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A review of the genus *Megalographa* Lafontaine and Poole
(Lepidoptera: Noctuidae: Plusiinae) with the description of a new
species from Costa Rica

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Abstract. The classification of the genus *Megalographa* Lafontaine and Poole, 1991, is reviewed and the five known species diagnosed. The genus is essentially restricted to the New World, although one species *M. biloba* (Stephens) is migratory and has occasionally straggled to western Europe. A **new species** (*Megalographa talamanca* Lafontaine and Sullivan) endemic to the Talamanca Mountain Range in Costa Rica is described. Adults and genitalia are illustrated.

Key words. *Megalographa*, *Lophoplusia*, *agualaniata*, *biloba*, *bonaerensis*, *culminicola*, *monoxyla*, *talamanca*.

Introduction

Recent biodiversity surveys of the Lepidoptera in Costa Rica, in collaboration with the Instituto Nacional de Biodiversidad, has resulted in the discovery of a previously unknown high elevation species of noctuid in the subfamily Plusiinae, probably the best known subfamily in the Noctuidae. The species is described herein in a review of the genus.

Materials and methods

Dissection of genitalia and terms for genital structures and wing markings follow Lafontaine (2004). Recently collected specimens were sent to Paul Hebert at the University of Guelph for barcode (CO1) analyses (Hebert et al. 2003; Ratnasingham and Hebert 2007).

Repository abbreviations

Specimens were examined from the following collections, with the following abbreviations used in the text:

AMNH — American Museum of Natural History, New York, NY, USA.

BMNH — Natural History Museum, London, Great Britain.

CNCI — Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada.

INBI — Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica.

USNM — National Museum of Natural History, Washington, District of Columbia, USA.

JBSC — J. Bolling Sullivan Collection, Beaufort, North Carolina, USA.

Megalographa Lafontaine and Poole

Megalographa Lafontaine and Poole 1991: 94. **Type species.** *Plusia biloba* Stephens, selected by Lafontaine and Poole (1991) because it is widely distributed.

Diagnosis. *Megalographa* was established to accommodate those New World plusiines with a bilobed silver stigma in the forewing. This stigma, which looks like two large joined adjacent hemispheres, is characteristic of all but one of the known species, although in three species the spots may be partially or completely separated. Although the genus ranges throughout the Americas (largely because *M. biloba* is a migratory species) most species are found in the southern half of South America, particularly in the Andes. Lafontaine and Poole (1991) were aware of an undescribed species from the mountains of Costa Rica which we describe below.

Megalographa is best characterized by genital characters. In the male genitalia the valve is relatively short and broad; the clavus at the base of the sacculus is a short process (longer in *M. biloba*); the vesica is short, 1.0–1.5X as long as the aedeagus and with a subbasal pouch and an apical pouch in four species and a distinctive canoe-shaped cornutus at the apex in four species. In the female genitalia the corpus bursae is long, slender, J-shaped, usually with a mesial twist; the corpus bursae usually is 2–4X as long as the ductus bursae but is 6X as long in *M. talamanca*.

The larva of the well known and wide ranging *M. biloba* is distinct among plusiines because the segments are covered dorsally with a fine pelage of moderately long white hairlike spines which become coarse, conical spinules ventrally. Male and female genitalia are typical of other New World plusiines which historically have been arranged in genera largely on the basis of their forewing patterns, particularly the stigma.

Phylogeny. Lafontaine and Poole (1991) suggested that based on genitalic characters, *Megalographa* could be closely related to *Lophoplusia* Zimmerman, a genus restricted to Hawaii, because both genera share the peculiar canoe-shaped cornutus at the apex of the vesica (Figure 14). DNA sequence analyses of the CO1 locus indicates that *Megalographa* is most closely related to *Anagrapha* McDunnough and *Syngrapha* Hübner (5–6% different) (Hebert et al. 2003; Ratnasingham and Hebert 2007), although CO1 from *Lophoplusia* have not been sampled. The genera *Megalographa*, *Anagrapha*, *Syngrapha*, *Autographa* Hübner occupy a distinct phylogenetic branch within the New World plusiines (genera sequenced are: *Abrostola* Ochsenheimer, *Allagrapha* Franclemont, *Anagrapha*, *Argyrogramma* Hübner, *Autographa*, *Chrysanympha* Grote, *Diachrysis* Hübner, *Enigmogramma* Lafontaine and Poole, *Eosporopteryx* Dyar, *Exyra* Grote, *Euchalcia* Hübner, *Plusia* Ochsenheimer, *Polychrysis* Hübner, *Pseudeva* Hampson, *Syngrapha* and *Trichoplusia* McDunnough). Within the clade containing *Megalographa*, *Autographa* is the sister group to the other three genera and *Megalographa* is the sister group to *Syngrapha* with *Anagrapha* nested within *Syngrapha* (pers. observation).

