

Six new cryptic species of *Xylodonta* Becker, 2014 (Notodontidae: Nystaleinae) from Costa Rica

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Abstract: The genus *Xylodonta* Becker (Notodontidae, Nystaleinae) is reviewed for Costa Rica based on 1,571 reared and wild-collected specimens. Eleven species are recorded, of which six are newly described: *Xylodonta markvanputteni* Chacón, *Xylodonta patrickgoodwilliei* Chacón, *Xylodonta scottmilleri* Chacón, *Xylodonta andrewrusselli* Chacón, *Xylodonta robertodelgadoi* Chacón, and *Xylodonta billhaberi* Chacón. *Xylodonta terrena* (Schaus, 1892) and *Xylodonta xylinata* (Walker, 1865) are redescribed and *Xylodonta angustipennis* (Schaus, 1911), *Xylodonta rufitincta* (Dyar, 1913), and *Xylodonta guarana* (Schaus, 1892) are discussed. Adults and genitalia are illustrated. Species are described and diagnosed through their distinctive COI barcodes, genital morphology and life histories. *Xylodonta* adults and caterpillars, and their foodplants in Área de Conservación Guanacaste (ACG) in northwestern Costa Rica, are reviewed. Larvae of four species are illustrated.

Keywords: DNA barcoding, cryptic species, Área de Conservación Guanacaste, rain forest, tropical dry forest, tropical cloud forest, Museo Nacional de Costa Rica

Resumen: El género *Xylodonta* Becker (Notodontidae, Nystaleinae) se revisa para Costa Rica, con base en 1.571 especímenes criados y recolectados en el medio silvestre. Se registran once especies, de las cuales seis son descritas como nuevas: *Xylodonta markvanputteni* Chacón, *Xylodonta patrickgoodwilliei* Chacón, *Xylodonta scottmilleri* Chacón, *Xylodonta andrewrusselli* Chacón, *Xylodonta robertodelgadoi* Chacón y *Xylodonta billhaberi* Chacón. Se describen *Xylodonta terrena* (Schaus, 1892) y *Xylodonta xylinata* (Walker, 1865). Se discute acerca de *Xylodonta angustipennis* (Schaus, 1911), *Xylodonta rufitincta* (Dyar, 1913) y *Xylodonta guarana* (Schaus, 1892). Se ilustran los adultos y los genitales de todas las especies. La mayoría de las especies se describen a través de sus códigos de barras COI, genitales e historia natural. Los adultos, orugas y plantas hospederas de *Xylodonta* en el Área de Conservación Guanacaste (ACG) en el noroeste de Costa Rica, se revisan. Se ilustran las larvas de cuatro especies.

Palabras clave: Código de barras de ADN, especies crípticas, Área de Conservación Guanacaste, bosque lluvioso, bosque seco, bosque nuboso, Museo Nacional de Costa Rica

INTRODUCTION

The genus *Xylodonta* Becker previously contained 11 described species of medium-sized, brownish gray moths that occur from Mexico to Argentina (Becker, 2014). The type species, *Nystalea xylinata* (Walker, 1865), was described from Bogotá, Colombia. Here, we treat the single previously recorded Costa Rican *Xylodonta* species, *X. terrena* (formerly known as *Dasylophia maxtla* Schaus), as well as *X. xylinata* (Walker, 1865), *X. angustipennis* (Schaus, 1911), *X. rufitincta* (Dyar, 1913), *X. guarana* (Schaus, 1892) and the six undescribed ones that until now were hidden under the name *D. maxtla*. *Xylodonta terrena* has also sometimes been misidentified as *Dasylophia xylinata* in collections. As will be seen in our illustrations, all six new species can be easily distinguished from *X. terrena* by the morphology of their male genitalia, as well as by their DNA

barcodes, and in the case of the four species whose caterpillars have been found in the wild, by their relatively different food plants as well.

MATERIALS AND METHODS

A total of 1,571 specimens were examined for this study: 624 were reared from wild-caught caterpillars in Área de Conservación Guanacaste (ACG) in northwestern Costa Rica (Janzen *et al.*, 2009); 131 were collected by the ACG BioLep project using light traps; and 816 are in the Lepidoptera collection of Costa Rica's Museo Nacional (formerly that of INBio) and were collected with light traps. Of these 1,571 specimens, 519 have been barcoded and can be reviewed in the Barcode of Life Data System (BOLD; <http://dx.doi.org/10.5883/DS-ASDASY>). A total of 58 specimens were

dissected for comparison of genital morphology: 34 males and 24 females. It was also necessary to barcode the type specimens of *Oedemasia terrena*, *Oedemasia maxtla*, *Notodonta dares* and *Notodonta pythia* to test whether the barcodes of any of the putatively new species matched them. None of the six new species described here have a DNA barcode matching that of these types (Grishin, unpubl.), while the barcode of the Schaus holotype of *Oedemasia terrena* in the National Museum of Natural History, Washington, D.C., USA (USNM) is identical to material treated here as *Xylodonta terrena*.

It is important to mention that no barcode was obtained from the type specimens of *Dasylophia angustipennis*, *Dasylophia rufitincta* and *Oedemasia guarana*, because the USNM did not approve such procedures. Nevertheless a comparison of genital morphology was performed between the types of *Dasylophia angustipennis*, *Dasylophia rufitincta* and our barcoded and dissected *Xylodonta* specimens, in order to confirm similarities or differences.

Genitalia comparison was not possible for the type of *Dasylophia guarana* as there are no genitalia available, but in August of 2008, Jim Miller identified the voucher specimen 87-SRNP-1251 as *D. guarana*, based on wing pattern comparisons with the type specimen of *O. guarana* deposited in the USNM. This voucher specimen was then used to identify *X. guarana* from Costa Rica.

We were unable to sequence or dissect the *X. xylinata* male holotype from Bogotá, deposited at the Natural History Museum, London, UK (BMNH). Nevertheless, Nick Grishin barcoded the holotype of *Notodonta pythia* (Druce, 1895), in the BMNH, which according to Becker (2014) is a synonym of *X. xylinata*. The barcode of *N. pythia* is similar to the barcodes of all specimens we identify as *X. xylinata* from Costa Rica.

The holotypes of the new species have been deposited in the collection of the Museo Nacional de Costa Rica (MNCR), and paratypes have been distributed between the MNCR, the Muséum national d'Histoire naturelle, Paris (MNHN), the Paul Thiaucourt collection, and the USNM.

The following abbreviations are used for morphological terms: AD: Adterminal line; CB: Corpus bursae; DB: Ductus bursae; FW: Forewing; HW: Hind wing; M: Medial line; PM: Postmedial line; ST8: Sternum 8; STL: Subterminal line; T8: Tergum 8; TL: Terminal line; FWL: Forewing length.

SYSTEMATICS

Xylodonta Becker

Xylodonta Becker, 2014, Checklist of New World Notodontidae (Lepidoptera: Noctuoidea). *Lepidoptera Novae* 7: 1-40.

Type-species: *Nystalea xylinata* Walker, 1865, List of the Specimens of Lepidopterous Insects in the Collection of the British Museum. Supp. 33: 759-760.

Type specimens: Unspecified number of syntypes [BMNH], London.

Diagnosis: Adults – Medium-sized notodontid moths, FWL 16-27 mm, females larger than males; male antenna bipectinate in basal 2/3, distal 1/3 simple, scape bearing a long tuft; female antenna bipectinate halfway, rami shorter and less dense

than in males; lashed eye, smooth, round; palpi upcurved to medial area of frons, 2nd segment 2 × first segment in length, 3rd segment small and slightly decumbent; scaling appressed, haustellum present, 13-14 mm long, ocelli present. Patagia covered with long scales, thoracic scaling not tightly appressed, with moderately long scales, without tufts, concolorous with forewing; abdominal scaling appressed, without tufts, concolorous with hind wing. In fresh specimens, the brown and black pattern is overlaid with light greens and pinks that give the forewing a lichen- and moss-covered appearance. Forewing elongate, narrow, with a 'woody' pattern. Male terminal tergite distinctive (Figs 7, 17, 27, 37, 46, 55, 64, 75, 84, 92, 98, 105).

Male genitalia: Uncus acute or rounded, sometimes divided; socii small, sclerotized, globular, pubescent, rarely thin and elongated; valvae often asymmetrical with costal margin sclerotized, sometimes with projections, saccular margin smooth, toothed or with protuberances; phallus well developed, sclerotized, usually extending to uncus and narrowing distally; often with distinct lateral and dorsolateral processes; ST8 diagnostic, bifurcate, often asymmetrical with serrate or dentate margins.

Female genitalia: ST8 sclerotized, with lateral margins slightly toothed; ductus bursae compressed or short; corpus bursae elongate and globular, surface wrinkled, signa present; papillae anales ovoid with multiple setae, apophysis anterior shorter than posterior. The sclerotized ST8 is the principal diagnostic character of the genus (Figs 9, 19, 29, 39, 48, 57, 66, 77, 86).

Etymology: The generic name is derived from the Greek words "xylon", meaning wood, and "odontos", meaning tooth (as in *Notodonta*), and it is treated as feminine.

Larvae: Brightly colored, feeding on Fabaceae. Head surface rugose; head taller than thoracic segment 1; anal prolegs small, tubular in shape, crochets present; segment A8 with a dorsal protuberance.

Remarks: The species belonging to this genus resemble those in *Dasylophia* Packard, in which they were formerly placed.

Species accounts

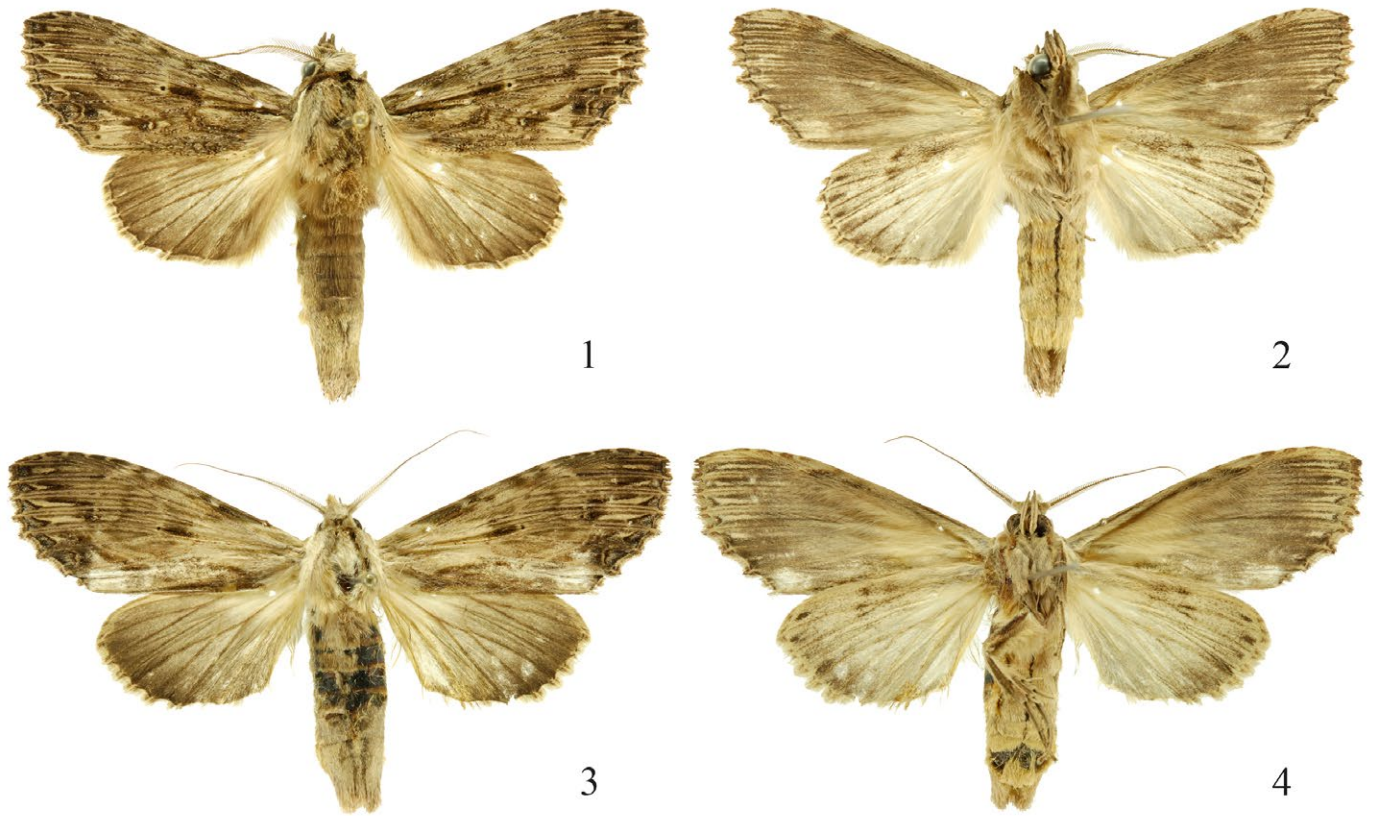
Xylodonta terrena (Schaus, 1892) (Figs 1-10; Figs 108-111)

Synonyms: *Oedemasia maxtla* Schaus, 1892; *Notodonta dares* Druce, 1894.

