25). All her progeny, however, were colored as the ♂♂. Eggs were solid tan-white. I divided the larvae between *Persea* and *Pinus radiata,* the pine species it had utilized in Ecuador. Most of the larvae on pine died, but a good number on avocado survived. Last instar (Fig. 60) with strong black and white diagonal lateral bands on most segments, forward arching spines weak and white. The cocoon is dis-

tinct from those of most other *Copaxa:* bottle-shaped, solid with no open mesh, and placed vertically with the valve straight up instead of horizontally or diagonally (Fig. 45).

Genitalia (Figs. 75, 84) are very different from the *C. semioculata* group; in the ♂, the aedeagus is very heavy and evaginates ventrally; arms of the transtilla broad, shallow.

Copaxa medea is found at high to very high altitudes from 2500–4000 m in rather barren situations, often with little vegetation other than short grasses. Most of the ♂♂ we captured came to the lights near midnight, which is surprising for such a cold climate. We captured this species in steep, barren mountains and in level, shrubby semiarid wide valleys. The species ranges from the Andean Corridor and drier areas of the eastern Andes of central Ecuador south through Peru to northern Bolivia.

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Literature

Bouvier, E.-L. (1936): Étude des Saturnioïdes normaux, famille des Saturniidés. — Mémoirs du Muséum national d'Histoire naturelle, Paris, Nouv. Sér., **3:** 1–354, 12 pls.

Draudt, M. (1929/1930): 12. Familie: Saturnidae [*sic*]. — Pp. 713–827, pls. 101–137, 142 *in:* Seitz, A. (ed.) (1913–1940), Die Gross-Schmetterlinge der Erde, vol. **6,** Die Amerikanischen Spinner und Schwärmer. — Stuttgart (A. Kernen), viii + 1452 pp., viii + pls. 1–185.

Druce, H. (1906): Descriptions of some new species of Heterocera from Peru. — Annals and Magazine of Natural History, London, (7) **17:** 406–415.

Dyar, H. G. (1913): Results of the Yale Peruvian expedition of 1911. Lepidoptera. — Proceedings of the U.S. National Museum (Washington), **45:** 627–649.

[Felder, C., &] Felder, R. (1874): [Fascicle 4]. — Pp. 1–10 ("Erklärung der Tafeln lxxv–cvii"), pls. lxxv–cvii *in:* Felder, C., Felder, R., & Rogenhofer, A. F. (eds.) (1864–1875): Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859 unter den Befehlen des Commodore B. von Wüllerstorf-Urbair. Zoologischer Theil. — Vienna (Akademie der Wissenschaften Wien), Band **II,** Abtheilung 2.

Jordan, K. (1911): Descriptions of new Saturniidae. — Novitates Zoologicae, Tring, **18:** 129–134.

Lemaire, C. (1971): Descriptions d'Attacidae (= Saturniidae) nouveaux d'Amérique centrale et du Sud (Lepidoptera). — Tijdschrift voor Entomologie, Leiden, **114** (3): 141–162, pls. 1–12.

—— (1975a): Liste synonymique des Attacidae américains [Lep.]. Première partie: Attacinae Blanchard, 1840. — Bulletin de la Société entomologique de France, Paris, **80:** 89–98.

—— (1975b): Description de neuf Attacidae sud-américains [Lep.]. — Lambillionea, Revue bimestrielle, Bruxelles, **75:** 55–61, 6 figs.

—— (1978): Les Attacidae Américains. The Attacidae of America (= Saturniidae). — Éditions Lemaire; Neuilly-sur-Seine, pp. [1]–238 [+ 51 pp. without pagination], pls. 1–49.

—— (1996): 117. Saturniidae. — Pp. 28–49, 61–62 *in:* Heppner, J. B. [ed.], Atlas of Neotropical Lepidoptera, Volume **5B.** Checklist: Part 4B. Drepanoidea — Bombycoidea — Sphingoidea. — Gainesville, Washington, Hamburg, Lima, Taipei, Tokio (ATL, SP), l + 87 pp.

Maassen, J. P. (1890): [Saturniidae.] — *In* Weymer, G., & Maassen, J. P., Lepidopteren gesammelt auf einer Reise durch Columbia, Ecuador, Peru, Brasilien, Argentinien und Bolivien in den Jahren 1868–1877 von Alphons Stübel. — *In* Reiss, W., & Stübel, A., Reisen in Süd-Amerika. — Berlin (Asher), 182 pp., 9 pls.

Michener, C. D. (1952): The Saturniidae (Lepidoptera) of the Western Hemisphere. Morphology, phylogeny, and classification. — Bulletin of the American Museum of Natural History **98** (5): 335–502, text figs. 1–420, 5 pls.

Schüssler, H. (1933): Saturnioidea II: Saturniidae: 2. Subfam. Saturniinae. — Pp. 85–324 *in:* Strand, E. (ed.), Lepidopterorum Catalogus, pars **56.** — Berlin (W. Junk).

Westwood, J. O. (1853): Description of some new species of exotic moths belonging or allied to the genus *Saturnia*. — Proceedings of the Zoological Society of London **21:** 57–167, pls. 32–33.

Wolfe, K. L. (1993): The *Copaxa* of Mexico and their immature stages (Lepidoptera: Saturniidae). — Tropical Lepidoptera, Gainesville, **4 (Suppl. 1):** 1–26.

——, & Lemaire, C., Amarillo S., A., & Conlan, C. A. (2003a): 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. — Journal of the Lepidopterists' Society, Los Angeles, **57** (1): 54–61.

——, Bonilla, D., Ramírez, L. D., & Decaëns, T. (2003b): Rediscovery of *Copaxa sapatoza* and revealing of its immature stages (Lepidoptera: Saturniidae, Saturniinae). — Nachrichten des Entomologischen Vereins Apollo, Frankfurt am Main, N.F. **24** (3): 143–146.

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