Discussion. *Megalographa* would seem to be a genus of South American origin which spread northward via the species *M. biloba*, a well known migrant. The undescribed species in Costa Rica and the genus *Lophoplusia* may have originated from periodic migrations of a *biloba*-like ancestor.

Key to the species of *Megalographa*

1. Forewing with reniform spot partially outlined or partially filled with silvery white 2
- Forewing with reniform spot partially outlined in pale ground color (pale gray or pale coppery brown) 4

- 2(1). Forewing with central part of subterminal area and fringe unmarked; reniform spot represented by silvery-white oval with dark dot in basal third of oval; male vesica with apical cornutus ...
..... ***M. bonaerensis* (Berg)**
- Forewing with central part of subterminal area and fringe with contrasting dark patch; reniform spot partially outlined with silvery-white line; male vesica without apical cornutus 3
- 3(2). Postmedial line of forewing slightly and evenly curved; male genitalia with clavus about 0.25–0.50X as long as clasper; endemic to Talamanca Mountain Range of southern Costa Rica
..... ***M. talamanca* Lafontaine and Sullivan**
- Postmedial line of forewing often slightly S-curved, usually with a notch above silver stigma (between veins M3 and CuA1); male genitalia with clavus as long as clasper; widely distributed



Figure 1–8. *Megalographa* spp. 1) *M. monoxyla*, m, Cochabamba, Incachaca, Bolivia. 2) *M. agualaniata*, m, Cochabamba, Incachaca, Bolivia. 3) *M. culminicola*, m, Ecuador. 4) *M. culminicola*, f, Junin to Huanuco Hwy., Pasco, Peru, 3600 m. 5) *M. bonaerensis*, m, Curitiba, 920 m, Paraná, Brazil. 6) *M. biloba*, m, San Gerardo de Dota, Cartago, Costa Rica. 7–8) *M. talamanca*, m, Reserva los Nimburos, 3150 m, Cerro de la Muerte, San José, Costa Rica.

- in New World from Canada to Argentina and in Hawaii (occasional in Great Britain)
 *M. biloba* (Stephens)
- 4(1). Forewing bronzy brown with basal area concolorous with median area; clasper in male genitalia long, about 0.3X length of valve and extended beyond costal margin of valve by 0.5X its length.
 *M. monoxyla* (Dyar)
- Forewing gray with basal area paler than median area; clasper shorter, about 0.20–0.25X length of valve and extended beyond costal margin of valve by 0.3X its length or less 5
- 5(4). Forewing stigma either two spots or two rounded lobes *M. agualaniata* (Dognin)
- Forewing stigma elongated and evenly tapered to apex ... *M. culminicola* Barbut and Piñas

Megalographa monoxyla (Dyar)

(Figure 1, 9)

Plusia monoxyla Dyar 1913: 645. **Holotype:** female, USNM, Washington [examined]; **Type locality:** Ollantaytambo, [Peru].

Diagnosis. *Megalographa monoxyla* is recognizable by its pattern. The lack of silvery-white shading on the reniform spot, the silver stigma mark noticeably angled toward the costa basally, and the reddish-brown ground color with a bronzy hue are characteristic. The silver stigma is separated into two spots in one of three specimens examined. The hindwing is lighter than those of other *Megalographa* species except *M. bonaerensis*. In the male genitalia the clasper extends well beyond the costa of the valve; the clavus is reduced to a small process. The vesica is slightly upcurved, with a prominent dorsal bulge mesially and a slender apical cornutus. The sexes are similar. The female is known only from the holotype which has not been dissected.