Original description (Schaus, 1892):

"**Female:** Primaries fawn-colored, shaded with dark brown, darkest along the inner margin; a cluster of black scales below the middle of the median vein; halfway between this spot and the outer margin another similar spot resting on the portion of a very indistinct, outwardly curved, and wavy pale line, which reaches from the costal to the inner margin; the outer margin with the veins dark, finely edged with buff; a series of oblique pale lines between the veins; a large pale space at the base of the primaries. Secondaries dark brownish grey. Centre of thorax and abdomen very dark cinereous. Thorax laterally and head light fawn-colored. Expanse 50 mm. Hab. Coatepec, Mexico."

Redescription: MALE (Figs 1, 2): FWL 19-23 mm. **Head:** Antenna light brown, antennal shaft beige dorsally and brown ventrally; scape bearing a long beige tuft, cream and light-brown scales; eyes dark gold; frons mostly light brown with dark brown scales intermixed; labial palpus porrect, light brown ventrally, dark brown dorsally; vertex dark brown. **Thorax:** Tegula cream at base, a mix of light and dark brown scales distally; patagium dirty brown; mesoscutellum dirty brown; thoracic pleuron light brown to dirty brown; metathoracic dorsum with dirty brown hair-like scales. **Legs:** Mostly dirty brown and beige with black scales between segments. **Abdomen:** Dorsum



Figs 1-4. *Xylodonta terrena*: 1, 2 male dorsal and ventral (97-SRNP-761) forewing length 21.13 mm; 3, 4 female dorsal and ventral (07-SRNP-58051) forewing length 25.88 mm.



Figs 5-10. *Xylodonta terrena*: 5, 6 male genitalia 4.3 mm length, 7 male ST8 5.2 mm length, 8 phallus 4 mm length (88-SRNP-514); 9, 10 female genitalia (95-SRNP-879) 5.5mm length.

dirty brown, venter light brown with a dark brown line in the middle. **Wings:** Dorsal FW ground color beige with black scales covering veins, a dark basal dash, with a black orbicular spot; M dark brown, from inner margin to costal margin, S-shaped, PM irregular beige, STL formed by triangular dark brown marks, TL black, fringe dirty and light brown, dorsal HW dark brown; fringe light brown and dark brown. **Male genitalia** (Figs 5-8): T8 (Fig. 7) rectangular, longer than wide, posterior margin sclerotized, with a small invagination in center; ST8 (Fig. 7) dark-brown, sclerotized with serrate margins, V-shaped with two denticulate rounded projections, projections asymmetrical, right one shorter with a heavily sclerotized tooth at inner basal margin, antecostal apodemes long, thin and symmetrical, internal ridges present. Valvae slightly asymmetrical and curved, apices rounded and flattened, saccular margin sclerotized, slightly jagged, costal margin sclerotized, juxta sclerotized with two asymmetrical projections, the left one longer with irregular apical margin; uncus short, apex acute and curved, with a short acute dorsal projection (Figs 5, 6); proximal part of phallus tube thin and membranous, distal part sclerotized and robust, vesica with three spinose patches (Fig. 8).

FEMALE (Figs 3, 4): Similar to male but larger (FWL 24-27 mm). **Female genitalia** (Figs 9, 10): ST8 with a dark ovoid sclerotized plate; ductus bursae compressed; corpus bursae elongate and globular, surface wrinkled, signum hemispherical with sclerotized margins; papillae anales ovoid, densely setose, apophysis anterior shorter than apophysis posterior.

Specimens examined: 141 specimens (100 males, 41 females). Data for specimens examined with barcodes and morphology matching those of the type specimen of *Xylodonta terrena*, and for other specimens examined but not barcoded, are listed in Supplementary Information (Chacón *et al.*, 2017).

Diagnosis: ST8 dark-brown, sclerotized with dentate margins, V-shaped with two asymmetrical, rounded projections, right projection shorter with a heavily sclerotized tooth at base of margin, antecostal apodemes long, thin and symmetrical, internal ridges present on inner margin (Fig. 7); uncus short with acute and curved bifurcated apex, and a short, acute dorsal projection (Figs 5, 6); proximal part of phallus tube thin and membranous, distal part sclerotized and robust, vesica with three spinose patches (Fig. 8).

Distribution: In Costa Rica, *Xylodonta terrena* has been collected on the eastern slope of Cordillera Volcánica de Guanacaste, Cordillera de Tilarán, Cordillera Volcánica Central and Cordillera de Talamanca, from 280 to 2600 m elevation (Fig. 129). The type specimens are from Coatepec, Mexico (1192 m). It should be emphasized that a given numerical elevation in one place, for example western Mexico, is not biologically equivalent to that same numerical elevation in a Costa Rican rain forest. Furthermore, elevation is not generally available for older specimens and species identifications cannot be assumed from the name applied in collections. Therefore, elevation should not be viewed as a diagnostic characteristic. The true distribution of *X. terrena* is thus impossible to evaluate given our current state of knowledge; to sort through the massive confusion about its identity would require barcoding and dissecting specimens from other countries throughout its supposed range, a task beyond the scope of our work.

Natural history (Figs 108-111): 62 rearing records: ACG locations: Sector Cacao (n=34), Sector Del Oro (n=3), Sector Mundo Nuevo (n=8), Sector Pitilla (n=2), Sector San Cristóbal (n=15).

Food plants: Exclusively Fabaceae; *Dioclea malacocarpa* Ducke (n=2), *Erythrina costaricensis* Micheli (n=3), *Erythrina lanceolata* Standl. (n=2), *Lennea viridiflora* Seem. (n=2), *Lonchocarpus felipei* Zamora (n=2), *Lonchocarpus macrophyllus* Kunth (n=2), *Lonchocarpus oliganthus* F.J. Herm.

(n=43), *Platymiscium parviflorum* Benth. (n=1), *Pterocarpus officinalis* L. (n=2), *Pterocarpus rohrii* Vahl (n=1).

Remarks: This is the *Xylodonta* species most frequently encountered in light traps in Costa Rica. Caterpillars (Figs 108-111) are frequently found feeding on *Lonchocarpus oliganthus* growing in the rain forest understory at intermediate elevations. Genbank Accession: GU159561

DNA barcode of male 97-SRNP-761.

MHANC422-06 |97-SRNP-761| *Xylodonta terrena* (*D. maxtlaDHJ06*) |COI-5P

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NNACTTTTATATTTTATTTTGGAAATTTGAGCCGGTATATTAGGTAATTCAT
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TACAATACTTTTAACTGATCGAAATTTAAATACTTCATTTTTGACCAGCT
GGAGGAGGAGATCCAATTTTATATCAACATTTATTT
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Xylodonta markvanputteni Chacón, new species

(Figs 11-20; Figs 112-116)

Description: **MALE** (Figs 11, 12): FWL 20-22 mm. **Head:** Antenna dark brown, antennal shaft dorsally beige and ventrally brown; scape bearing long tuft of beige, cream and red-brown scales; eyes dark gold; frons mostly light brown with red brown intermixed scales; labial palpus porrect, light brown ventrally, beige dorsally; vertex beige. **Thorax:** Tegula dirty brown at base, a mix of cream and dark brown scales distally; patagium dirty brown; mesoscutellum beige and dirty brown; thoracic pleuron beige to dirty brown; dorsal area of metathorax with dirty brown hair-like scales. **Legs:** Mostly dirty brown and beige with black scales between segments. **Abdomen:** Dorsum dirty brown, venter beige with a dark brown line at midline. **Wings:** Dorsal FW ground color beige with black scales covering veins, a dark basal dash, orbicular spot black; M beige colored, S-shaped from inner margin to costal margin, PM irregular, light brown, STL formed by triangular dark brown marks, TL black, fringe dirty brown, dorsal HW dark brown; fringe light brown (Figs 11, 12). **Male genitalia** (Figs 15-18): T8 trapezoidal, posterior margin with two slightly asymmetrical lobes, sclerotized; ST8 with antecostal apodemes long, robust and symmetrical anterior margin, internal ridges present, two dark, robust projections on posterior margin, asymmetrical, heavily sclerotized, with prominent teeth laterally, teeth smaller on inner margin (Fig. 17); valvae asymmetrical, sclerotized and setose, left valve wide, with costal margin sclerotized, saccular margin membranous and setose, apex wide and sclerotized. Saccular margin of right valve membranous, finely pubescent at base, sclerotized, setose and elongate towards apex, costal margin sclerotized; uncus hook-shaped, sclerotized, setose ventrally, socii comprising two small setose protuberances (Figs 15, 16); proximal part of phallus tube slender, rounded at base, distal part of phallus tube robust, slightly sclerotized with a dorsal projection, vesica bulbous with two spiny patches (Fig. 18).

FEMALE: Similar to male but larger, dorsal FW ground color mostly beige (Figs 13, 14). FWL 24-25 mm. **Female genitalia** (Figs 19, 20) – ST8 completely sclerotized, lateral margins with small black sclerotized bumps, postvaginal plate heavily sclerotized, four short spine-like lateral processes on distal margin, ductus bursae extremely short, corpus bursae elongate, rounded with multiple folds in membrane, signum boat-shaped, sclerotized, elongated, acute at ends. Papillae anales ovoid, densely setose, anterior apophysis sclerotized, longer than posterior apophysis.

Etymology: *Xylodonta markvanputteni* is named in honor of Mark Van Putten of Grand Rapids, Michigan in recognition of his many years of outstanding support for the Guanacaste Dry Forest Conservation Fund and Área de Conservación Guanacaste.



Figs 11-14. *Xylodonta markvanputteni*: 11, 12 Holotype male dorsal and ventral (09-SRNP-31078) forewing length 21.35 mm; 13, 14 Paratype female dorsal and ventral (08-SRNP-4651) forewing length 24.53 mm.



Figs 15-20. *Xylodonta markvanputteni*: 15, 16 Holotype male genitalia (08-SRNP-1546) 5.9 mm length, 17 male ST8 4.5 mm length, 18 phallus 3.5 mm length, 19, 20 Paratype female genitalia (08-SRNP-4651) 6.00 mm length.

Specimens examined: 98 specimens (58 males, 40 females).

Type specimens: **HOLOTYPE MALE:** 09-SRNP-31078 (COI Barcoded), Costa Rica, Área de Conservación Guanacaste, Prov. Guanacaste, Sector Pitilla, Sendero Bernales 10.98350 -85.42117, 660 m, 30 April 2009, Petrona Ríos (USNM).

PARATYPES: 53 males, 39 females. Data for paratypes and other specimens examined are listed in Supplementary Information (Chacón *et al.*, 2017).

Diagnosis: ST8 heavily sclerotized, with two robust, slightly asymmetrical postero-lateral projections, projections coarsely dentate; valvae asymmetrical, sclerotized and setose, left valve wide, with costal margin sclerotized, saccular margin membranous and setose, apex wide and sclerotized; saccular margin of right valve membranous and finely pubescent at base, sclerotized, setose and elongate towards apex, costal margin sclerotized; uncus hook-shaped and sclerotized, setose ventrally; proximal portion of phallus tube slender, rounded at base, distal portion of phallus tube robust, slightly sclerotized and acute posteriorly, with a bulbous spiny patch.