Distribution and Habitat. *Megalographa monoxyla* is known only from Peru and Bolivia and has a narrow distribution in the Andes. Its simple pattern and central distribution may indicate it has a basal position in the phylogeny of the genus.

Megalographa agualaniata (Dognin)

(Figure 2, 10, 15)

Plusia agualaniata Dognin 1912: 7. **Syntypes:** 3 males, USNM, Washington [examined]. **Type locality:** Aqualani, Peru.

Diagnosis. This species is characterized by the lack of silvery-white shading on the reniform spot and the brownish-gray forewing with hoary-gray shading in the outer and costal parts of the wing. The silver stigma mark is separated into two spots in four of the 12 specimens examined. The sexes are similar. In the male genitalia, the clasper reaches the costa; the clavus is short; the vesica is slightly upcurved mesially with a slight dorsal bulge mesially and apically and a long, slender apical cornutus. In the female genitalia, the ductus bursae is very long, 0.5X as long as the corpus bursae; the posterior half of the corpus bursae has long sclerotized, spiculate bands, like those of the ductus bursae; the appendix bursae is about 0.3X as long as the corpus bursae but appears shorter because it curls dorsally around the posterior end of the corpus bursae.

Distribution and Habitat. *Megalographa agualaniata* occurs in montane areas of South America from Venezuela and Colombia southward to Bolivia and Peru.

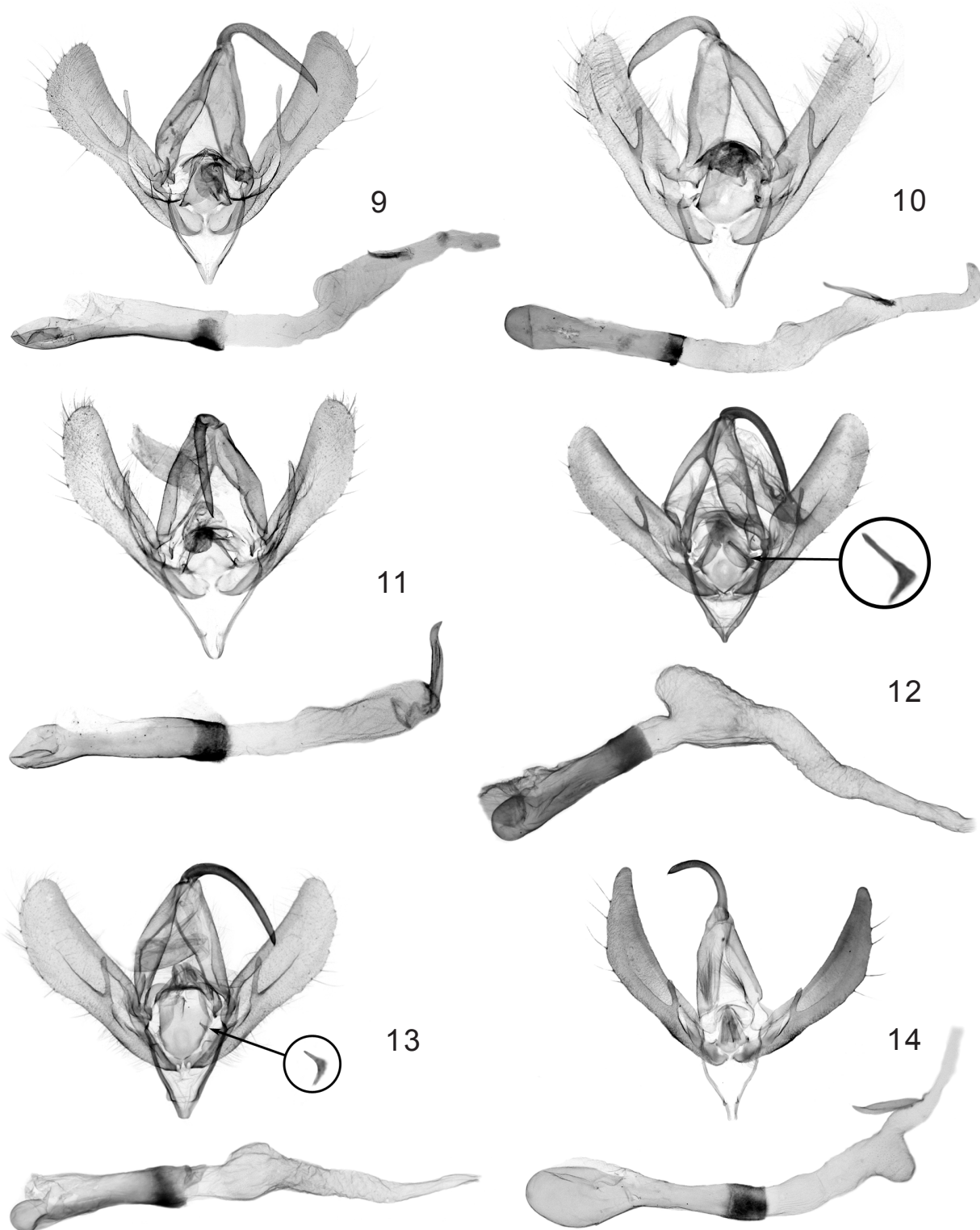


Figure 9–14. Male genitalia of *Megalographa* spp. and *Lophoplusia* sp. **9)** *M. monoxyla*, Cochabamba, Incachaca, Bolivia. **10)** *M. agualaniata*, Venezuela. **11)** *M. bonaerensis*, Curitiba, 920 m, Paraná, Brazil. **12)** *M. biloba*, Verdugo, California. **13)** *M. talamanca*, Reserva los Nimbulos, 3150 m, Cerro de la Muerte, San José, Costa Rica. **14)** *Lophoplusia* sp., Kauai, Hawaii.

***Megalographa culminicola* Barbut and Piñas**

(Figure 3, 4)

Megalographa culminicola Barbut and Piñas 2007: 19. **Holotype:** male, MNHN, Paris [photographs examined]; **Type locality:** Carchi, Impuera, Ecuador.

Diagnosis. This species is an anomaly. The forewing pattern is unlike any other species of *Megalographa*, whereas the genitalia appear to be indistinguishable from those of *M. agualaniata*. The species can easily be recognized within *Megalographa* by the elongated, narrow, tapering stigma, not the usually bilobed or two-lobed stigma of the other species in the genus. The sexes are similar. The male genitalia are like those of *M. agualaniata* (Fig. 10), but the uncus is slightly stouter and the mesial bulge in the vesica is positioned closer to the base because the basal part of the vesica is much shorter in *M. culminicola*.

Distribution and Habitat. *Megalographa culminicola* occurs in the páramo zone, 3300–3940 m, high in the Andes in Ecuador and northern Peru.

***Megalographa bonaerensis* (Berg)**

(Figure 5, 11, 16)

Plusia bonaerensis Berg 1882: 287. **Types:** Probably Paris [not examined]; **Type locality:** Province Bonaerensis, [Argentina].

Autograha solida Ottolengui 1902: 64. **Holotype:** male, AMNH, New York [examined]; **Type locality:** Texas, USA. **Note:** A statement by Ottolengui that the type from Texas is in the collection of the author, together with a statement that another specimen from Mexico is “darker than the type,” are taken to indicate that the specimen from “Texas” should be treated as a holotype. Both the Texan and Mexican records are believed to be mislabeled as to locality.

Diagnosis. This species is immediately recognizable from the adult wing pattern and bright coloration. The wing apex is darkened, the silver spot in the lower part of the reniform spot is prominent and oval with a dark spot in the basal third. The wing margin is evenly colored and the hindwing is yellowish buff. The sexes are similar.

In the male genitalia the clasper is upcurved, extending slightly beyond the costa of the valve; the clavus is short; the vesica is straight with a slight median swelling and a long, stout apical cornutus. In the female genitalia, the ductus bursae and appendix bursae are both about 0.3X as long as the corpus bursae; there is a short zone of sclerotized, spiculate ridges subbasally in the corpus bursae near its junction with the ductus bursae.