Distribution: *Xylodonta markvanputteni* has been collected only in the rain forest of the Cordillera Volcánica de Guanacaste and Cordillera Volcánica Central from 400 to 1325 m elevation (Fig. 129). While feeding occasionally on other Fabaceae, it is the only species of *Xylodonta* whose caterpillars feed on *Swartzia simplex* in the ACG rain forest understory.

Natural history (Figs 112-116): 93 rearing records: ACG locations: Sector Cacao (n=16), Sector Del Oro (n=2), Sector Pitilla (n=23), Sector San Cristóbal (n=51), Sector Santa María (n=2).

Food plants: Exclusively Fabaceae: *Erythrina lanceolata* Standl. (n=1), *Lonchocarpus guatemalensis* Benth. (n=1), *Lonchocarpus macrophyllus* Kunth (n=1), *Lonchocarpus oliganthus* F.J. Herm. (n=8), *Ormosia panamensis* Benth. ex Seem. (n=2), *Platymiscium parviflorum* Benth. (n=1), *Pterocarpus officinalis* Jacq. (n=10), *Styphnolobium montevidis* M. Sousa & Rudd (n=2), *Swartzia cubensis* (Britton & P. Wilson) Standl. (n=3), *Swartzia simplex* (Sw.) Spreng. (n=64).

Remarks:

Genbank Accession: GU651267

DNA barcode of holotype male 09-SRNP-31078

MHMYC1056-09|09-SRNP-31078| *Xylodonta markvanputteni* (D. maxtlaDHHJ04)|COI-5P

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AACTTTATATTTTATTTTGGAAATTTGAGCCGGTATATTAGGTACTTCATTA
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CAATACTTTTAACTGATCGAAATTTAAATCTTCAATTTTTGATCCTGCTGG
AGGAGGAGATCCAATTTTATATCAACATTTATTT
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Xylodonta patrickgoodwilliei Chacón new species

(Figs 21-30; Figs 117-122)

Description: **MALE** (Figs 21, 22, 25-28): FWL 16-20 mm. **Head:** Antenna dark brown, antennal shaft cream dorsally and light brown ventrally; scape bearing a long tuft of beige, cream scales; eyes dark gold; frons mostly light brown; labial palpus porrect, dirty brown ventrally and dorsally, beige laterally; vertex light brown. **Thorax:** Tegula dirty brown at base, a mix of cream and dark brown scales distally; patagium beige; mesoscutellum dirty brown; thoracic pleuron beige; dorsal area of metathorax with dirty brown hair-like scales. **Legs:** Mostly dirty brown and beige with black scales between segments. **Abdomen:** Dorsum dirty brown, venter beige with a dark brown midline. **Wings:** Dorsal FW ground color beige with black scales covering veins, a dark basal dash with a black orbicular spot; PM cream colored, from inner margin to costal margin with a question mark sign-shaped line, STL formed by triangular dark brown marks, TL black, fringe dirty brown, dorsal HW dark brown; fringe light brown. **Male genitalia** (Figs 25-28): T8 rectangular, wider than long, posterior margin finely dentate and sclerotized, a central dome covered by a brush; ST8 posterior margin sclerotized, dentate with a deep central depression and a projection on each side, anterior margin with antecostal apodeme symmetrical, short and thin, slightly curved, internal ridges present (Fig. 27); valvae symmetrical, saccular margin membranous and setose, costal margin sclerotized, apices strongly curved, flattened sclerotized, hook-like and acute; sclerotized uncus curved, trident-shaped, socii tiny, sclerotized, globular and setose (Figs 25, 26); proximal portion of phallus tube wide and robust, distal portion sclerotized, robust, curved, with a strongly sclerotized dorsal spatulate projection, apex thin, sharp and denticulate (Fig. 28).

FEMALE (Figs 23, 24): Similar to male but larger, basal dash absent, FWL 23-25 mm. **Female genitalia** (Figs 29, 30): ST8 with a sclerotized triangular plate, lateral margins slightly toothed; ductus bursae dorsoventrally compressed; corpus bursae globular, membrane with numerous folds, signa rectangular and slightly elongate; papillae anales slightly ovoid, with irregular borders and multiple setae, anterior apophyses sclerotized, longer than posterior apophyses.

Etymology: *Xylodonta patrickgoodwilliei* is named in honor of Patrick Goodwillie of Chicago, Illinois in recognition of his many years of outstanding support for the Guanacaste Dry Forest Conservation Fund and Área de Conservación Guanacaste.

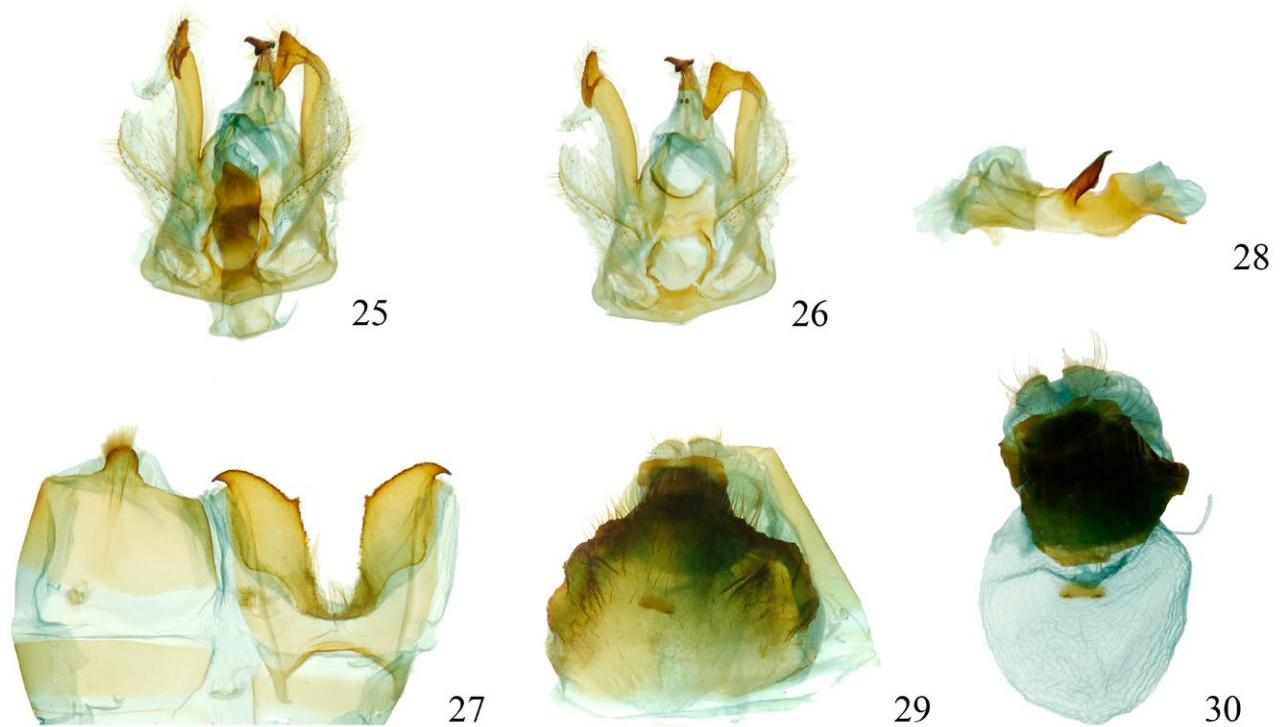
Specimens examined: 26 specimens (15 males, 11 females).

Type specimens: **HOLOTYPE MALE** 06-SRNP-4506 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Areño 10.91407 -85.38174, 460 m, 8 July 2006, Gloria Sihezar (USNM).

PARATYPES: 15 males, 11 females. **Males:** 05-SRNP-2958 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Areño 10.91407 -85.38174, 460 m, 15 June 2005, Yessenia Mendoza (MNCR). 06-SRNP-3023 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Areño 10.91407 -85.38174, 460 m, 8 May 2006, Osvaldo Espinoza (USNM). 00-SRNP-11094 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 13 June 2000, Carolina Cano (USNM). 00-SRNP-11096 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 14 June 2000, Carolina Cano (USNM). 00-SRNP-11319 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 21 June 2000, Osvaldo Espinoza (USNM). 00-SRNP-11384 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 3 July 2000, Freddy Quesada (USNM). 01-SRNP-2232 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 16 July 2001, Freddy Quesada (USNM). 03-SRNP-8252 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 24 September 2003, Carolina Cano (USNM). 03-SRNP-8253 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 27 September 2003, Carolina Cano (USNM). 00-SRNP-1899 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Sendero Corredor 10.87868 -85.38963, 620 m, 12 July 2000, Gloria Sihezar (USNM). 06-SRNP-4504 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Areño 10.91407 -85.38174, 460 m, 6 July 2006, Gloria Sihezar (USNM). 01-SRNP-2231 (COI Barcoded), Costa



Figs 21-24. *Xylodonta patrickgoodwilliei*: 21, 22 Paratype male dorsal and ventral (05-SRNP-2958) forewing length 19.02 mm; 23, 24 Paratype female dorsal and ventral (00-SRNP-11186) forewing length 23.42 mm.



Figs 25-30. *Xylodonta patrickgoodwilliei*: 25, 26 Paratype male genitalia (06-SRNP-7666) 4.1 mm length, 27 male ST8 4.7 mm length, 28 phallus 2.6 mm length, 29, 30 Paratype female genitalia (00-SRNP-1186) 5.1 mm length.

Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 16 July 2001, Freddy Quesada (USNM). 06-SRNP-7666 (COI Barcoded dissected), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Puente Palma 10.9163 -85.37869, 460 m, 19 September 2006, Anabelle Córdoba (USNM). 00-SRNP-12608 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 15 June 2000, Freddy Quesada (USNM). **Females:** 08-SRNP-6232 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Puente Palma 10.9163 -85.37869, 460 m, 23 November 2008, Carolina Cano (USNM). 01-SRNP-3731 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 27 October 2001, Freddy Quesada (USNM). 01-SRNP-3732 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 26 October 2001, Freddy Quesada (USNM). 06-SRNP-6338 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 23 August 2006, Gloria Sihezlar (USNM). 06-SRNP-9230 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Sendero Perdido 10.8794 -85.38607, 620 m, 1 December 2006, Gloria Sihezlar (USNM). 07-SRNP-2338 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Potrero Argentina 10.89021 -85.38803, 520 m, 21 June 2007, Osvaldo Espinoza (USNM). 03-SRNP-12592.1 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector Rincón Rain Forest, Vado Río Francia 10.90093 -85.28915, 400 m, 2 October 2003, Minor Carmona (USNM). 06-SRNP-32372 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector Pitilla, Pasmompa 11.01926 -85.40997, 440 m, 7 July 2006, Manuel Ríos (MNCR). 00-SRNP-11186 (dissected, COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Sendero Palo Alto 10.88186 -85.38221, 570 m, 13 June 2000, Freddy Quesada (MNCR). 06-SRNP-2556 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 27 April 2006, Carolina Cano (USNM). 00-SRNP-11095 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Río Blanco Abajo 10.90037 -85.37254, 500 m, 14 June 2000, Carolina Cano (USNM).

Diagnosis: ST8 posterior margin sclerotized, dentate with a deep central depression and a projection on each side, anterior margin with antecostal apodeme symmetrical, short and thin, slightly curved, internal ridges present (Fig. 27). Uncus sclerotized, curved and trident-shaped, socii tiny, sclerotized, globular and setose (Figs 25, 26); proximal portion of phallus tube wide and robust, distal portion sclerotized, robust, curved, with a strongly sclerotized, spatulate projection dorsally, apex thin, sharp and finely dentate (Fig. 28).

Distribution: *Xylodonta patrickgoodwilliei* has been reared only from intermediate elevations on the eastern side of the Cordillera Volcánica de Guanacaste, from 400 to 570 m elevation (Fig. 129). None has been taken in light traps.

Natural history: (Figs 117-122) 42 rearing records: ACG locations: Sector Pitilla (n=3), Sector Rincón Rain Forest (n=2), Sector San Cristóbal (n=38).