Distribution and Habitat. *Megalographa bonaerensis* occurs from southern Brazil and Paraguay southward to northern Argentina and Chile and does not follow the mountains.

***Megalographa biloba* (Stephens)**

(Figure 6, 12, 17)

Plusia biloba Stephens 1830: 104. **Type:** male, BMNH, London [examined]; **Type locality:** unknown. **Note:** The species was nominally described from England, where it occurs occasionally as a fall migrant from North America, but Stephens was also known to have mixed North American material in with European material in error.

Diagnosis. *Megalographa biloba* was thoroughly characterized by Lafontaine and Poole (1991) with adults and genitalia figured. It differs from *M. talamanca* in several aspects. In the region where *M. talamanca* was collected, three *M. biloba* were taken at lower altitudes (2200–2600m). These *M. biloba* are smaller (male wing length: 14.1mm; female wing length: 15.6mm) and the silver hemispheres of the

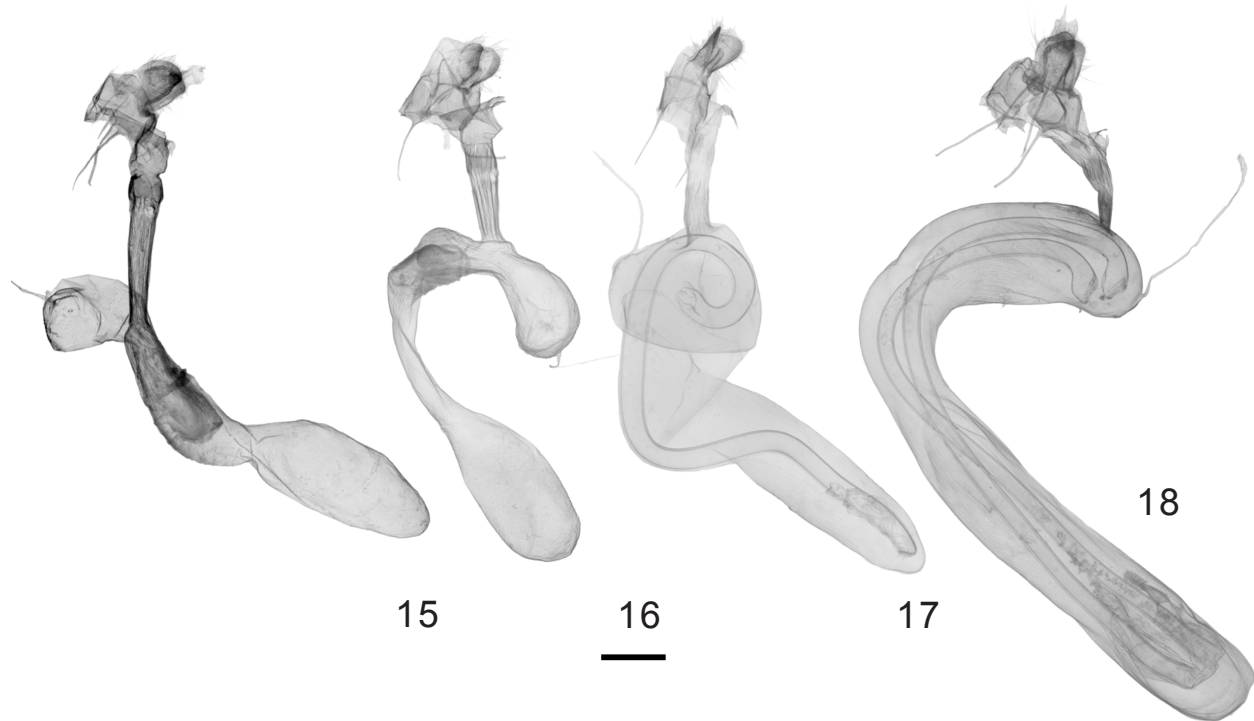


Figure 15–18. Female genitalia of *Megalographa* spp. **15)** *M. agualaniata*, Bolivia. **16)** *M. bonaerensis*, Curitiba, 920 m, Paraná, Brazil. **17)** *M. biloba*, Thunder Bay, Ontario, Canada. **18)** *M. talamanca*, Reserva los Nimbulos, 3150 m, Cerro de la Muerte, San José, Costa Rica.