Food plants: exclusively Fabaceae: *Dioclea malacocarpa* Ducke (n=39), *Dioclea wilsonii* Standl. (n=3).

Remarks: To date, this is the only species of *Xylodonta* whose caterpillars have been found feeding on mature foliage of *Dioclea*; they have not been found on any other plant genus.

Genbank accession: JQ54278

DNA barcode of male holotype 06-SRNP-4506.

MHMXD1252-06|06-SRNP-4506| *Xylodonta patrickgoodwilliei* (D. maxtlaDHF05)|COI-5P

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Xylodonta scottmilleri Chacón new species

(Figs 31-39)

Description: **MALE** (Figs 31, 32): FWL 18-20 mm. **Head:** Antenna dark brown, antennal shaft cream dorsally and light brown ventrally; scape bearing a long dorsal tuft of beige-cream scales; eyes dark gold; frons mostly dirty brown; labial palpus porrect, cream ventrally and laterally, dark brown dorsally; vertex dirty brown. **Thorax:** Tegula dark brown at base, a mix of cream and light brown scales distally; patagium dark brown; mesoscutellum light brown; thoracic pleuron beige; dorsal area of metathorax with light brown, hair-like scales. **Legs:** Mostly dirty brown and beige, with black scales between segments. **Abdomen:** Dorsum light brown, venter light brown with a dark brown midline. **Wings:** Dorsal FW ground color beige with black scales covering veins, a dark basal dash and a black orbicular spot; STL formed by triangular dark brown marks, TL black, fringe dirty brown, dorsal HW cream with black scales covering veins; fringe light brown. **Male genitalia** (Figs 35-38): T8 rectangular, wider than long; ST8 with posterior margin sclerotized, finely serrate and setose, highly asymmetrical, right posterolateral angle with a tiny process, left posterolateral angle bearing an extremely long, horn-like projection, anterior margin with short apodemes. It is important to clarify that the apodemes shown in the image are symmetrical, but the left apodeme was not extended in the slide preparation therefore in the photograph the apodemes seem asymmetrical (Fig. 37). Valvae asymmetrical, right valva with sacular margin sclerotized, rounded, a small projection near apex, left valva with sacular margin sclerotized, rounded, two heavily sclerotized, acute projections near apex, distal one larger; costal margin of valvae sclerotized and smooth; juxta heavily sclerotized, inner margin irregular with a small spine-like projection; uncus wide, curved and laminated, with five, heavily sclerotized tooth-like processes at apex; socii comprising two small paddle-shaped, sclerotized, setose projections (Figs 35, 36); proximal portion of phallus tube thin, distal portion sclerotized, thin and slightly curved; vesica with two spiny patches (Fig. 38).

FEMALE (Figs 33, 34): Similar to male but larger, without the basal dash, FWL 23-25 mm. **Female genitalia** (Fig. 39): ST8 sclerotized, rectangular, longer than wide; ductus bursae short and thin; corpus bursae globular, with numerous folds; signa elongate and triangular; papillae anales ovoid, with multiple setae.

Etymology. *Xylodonta scottmilleri* is named in honor of Scott Miller of Washington, D.C., in recognition of his many years of outstanding support for the Guanacaste Dry Forest Conservation Fund and Area de Conservación Guanacaste.

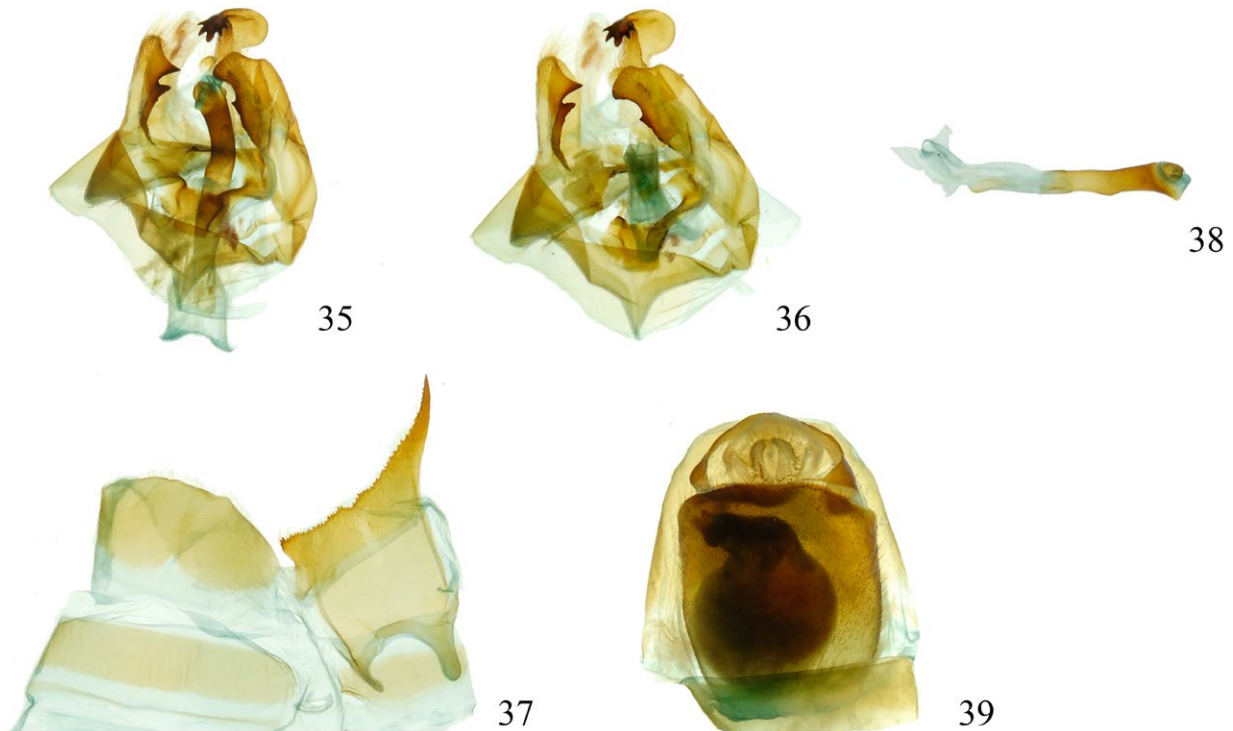
Specimens examined: 38 specimens (23 males, 15 females).

Type specimens: **HOLOTYPE MALE:** INB0004143801 (COI Barcoded), Costa Rica, Prov. Guanacaste, La Cruz, Bosque Nuevo 11.053652 -85.357650, 350 m, 15 April 2008, José Antonio Azofeifa (MNCR).

PARATYPES: 12 males, 13 females. **Males:** 07-SRNP-111327 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector Cacao, Estación Góngora 10.88449 -85.47306, 557 m, 12 September 2007, R. Franco & S. Ríos (MNCR). 07-SRNP-113292 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector Mundo Nuevo, La Perla (Tanque) 10.76760 -85.43243, 366 m, 9 December



Figs 31-34. *Xylodonta scottmilleri*: 31, 32 Paratype male dorsal and ventral (07-SRNP-113631) forewing length 19.04 mm; 33, 34 Paratype female dorsal and ventral (04-SRNP-4577) forewing length 22.76 mm.



Figs 35-39. *Xylodonta scottmilleri*: 35, 36 Paratype male genitalia (07-SRNP-113631) 4.9 mm length, 37 male ST8 5.5 mm length, 38 phallus 4.6 mm length, 39 Paratype female genitalia (06-SRNP-105688) 7.2 mm length.

2007, S. Ríos & F. Quesada (MNCR). 07-SRNP-113298 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector Mundo Nuevo, La Perla (Tanque) 10.76760 -85.43243, 366 m, 9 December 2007, S. Ríos & F. Quesada (MNCR). 07-SRNP-113631 (dissected, COI Barcoded), Costa Rica, Prov. Guanacaste, Sector Mundo Nuevo, La Perla (Tanque) 10.76760 -85.43243, 366 m, 10 December 2007, S. Ríos & F. Quesada (MNCR). INBIOCRI001706073 (COI Barcoded), Costa Rica, Prov. Alajuela, Los Chiles, Caño Negro 10.894 -84.789, 20 m, 6 March 1993, José Antonio Azofeifa (MNCR). INBIOCRI000694702 (COI Barcoded), Costa Rica, Prov. Puntarenas, Golfito, Sirena 8.480171 -83.591289, 50 m, 1 November 1990, Juan Carlos Saborío (MNCR). INBIOCRI001839346 (COI Barcoded), Costa Rica, Prov. Limón, Talamanca, Amubri 9.519349 -82.956275, 70 m, 2 September 1993, Gerardina Gallardo (MNCR). INBIOCRI000694718 (COI Barcoded), Costa Rica, Prov. Puntarenas, Golfito, Sirena 8.480171 -83.591289, 50 m, 1 November 1990, Juan Carlos Saborío (MNCR). INBIOCRI001394246 (COI Barcoded), Costa Rica, Prov. Puntarenas, Aguirre, P. N. Manuel Antonio 9.38778056 -84.13280611, 80 m, 1 April 1992, Gerardo Varela (MNCR). INBIOCRI000950641 (COI Barcoded), Costa Rica, Prov. Puntarenas, Aguirre, P. N. Manuel Antonio 9.38778056 -84.13280611, 80 m, 1 July 1992, Gerardo Varela (MNCR). INB0004204307 (COI Barcoded), Costa Rica, Prov. Puntarenas, Buenos Aires, Alto Jalisco 8.995830 -83.455554, 950 m, 22 February 2009, Elena Ulate (MNCR). INBIOCRI000707496 (COI Barcoded), Costa Rica, Prov. Puntarenas, Garabito, Estación Quebrada Bonita 9.767452 -84.608118, 50 m, June 1992, Juan Carlos Saborío (MNCR). INBIOCRI002024881 (COI barcoded), Costa Rica, Prov. Cartago, Turrialba, Monumento Nacional Guayabo 9.973978 -83.694935, 1000 m, 28 September-21 November 1994, Gilberto Fonseca (MNCR). **Females:** 04-SRNP-4577 (COI Barcoded), Costa Rica, Prov. Guanacaste, Sector San Cristóbal, Puente Palma 10.9163 -85.37869, 460 m, 10 September 2004, Yessenia Mendoza (USNM). 06-SRNP-105688 (dissected, COI Barcoded), Costa Rica, Prov. Guanacaste, Sector Santa Elena, La Angostura 10.85592 -85.67017, 300 m, 24 July 2006, H. Cambroner & R. Franco (MNCR). INBIOCRI001985307 (COI Barcoded, dissected), Costa Rica, Prov. Alajuela, Los Chiles, Caño Negro, Playuelas 10.955 -84.75, 20 m, 12 September 1993, Kattia Martínez (MNCR). INBIOCRI002036101 (dissected, COI Barcoded), Costa Rica, Prov. Alajuela, Los Chiles, Caño Negro, El Pueblo 10.894 -84.789, 20 m, 22 November 1993, Kattia Martínez (MNCR). INB0004137569 (COI Barcoded), Costa Rica, Prov. Puntarenas, Golfito, Estación el Tigre, Area Administrativa 8.546089 -83.397801, 47 m, 26 February 2008, José Antonio Azofeifa (MNCR). INB0004137567 (COI Barcoded), Costa Rica, Prov. Puntarenas, Golfito, Estación el Tigre, Area Administrativa 8.546089 -83.397801, 47 m, 26 February 2008, José Antonio Azofeifa (MNCR). INB0004222523 (COI barcoded), Costa Rica, Prov. Limón, Limón, Veragua Rainforest 9.925729 -83.191405, 420 m, 19 July 2009, Ronald Villalobos (MNCR). INB0004222533 (COI barcoded), Costa Rica, Prov. Limón, Limón, Veragua Rainforest 9.925729 -83.191405, 420 m, 19 July 2009, Ronald Villalobos (MNCR). INB0004127738 (COI barcoded), Costa Rica, Prov. Puntarenas, Golfito, Estación el Tigre, Área Administrativa 8.546089 -83.397801, 47 m, 28 November 2007, José Antonio Azofeifa (MNCR). INBIOCRI000198825 (COI Barcoded), Costa Rica, Prov. Puntarenas, Golfito, Sirena 8.480171 -83.591289, 51 m, 1 January 1990, Gilberto Fonseca (MNCR). INB0003316716 (COI barcoded), Costa Rica, Prov. Cartago, Turrialba, P.N. Barbilla. Estación Barbilla 9.981347 -83.454258, 500 m, 1 June 2001 Lucía Chavarría (MNCR). INBIOCRI000849892 (COI Barcoded), Costa Rica, Prov. Limón, Talamanca, R.V.S. Gandoca Manzanillo 9.632581 -82.659053, 51 m, 9 September 1992, Karla Taylor (MNCR). INBIOCRI000963833 (COI Barcoded), Costa Rica, Prov. Puntarenas, Osa, Rancho Quemado 8.679095 -83.566714, 200 m, 1 August 1992, Marianella Segura (MNCR). INBIOCRI000542824 (COI Barcoded), Costa Rica, Prov. Puntarenas, Golfito, Sirena 8.480171 -83.591289, 50 m, 1 November 1990, Juan Carlos Saborío (MNCR). INBIOCRI000579694 (dissected, COI Barcoded), Costa Rica, Prov. Puntarenas, Golfito, Sirena 8.480171 -83.591289, 50 m, 1 October 1990, Juan Carlos Saborío (MNCR). INBIOCRI000011639 (COI Barcoded), Costa Rica, Prov. Puntarenas, Res. Biol. Carara, Est. Quebrada Bonita 9.774233 -84.608124, 50 m, September 1989, R. Zuñiga (MNCR).

Other specimens examined but not barcoded: Males: INBIOCRI000161755 (dissected), Costa Rica, Prov. Puntarenas, Est. Sirena, P.N. Corcovado 8.480171 -83.591289, 0 - 100 m, February 1990, G. Fonseca (MNCR). INBIOCRI000178170 Costa Rica, Prov. Puntarenas, Est. Sirena, P.N. Corcovado 8.480171 -83.591289, 0 - 100 m, December 1989, G. Fonseca (MNCR). INBIOCRI000196748 Costa Rica, Prov. Puntarenas, Est. Sirena, P.N. Corcovado 8.480171 -83.591289, 0 - 100 m, December 1989, G. Fonseca (MNCR). INB0003008939 Costa Rica, Prov. Heredia, La Selva Biol. Sta.

Puerto Viejo Sarapiquí 10.431958 -84.0091, 40 m, September 1986, M. M. Chavarría (MNCR). INB0003008945 Costa Rica, Prov. Heredia, La Selva Biol. Sta. Puerto Viejo Sarapiquí 10.431958 -84.0091, 40 m, October 1987, M. M. Chavarría (MNCR). INB0003548569 Costa Rica, Prov. Guanacaste, Santa Rosa National Park, 10.83641 -85.615491, 300 m, 18-24 July 1981, D.H. Janzen & W. Hallwachs (MNCR). INB0003548570 Costa Rica, Prov. Guanacaste, Est. Pitilla, 9 Km S. Santa Cecilia 10.992609 -85.429477, 700 m, November 1988. Biodiversity Survey (MNCR). INB0003008944 Costa Rica, Prov. Guanacaste, Est. Pitilla, 8 Km S. Santa Cecilia, 10.992609 -85.429477, 700 m, 20 November 1987, D.H. Janzen & W. Hallwachs (MNCR). INBIOCRI000161755 (dissected), Costa Rica, Puntarenas, Est. Sirena, Corcovado N. P. 8.480171 -83.591289, 0 - 100 m, February 1990, G. Fonseca (MNCR).

Diagnosis: ST8 with posterior margin sclerotized, finely serrate and setose, highly asymmetrical, right posterolateral angle with a tiny process, left posterolateral angle bearing an extremely long, horn-like projection, anterior margin with asymmetrical antecostal apodeme short, wide at base, thin at apex, slightly curved, internal ridges present (Fig. 37). Uncus wide, curved and laminated, with five, heavily sclerotized tooth-like processes at apex; socii comprising two small paddle-shaped, sclerotized, setose projections (Figs 35, 36)

Distribution: *Xylodonta scottmilleri* has been collected with light traps in the dry forest and rain forest on both slopes of Cordillera Volcánica de Guanacaste and Cordillera de Talamanca, on the east slope of Cordillera Volcánica Central, and in the Caribbean and Pacific lowlands, from 20 to 1000 m elevation (Fig. 129).

Natural history: Rearing records: ACG locations: Sector San Cristóbal (n=1), 04-SRNP-4577.

Food plants: Exclusively Fabaceae: *Gliricidia sepium* (Jacq.) Kunth ex Walp. *Gliricidia sepium* is an introduced plant at this rain forest site, so the native food plant of *X. scottmilleri* is unknown. The single larva of this species was not photographed.

Remarks:

Genbank Accession: KX676403

DNA barcode: male holotype INB0004143801

ASARD9192-14|INB0004143801| *Xylodonta scottmilleri* (*D. maxtlaDHJ07*)(COI-5P

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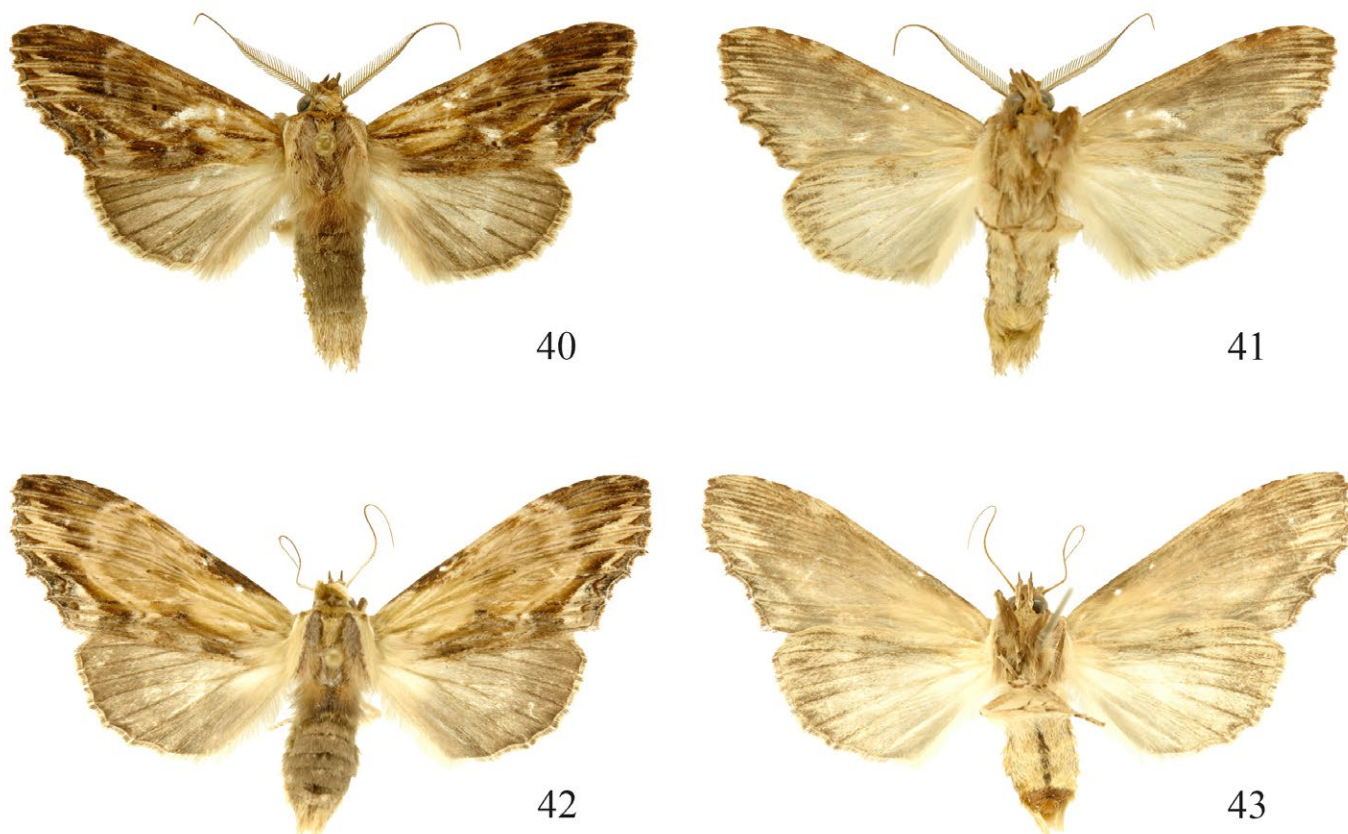
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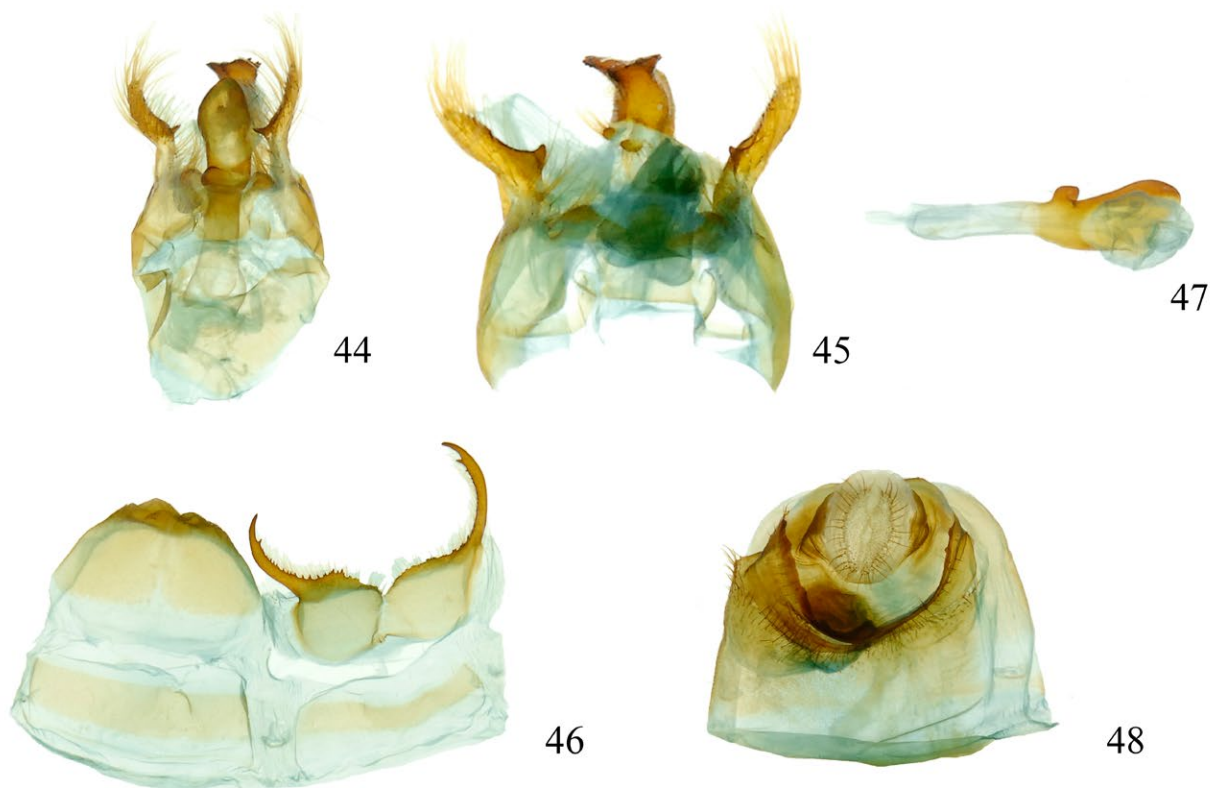
Xylodonta andrewrusselli Chacón new species

(Figs 40-48)

Description: MALE (Figs 40, 41): FWL 18-21 mm. **Head:** Antenna dark brown, antennal shaft cream dorsally and dark brown ventrally; scape bearing a long tuft of cream, dirty brown scales; eyes dark gold; frons mostly dark brown; labial palpus porrect, dark brown; vertex dirty brown. **Thorax:** Tegula dirty brown at base, a mix of cream and dark brown scales distally; patagium light brown; mesoscutellum dirty brown; thoracic pleuron beige; metathoracic dorsum with dark brown hair-like scales. **Legs:** Mostly dirty brown and beige with black scales between segments. **Abdomen:** Dorsum dirty brown, venter light brown with a dark brown midline. **Wings:** Dorsal FW ground color dirty



Figs 40-43. *Xylodonta andrewrusselli*: 40, 41 Holotype male dorsal and ventral (INB0003089168) forewing length 18.75 mm; 42, 43 Paratype female dorsal and ventral (INB0003012047) forewing length 24.06 mm.