stigma are joined. The postmedian line is notched between M3 and CUA1 in *M. biloba*; in *M. talamanca* there is a defined dash. The silver crescent below the reniform spot is entire and prominent in *M. biloba* but often broken and indistinct in *M. talamanca*. In the male genitalia the clavus is approximately the length of the clasper in *M. biloba* but 0.25X its length in *M. talamanca* (*M. biloba* clasper (0.31mm) and clavus (0.31mm); *M. talamanca* clasper (0.50mm) and clavus (0.13mm). The subbasal evagination in the vesica is larger in *M. biloba*. In the female genitalia, the ductus bursae is 0.25X as long as the corpus bursae, whereas in *M. talamanca* it is 0.13X as long, and the corpus bursae has a mesial twist where the bursa bends through a 90° angle that is absent in *M. talamanca*.

Distribution and Habitat. *Megalographa biloba* is widely distributed from southern United States southward through Central and South America to Argentina. It occurs farther north into northern United States and southern Canada as a seasonal migrant where it usually produces one or two generations each summer, but it rarely survives the winter in the northern part of its range. It also occurs in the Hawaiian Islands but it is unknown if the species occurs there naturally or was introduced. The species also occurs as a rare migrant in Great Britain, mainly in the summer and fall, but its travel to Europe could be aided by ships crossing the Atlantic.

***Megalographa talamanca* nov. sp.**

(Figure 7, 8, 13, 18)

Type locality. Cerro de la Muerte, Provincia San José, Costa Rica.

Type material. Holotype, male: Costa Rica. Provincia Cartago: El Guarco, San Isidro, Estacion Esperanza, 2700 m, R Delgado (INBio). **Paratypes:** 26 m, 8 f: Costa Rica. Provincia Cartago: Cerro de la Muerte, [Hotel La Georgina], 3300 m, 23–24.ii.1987, Lafontaine and Wood (2 m); Provincia San José: Estación Biológica, Cerro de la Muerte, Reserva los Nimbulos, 09° 33' 42.3" N, 83° 44' 27.2" W, 3150 m,

20.iii.2004, J. B. Sullivan & J. D. Lafontaine (8 m, 6 f); 24-27.vii.2006, J. B. Sullivan & B. Espinosa (8 m 2 f). (CNC, USNM, JBS); Provincia San Jose: 4.6 km. E. of Villa Mills, 2640 m, 17-22.iii.1996 (5 m); 7-10.xii.1996 (3 m) (INBio).

Etymology. The name refers to the mountain range in Costa Rica where the species occupies elevations above 3000 m.

Diagnosis. This species is easily confused with *M. biloba* but usually can be recognized externally by the more roughened bronzy-brown ground color, more even postmedial line, and the relatively smaller silvery-white stigma that is separated into two spots in two thirds of the specimens. The male genitalia differ from those of the other species in the genus, other than *M. biloba*, in having a more slender uncus, the vesica lacks an apical cornutus, and the swelling in the vesica is subbasal rather than mesial. They differ from those of *M. biloba* in having a short clavus, like other species in the genus, and in having an almost straight vesica with a small dorsal pouch subbasally. In the female genitalia, the corpus bursae is long and J-shaped, without the mesial coil and angle of *M. biloba*.

Description. Palpae with middle segment 2X length of other segments. Brown dorsally with scattered gray scales, laterally brown, sooty gray scales ventrally, light gray scales prominent on upper half of 2nd segment. Pinkish-gray scales on ventral edge and on inner surface. Frons a dense mass of brown upright scales tipped in gray; upright scales length of 2nd palpal segment. Interantennal area with similar scaling but only 0.66X as long. Eye round, without setae or lashes; ocelli present. Scape white distally, base brown. Antennae fasciculate; 8–10 sublateral setae on each segment side, setal length about half width of segment; approximately 84 segments per antenna which has white scaling on dorsal side along basal half of flagellum and orange tan ventrally. Collar a mass of upright scales, tricolored from basal orange to brown mesially to white tips. Thoracic scales similarly colored, almost 2X as long as those of collar; tegula similarly scaled, two masses of scales extended toward abdominal tip. Abdomen with dark-brown dorsal tuft on T1 and T2; remaining segments gray dorsally, whereas ventral side is straw and pink scaled. Leg dorsally with chocolate colored scales with light gray tips; ventrally mostly pale yellow. Tarsal joints usually white tipped. Tympanum with large hood with a distinct white abdominal tuft above it.