Figs 44-48. *Xylodonta andrewrusselli*: 44, 45 Paratype male genitalia (INBIOCRI002559528) 3.7 mm length; 46 male ST8 3.3 mm length, 47 phallus 2.7 mm, 48 Paratype female genitalia (INBIOCRI002352649) 3.7 mm length.

brown with black scales covering veins, a dark basal dash and a black orbicular spot; discal cell beige; STL formed by beige marks, TL black, fringe dirty brown; dorsal HW dirty brown; fringe beige with some dirty brown scales. **Male genitalia** (Figs 44-47): T8 posterior margin irregular and sclerotized with seven tiny irregular teeth; ST8 posterior margin sclerotized, serrate, with two long, thin slightly asymmetrical posterolateral projections, these resembling myrmeleon larval forceps, outer margin smooth, inner margin serrate (Fig. 46). Valvae symmetrical, small; saccular margin sclerotized, with a small tooth-like projection near midpoint; valva apex setose; uncus curved and laminated, with three sclerotized projections at apex, distal margin toothed (Figs 44, 45); proximal portion of phallus tube thin and rounded, distal portion sclerotized, broad and robust, with a small sclerotized dorsal flange, cornuti comprising a small spiny patch (Fig. 47).

FEMALE (Figs 42, 43): Similar to male but larger, dorsal FW ground color beige and without a basal dash, FWL 23-26 mm. **Female genitalia** (Fig. 48): ST8 rectangular, sclerotized, wider than long; postvaginal plate sclerotized, posterior margin toothed; ductus bursae short; corpus bursae globular, with folds; signum small, boomerang-shaped; papillae anales ovoid, setose, apophysis anterior longer than apophysis posterior.

Etymology. This species is named in honor of Andrew Russell, from La Kandela farm at El Roble, Heredia, Costa Rica, for his support with our collecting work and the donation of his personal collection to the National Museum of Costa Rica.

Specimens examined: 12 specimens (5 males, 7 females).

Type specimens: **HOLOTYPE MALE:** INB0003089168 (COI Barcoded) Costa Rica, Prov. Puntarenas, Fca. William Gamboa, 1 Km O. de Mellizas 8.892362 -82.78657, 1280 m, 4 October 1997. A. Picado (MNCR).

PARATYPES: 1 male, 5 females. **Male:** INBIOCRI002559528 (dissected, COI Barcoded) Costa Rica, Prov. Puntarenas, Sabalito, Sendero al Higuierón Central, 2.5 Km NE. del Progreso 8.916766 -82.781964, 1450 m, 2 September 1997. A. Picado (MNCR). **Females:** INB0003012047 (COI Barcoded) Costa Rica, Prov. Puntarenas, Est. Pittier, 4.2 Km SO. del Cerro Gemelo 9.025664 -82.962695, 1670 m, 25 May 1998. M. M. Moraga (MNCR). INBIOCRI000671777 (COI Barcoded) Costa Rica, Prov. Puntarenas, Fca. Cafrosa, Est. Las Mellizas, P. N. Amistad 8.891473 -82.792936, 1300 m, May 1990, M. Ramírez & G. Mora (MNCR). INBIOCRI000510534 (COI Barcoded) Costa Rica, Prov. Puntarenas, Fca. Cafrosa, Est. Las Mellizas, P. N. Amistad 8.891473 -82.792936, 1300 m, May 1990, G. Mora (MNCR). INBIOCRI001619323 (COI Barcoded) Costa Rica, Prov. Puntarenas, Buenos Aires, Est. Altamira 9.032987 -83.010887, 1340 m, 15 Set-14 October 1993. R. Delgado (MNCR). INBIOCRI002352649 (dissected, COI Barcoded) Costa Rica, Prov. San José, Est. Santa Elena, Viejo, Santa Elena, Las Nubes 9.395701 -83.595652, 1210 m, 14 September 1995. E. Alfaro (MNCR).

Other specimens examined but not barcoded: Males: INBIOCRI002357726 (dissected) Costa Rica, Prov. San José, Est. Santa Elena, Viejo, Santa Elena, Las Nubes 9.395701 -83.595652, 1210 m, 20-24 November 1995. B. Gamboa (MNCR). INBIOCRI002566170 (dissected), Costa Rica, Prov. Puntarenas, Est. Pittier. Send ac. Pittier, 1 Km N. de la Estación 9.033802 -82.96268, 1800-2000 m, 5 June 1997, M. M. Moraga (MNCR). INBIOCRI002321519 Costa Rica, Prov. Puntarenas, Est. Pittier 9.025664 -82.962695, 1670 m, 5-18 January 1995, S. Ávila (MNCR). **Female:** INBIOCRI002573185 Costa Rica, Prov. Puntarenas, Est. Pittier, 4.2 Km SO. del Cerro Gemelo 9.025664 -82.962695, 1670 m, September 1997, M. M. Moraga (MNCR). INB0004297334 Costa Rica, Prov. Heredia, Santa Bárbara, Finca La Kandela 10.07945 -84.159082, 1400 - 1500 m, 2-12 September 2011, A. Russell (MNCR).

Diagnosis: ST8 posterior margin sclerotized, serrate, with two long, thin asymmetrical posterolateral projections resembling forceps, their outer margins smooth, inner margins serrate (Fig. 46). Valvae symmetrical, small; saccular margin sclerotized, with a small tooth-like projection near midpoint; valva apex setose; uncus curved and laminated, with 3 sclerotized projections at apex, distal margin toothed (Figs 44, 45).

Distribution: *Xylodonta andrewrusselli* has been collected on the Pacific slope of Cordillera de Talamanca and Cordillera Volcánica Central, from 1200 to 1800 m elevation (Fig. 129).

Natural history: All specimens have been collected with light traps; the life history of *X. andrewrusselli* is unknown.

Remarks:

Genbank Accession: KX676429

DNA barcode of male holotype INB0003089168.

ASARD7442|INB0003089168| *Xylodonta andrewrusselli* (*X. xylinata*ICG01) |COI-5P

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AGGAGGAGATCCAATTTTATATCAACATTTATTT
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Xylodonta xylinata (Walker, 1865)

(Figs 49-57)

Synonym: *Xylodonta pythia* (Druce, 1895).

Original description (Walker, 1865):

“Male, Pale wood-colour, or cinereous with a tinge of fawn-colour. Palpi extending somewhat beyond the head; second joint densely fringed beneath; third linear, less than half the length of the second. Antennae slightly pectinated to nearly half the length from the base, minutely setulose from thence to the tips. Abdomen extending much beyond the hind wings. Fore wings with two irregularly bent dentate fawn-coloured bands, the second darker than the first; a reddish cinereous brown-speckled stripe along the interior border, and a short broad costal streak of the same space along the exterior border mostly fawn-colour, including a deeply dentate cinereous submarginal line. Hind wings cinereous, irregularly fawn-coloured along the exterior border. Length of the body 11 lines; of the wings 26 lines.

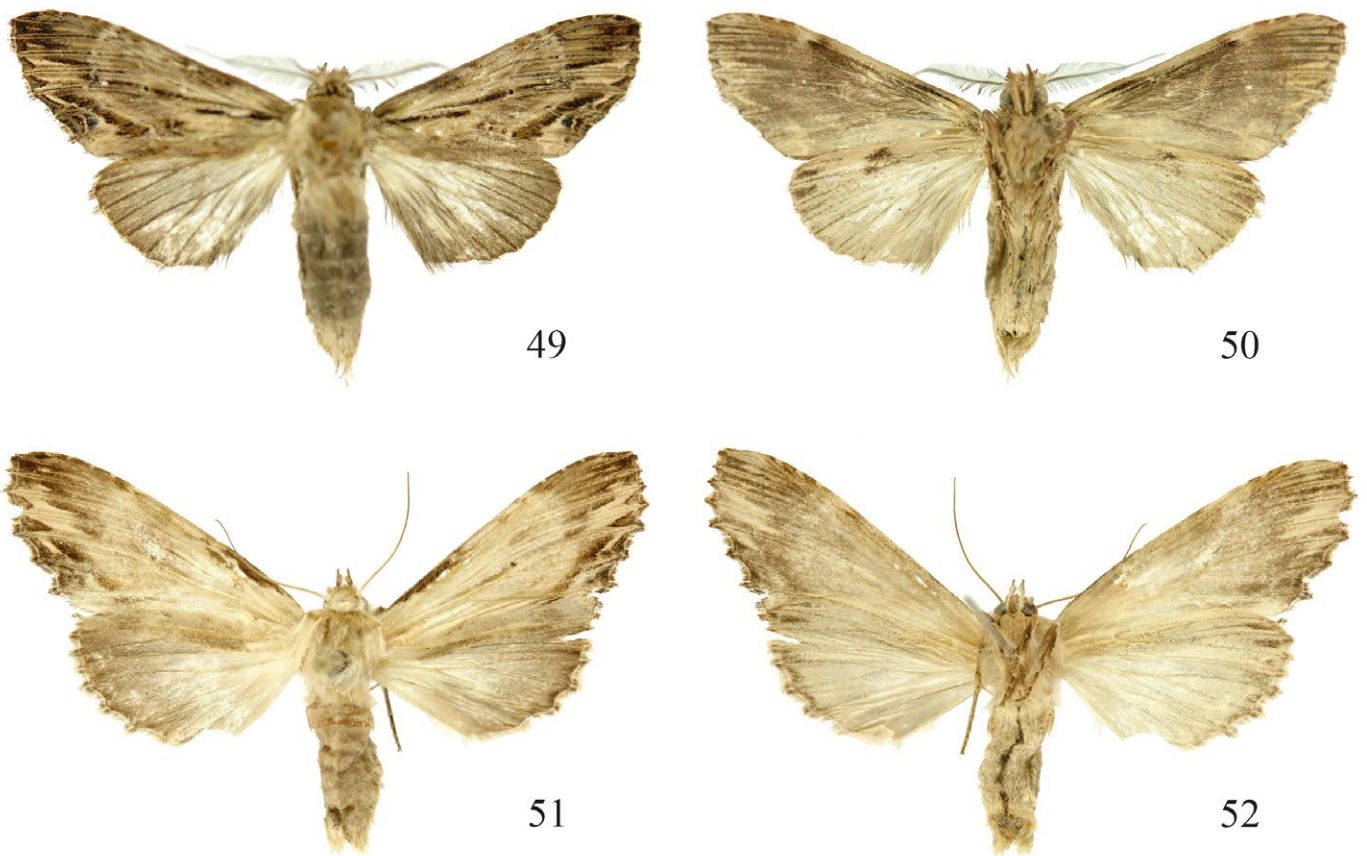
Bogotá. In Mr. Birchall's collection.”

Redescription: MALE (Figs 49, 50): FWL 19-22 mm. **Head:** Antenna dark brown, antennal shaft cream dorsally and light brown ventrally; scape bearing a long tuft of beige cream scales; frons mostly dirty brown; labial palpus porrect, dark brown; vertex dirty brown. **Thorax:** Tegula dirty brown at base, a mix of cream and light brown scales distally; patagium dark brown; mesoscutellum light brown; thoracic pleuron beige; dorsal area of metathorax with dark brown hair-like scales. **Legs:** Mostly dirty brown and beige with black scales between segments. **Abdomen:** Dorsum dark brown, venter beige with a dark brown midline. **Wings:** Dorsal FW ground color beige, with black scales covering veins, a dark basal dash and a black orbicular spot; STL formed by triangular dark brown marks; TL black; fringe light brown; dorsal HW dark brown; fringe light brown. **Male genitalia** (Figs 53-56): T8 rectangular, wider than long, posterior margin irregularly sclerotized, bearing roughly ten variously sized, sclerotized teeth; posterior margin of ST8 sclerotized, finely serrate and setose, symmetrical, with a mesal notch and two strong, acute, posterolateral projections (Fig. 55). Valvae symmetrical, saccular margin irregular, heavily sclerotized and setose, costal margin smooth and lightly sclerotized; uncus sclerotized, apex bearing two sharp lateral projections, as well as three short sharp central projections; socii comprising two tiny sclerotized setose balls (Figs 53, 54); proximal portion of phallus tube wide, distal portion sclerotized, with a thorn-like subapical process and a longer, horn-like apical process (Fig. 56).

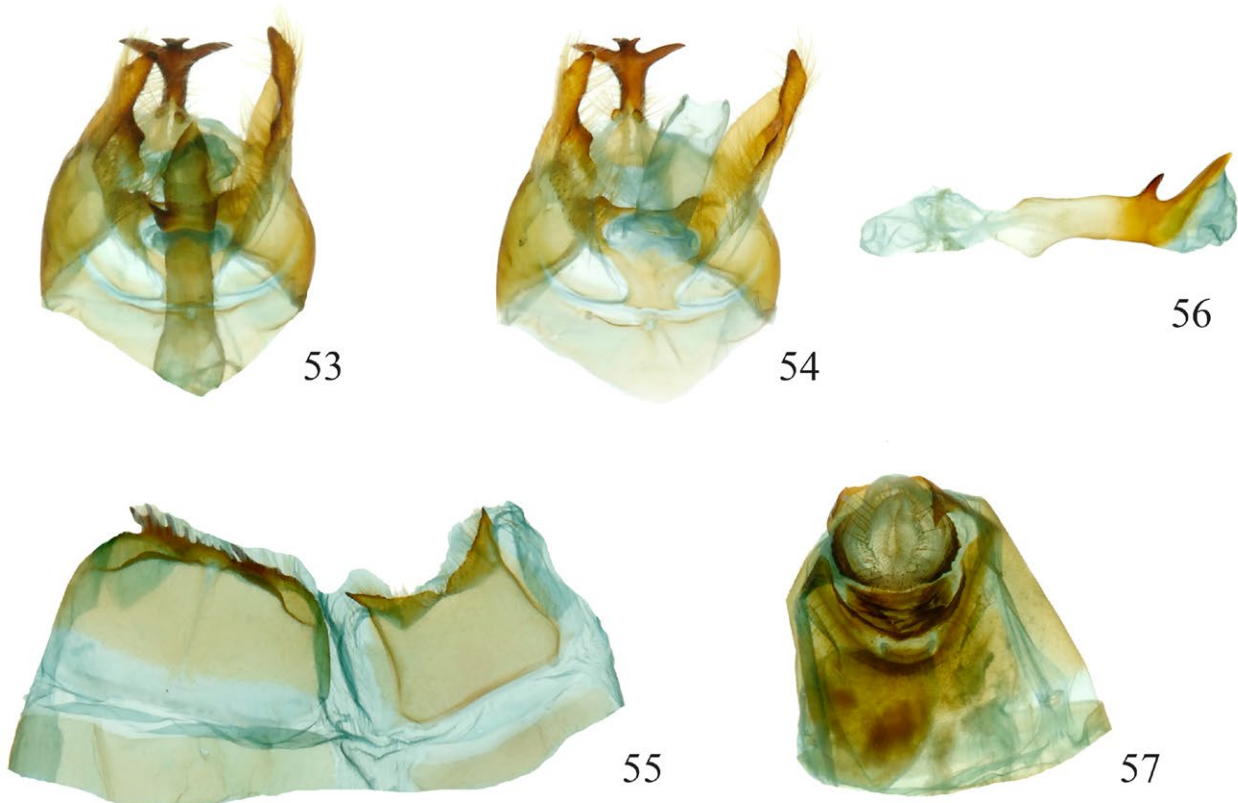
FEMALE (Figs 51, 52): Similar to male but larger and whitish, without basal dash, FWL 23-24 mm. **Female genitalia** (Fig. 57): Posterior margin of T8 sclerotized, dentate, with acute lateral projections; ductus bursae short and thin; corpus bursae globular, with folds; papillae anales ovoid, with multiple setae, set within a heavily sclerotized, dentate ring.

Specimens examined: 9 specimens (7 males, 2 females). This identification is based on barcode results from 7 of these specimens, which showed a barcode similar to that of the holotype of *Notodonta pythia*, synonymous with *X. xilinata* according to Becker (2014).

Males: INB0004072468 (COI Barcoded) Costa Rica, Prov. Limón. P. I. La



Figs 49-52. *Xylodonta xylinata*: 49, 50 Male dorsal and ventral (INB0004072468) forewing length 21.74 mm; 51, 52 Female dorsal and ventral (INBIOCRI000816081) forewing length 22.06 mm.



Figs 53-57. *Xylodonta xylinata*: 53, 54 Male genitalia (INBIOCRI000954759) 3.2 mm length, 55 male ST8 2.0 mm length, 56 phallus 2.4 mm length, 57 Female genitalia (INBIOCRI0001849490) 3.9 mm length.

Amistad Caribe. Camp. 2: Río Coen, orilla campamento 9.383056 -83.213333, 1700-1800 m, 22 February 2007, B. Gamboa, M. Moraga (MNCR). INBIOCRI000362129 (COI Barcoded) Costa Rica, Prov. Cartago, Quebrada Segunda, P. N. Tapantí 9.76258 -83.786505, 1250 m, 1 May 1992, G. Mora (MNCR). INBIOCRI000954759 (dissected, COI Barcoded) Costa Rica, Prov. Cartago, Chirripó, Turrialba, Grano de Oro 9.818357 -83.459163, 1120 m, 1 Set 1992, P. Campos (MNCR). INBIOCRI000954758 (COI barcoded) Costa Rica, Prov. Cartago, Grano de Oro, Chirripó, Turrialba 9.818357 -83.459163, 1120 m, 1 September 1992, P. Campos (MNCR). INBIOCRI001830320 (COI Barcoded) Costa Rica, Prov. Cartago, P.N. Tapantí, A. C. Amistad 9.762583 -83.788328, 1150 m, 1 January 1994, G. Mora (MNCR). **Females:** INBIOCRI001849490 (dissected, COI Barcoded) Costa Rica, Prov. Cartago, Grano de Oro, Chirripó, Turrialba, A. C. Amistad 9.818357 -83.459163, 1120 m, 19-30 June 1993, P. Campos (MNCR). INBIOCRI000816081 (COI Barcoded) Costa Rica, Prov. Cartago, Grano de Oro, Chirripó, Turrialba 9.818357 -83.459163, 1120 m, 1 October 1992, J. C. Saborio (MNCR).

Other specimens examined but not barcoded. Males: INB0003328286 Costa Rica, Prov. Cartago, P.N. Tapantí, Estación Quebrada Segundo 9.762583 -83.788328, 1200 m, October 2000, R. Delgado (MNCR). INB0004072430 Costa Rica, Prov. Limón. P. I. La Amistad Caribe. Camp. 2: Río Coen, orilla campamento 9.383056 -83.213333, 1700-1800 m, 22 February 2007, B. Gamboa, M. Moraga (MNCR).

Diagnosis: Male T8 rectangular, wider than long, posterior margin irregularly sclerotized, bearing roughly ten variously sized, sclerotized teeth; posterior margin of male ST8 sclerotized, finely serrate and setose, symmetrical, with a mesal notch and two strong, acute, posterolateral projections (Fig. 55). Uncus sclerotized, apex bearing two sharp lateral projections, as well as three short sharp central projections; socii comprising two tiny sclerotized setose balls (Figs 53, 54).

Distribution: *Xylodonta xylinata* has been collected on the Caribbean slope of Cordillera de Talamanca, at elevations between 1120 and 1800 meters (Fig. 129).

Natural history: All specimens have been collected with light traps.

Remarks:

Genbank Accession: KX676442

DNA barcode of male INB0004072468. (The DNA barcode of the holotype *N. pythia* extracted by N. Grishin is similar to this specimen.)

ASARD8881|INB0004072468| *Xylodonta xylinata* (*X. xylinata*ICG02)|COI-5P

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Xylodonta robertodelgadoi Chacón new species

(Figs 58-68)

Description: MALE (Figs 58, 59): FWL 22-24 mm. **Head:** Antenna dark brown, rami long and thin, antennal shaft cream dorsally and dark brown ventrally; scape bearing a long tuft of beige, dark brown scales; eyes dark gold; frons mostly dirty brown; labial palpus porrect, dark brown with some cream scales laterally; vertex dirty brown. **Thorax:** Tegula dirty brown and black at base, a mix of black and light brown scales distally; patagium dark brown; mesoscutellum light brown; thoracic pleuron beige; dorsal area of metathorax

with dark brown and black hair-like scales. **Legs:** Mostly dark brown and black, with cream scales between segments. **Abdomen:** Dorsum dirty brown, venter beige, with a dark brown midline. **Wings:** Dorsal FW ground color beige with black scales covering veins, a dark basal dash, and a black orbicular spot; PM irregular, beige from inner margin to costal margin; STL formed by triangular dark brown marks; TL black; fringe dark brown; HW dark brown dorsally; fringe light brown. **Male genitalia** (Figs 62-65): T8 trapezoidal, anterior margin wide, posterior margin slightly smooth and sclerotized; ST8 posterior margin sclerotized, slightly serrate, with a deep mesal excavation and robust, symmetrical, setose posterolateral projections, apices hook-shaped (Fig. 64). Valvae symmetrical, sacculus margin setose, valva apex sclerotized, club-shaped with two blunt projections, costal margin slightly curved, slender and sclerotized; uncus slender, heavily sclerotized, with a tooth-like ventral process near apex, base bearing laminate, triangular lateral projections; socii ovoid, setose (Figs 62, 63); proximal portion of phallus tube narrow and membranous, distal portion sclerotized, thin at base, extremely narrow and sharp at apex; vesica bag-shaped, wide at base and narrow at apex (Fig. 65).

FEMALE (Figs 60, 61): Similar to male but larger, withish, more beige, with dark brown marks from postmedial band to terminal line, FWL 24-27 mm. **Female genitalia** (Figs 66-68): Ductus bursae short and wide; corpus bursae globular, with folds, signa present; papillae anales ovoid, with irregular margins, densely setose.