Wing ground color iridescent brown with dark reddish brown, and silver areas. Stigma usually two separate silver, tear shaped hemispheres, basally joined in a third of the specimens, particularly females. Median line angles toward thorax, proximally gray. Reniform spot a black dot, silver horseshoe-shaped crescent below it often broken. Transverse lines silver. Basal area reddish brown; median area of wing brown with some gray and some rusty patches; postmedian line appears double and is crossed in middle by black dash that extends to wing margin. Area beyond postmedian line gray then two toned brown distally above median dash; below dash colors reversed. Terminal line dark chocolate; fringe pale gray basally, dark gray brown distally. Costa almost black. Wing margin gently rounded. Spot-like rusty patch inward from junction of pm line and anal edge of wing. Hind wings fuscous; veins outlined with darker scaling. Postmedian line barely visible dorsally. Ventrally, postmedian line and discal spots prominent on both wings. Marginal line dark. Hindwings more yellow below; retinaculum a distinct patch of yellow scales. Sexes difficult to determine using frenulum because placement is quite similar in both sexes with setae in female retinaculum appressed and inserted below costa, not extended above margin of hindwing. Scaling below eye noticeably reddish brown. Sexes similar except that antennal setae reduced in females to a single bristle per segment attached to distal half of each segment. Wing length: males 15.8–17.8mm; average 16.8 mm (N=12); females 17.4–18.9 mm; average 18.2 mm (N=6).

Male pelt moderately sclerotized, terminal sternite with well defined, horseshoe-shaped apodeme. Valve with long, pointed uncus adorned on dorsal surface of distal third with setae about 2X width of uncus. Tegumen broad, sclerotized lightly in median area. Valva palmate shaped with mesial bulge along anal margin. Distinct hair-like socketed setae on rounded apex, longer setae along anal margin to below bulge. Clasper (ampulla) fleshy tubercle, apical half with numerous setae, length about 0.5X of widest part of valva. Ridge bearing clasper extends from basal area of valva to top of bulged region and slightly anal of mid valve. Clavus tubercle-like extension 0.5X length of clasper, setae prominent at distal end. Vinculum V-shaped, margins sclerotized, small ridge mesially along margin. Anellus broad curving straps,

anal tube simple, large in diameter and lightly sclerotized ventrally. Aedeagus straight, ductus enters dorsally on proximal end. Distal end of aedeagus heavily sclerotized dorsally and laterally, almost crenulated. Vesica straight, granulated and same diameter as aedeagus; shallow subbasal lobe. Valva length 2.78 mm, clasper 0.5 mm, clavus 0.13 mm; aedeagus 2.72 mm.

Female genitalia with moderately sclerotized pelt. Tergites undifferentiated. Anal papillae with rounded tips, setose. Apophyses approximately equal in length, pointed. Ductus bursae short, about 0.13X length of corpus bursae and with sclerotized, longitudinal, spiculate ridges. Corpus bursae very long, J-shaped with appendix bursae represented by a small ventrally projecting posterior bulge; corpus bursae with very lightly sclerotized, longitudinal, spiculate bands; no signum. Length: ductus bursae: 1.5 mm; corpus bursae: 12.0 mm; appendix bursae: 1.0 mm.

Distribution and Habitat. *Megalographa talamanca* is known only from the Talamanca Mountain Range of central Costa Rica where it has been collected at elevations above 3100 meters in oak dominated cloud forests. Two nights of collecting in August of 2007 on top of on Volcan Poas (65 km NW of the Talamanca Mountain Range) produced almost 2000 specimens of moths but no *Megalographa talamanca*, indicating that its distribution may be limited to the Talamanca Mountain Range.

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