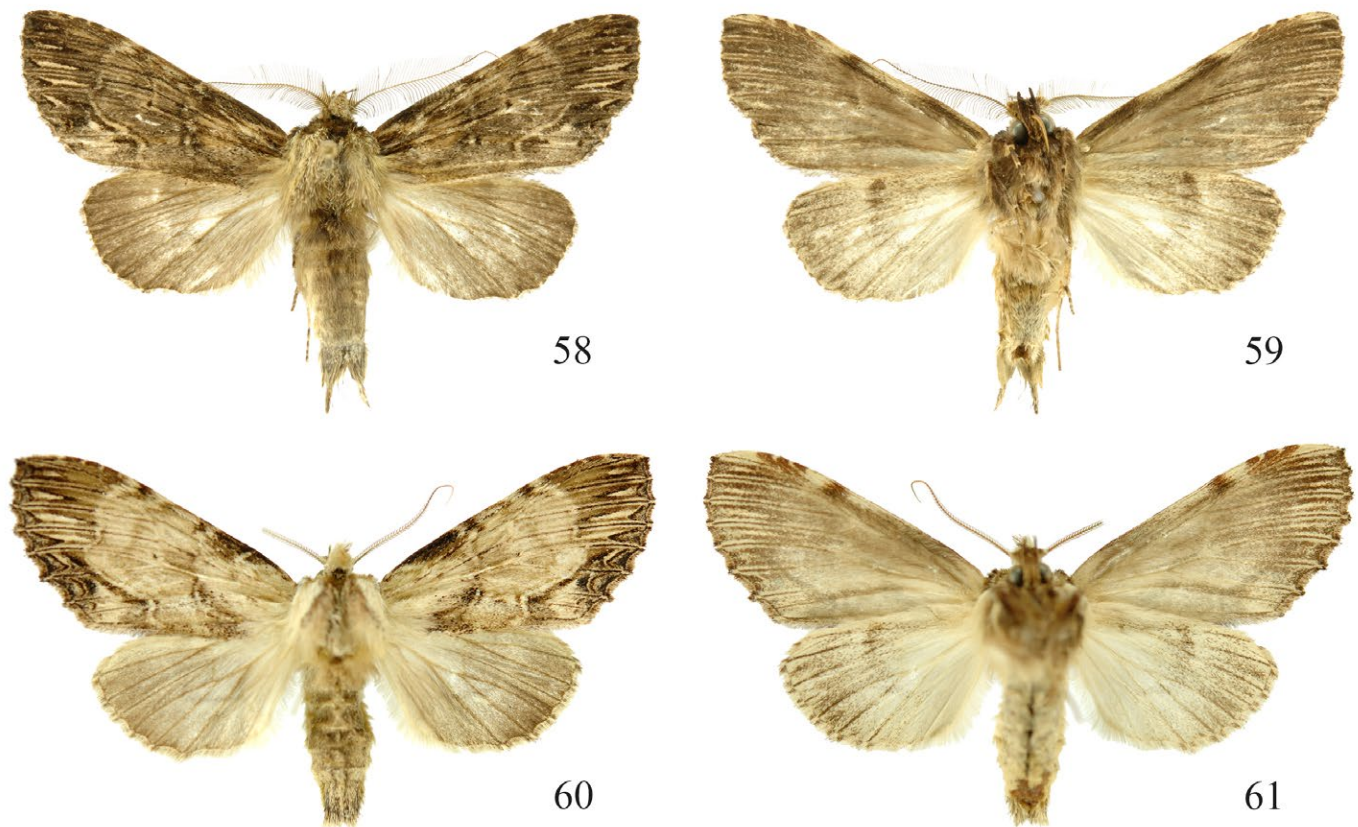
Etymology. This species is named in honor of Roberto Delgado, guardaparque of the Área de Conservación Amistad Pacífico, former parataxonomist of National Biodiversity Institute (INBio), who helped generate a valuable collection of insect specimens from the highlands of the Cordillera de Talamanca.

Specimens examined: 21 specimens (15 males, 6 females).

Type specimens: **HOLOTYPE MALE:** INB0003153956 (COI Barcoded) Costa Rica, Prov. Cartago, El Guarco, San Isidro, Estación La Esperanza 9.687685 -83.884582, 2450 m, 1 March 2001, R. Delgado (MNCR).

PARATYPES: 3 males, 1 female. **Males:** INBIOCRI000165195 (COI Barcoded) Costa Rica, Prov. Heredia, Est. Barva, P.N. Braulio Carrillo 10.119213 -84.121652, 2500 m, 1 March 1990, G. Rivera (MNCR). INB0004121521 (dissected, COI Barcoded) Costa Rica, Prov. Cartago, R.F. Río Macho, Sector Villa Mills, Send. Robleales 9.557477 -83.686681, 2762 m, 20-23 November 2007, B. Gamboa, M. Moraga, R. González (MNCR). INB0003487048 (COI Barcoded) Costa Rica, Prov. Cartago, El Guarco, R.F. Río Macho, Macizo de la Muerte, Sector de la Esperanza 9.686771 -83.87775, 2600 m, May 2002, R. Delgado (MNCR). **Female:** INB0003131292 (dissected, COI Barcoded) Costa Rica, Prov. Cartago, El Guarco, San Isidro, Estación Esperanza 9.687685 -83.884582, 2700 m, 28 February 2001, R. Delgado (MNCR).

Other specimens examined but not barcoded. Males: INB0003153950 (dissected), Costa Rica, Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582, 2450 m, March 2001, R. Delgado (MNCR). INB0003131357 Costa Rica, Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582, 2450 m, 28 February 2001, R. Delgado (MNCR). INB0003153951 Costa Rica, Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582, 2450 m, March 2001, R. Delgado (MNCR). INB0003131356 Costa Rica, Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582, 2450 m, 28 February 2001, R. Delgado (MNCR). INB0003153953 Costa Rica, Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582, 2450 m, March 2001, R. Delgado (MNCR). INB0003131355 Costa Rica, Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582, 2450 m, 28 February 2001, R. Delgado (MNCR). INB0003131354 Costa Rica, Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582, 2450 m, 28 February 2001, R. Delgado (MNCR). INB0003153955 Costa Rica, Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582, 2450 m, March 2001, R. Delgado (MNCR). INB0003153954 Costa Rica, Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582, 2450 m, March 2001, R. Delgado (MNCR). INBIOCRI002394300 Costa Rica, San José, Est. Cuericí, Sendero al Mirador, 4.6 Km al E. de Villa Mills 9.558008 -83.67031, 2640 m, 19-20 April 1996, B. Gamboa (MNCR). INBIOCRI000089138 Costa Rica, Heredia, Est. Barva, Braulio Carrillo N. P. 10.119213 -84.121652, 2500 m, November 1989, G. Rivera (MNCR). **Females:** INB0003561650 Costa Rica, Prov. Cartago, P.N. Tapantí, Est. La Esperanza 9.686324 -83.881395, 2600 m, December 2002, R. Delgado (MNCR). INB0003153952 Costa Rica, Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582,



Figs 58-61. *Xylodonta robertodelgadoi*: 58, 59 Paratype male dorsal and ventral (INB0003131357) forewing length 22.34 mm; 60, 61 Paratype female dorsal and ventral (INB0003131292) forewing length 25.96mm.

2450 m, March 2001, R. Delgado (MNCR). INB0003153949 Costa Rica. Prov. Cartago, El Guarco, San Isidro, Est. La Esperanza 9.687685 -83.884582, 2450 m, March 2001, R. Delgado (MNCR). INB0003487046 Costa Rica. Prov. Cartago, El Guarco, R.F. Río Macho, Macizo de la Muerte, Sector de la Esperanza 9.686771 -83.87775, 2600 m, May 2002, R. Delgado (MNCR). INB0003334486 (dissected), Costa Rica. Prov. Cartago, P.N. Tapantí. Macizo de la Muerte. Est. La Esperanza 9.686771 -83.87775, 2600-2700 m, April 2001. R. Delgado (MNCR).

Diagnosis: Posterior margin of male ST8 sclerotized, slightly serrate, with a deep mesal excavation and robust, symmetrical, setose posterolateral projections, apices hook-shaped (Fig. 64). Uncus slender, heavily sclerotized, with a tooth-like ventral process near apex, base bearing laminate, triangular lateral projections; socii ovoid, setose (Figs 62, 63).

Distribution: *Xylodonta robertodelgadoi* has been collected between 2450 and 2700 m in highland cloud forests, in the foothills west of Cordillera de Talamanca and Cordillera Volcánica Central (Fig. 129).

Natural history: All known specimens were collected with light traps.

Remarks:

Genbank Accession: KX676402

DNA barcode of male holotype INB0003153956.

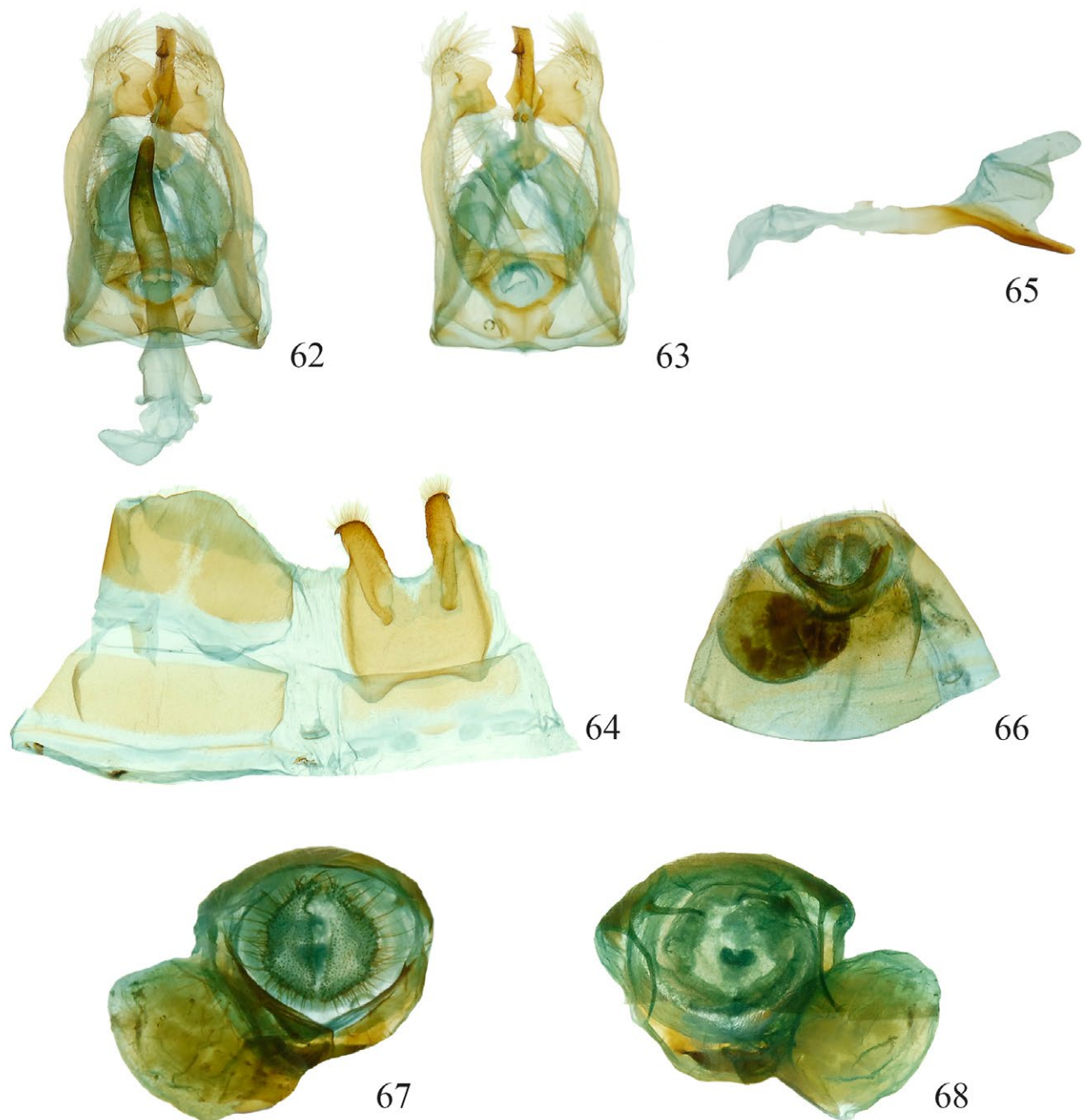
ASARD7605-14|INB0003153956| *Xylodonta robertodelgadoi* (*Xylodonta* Chacon22)|COI-5P

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Xylodonta billhaberi Chacón new species

(Figs 69-77)

Description: MALE (Figs 69, 70): FWL 20-24 mm. **Head:** Antenna dark brown, antennal shaft cream dorsally and dark brown ventrally; scape bearing a long tuft of beige, light brown scales; eyes dark gold; frons mostly brown-yellow; labial palpus porrect, brown with a lateral longitudinal dark brown line; vertex brown-yellow. **Thorax:** Tegula yellow-brown at base, a mix of beige and dark brown scales distally; patagium dark brown; mesoscutellum brown-yellow; thoracic pleuron light brown; dorsal area of metathorax with dark brown and black hair-like scales. **Legs:** Mostly brown-yellow and black with dark brown scales between segments. **Abdomen:** abdominal dorsum dirty brown, venter beige with a dark brown line in the middle. **Wings:** Dorsal FW ground color beige with black scales covering the veins, reduced dark basal dash with a black orbicular spot; PM beige color, from inner margin to costal margin



Figs 62-68. *Xylodonta robertodelgadoi*: 62, 63 Paratype male genitalia (INB0003153950) 3.6 mm length, 64 male ST8 3.1 mm length, 65 phallus 3.1 mm length, 66, 67, 68 Paratype female genitalia (INB0003131292) 3.7 mm length.

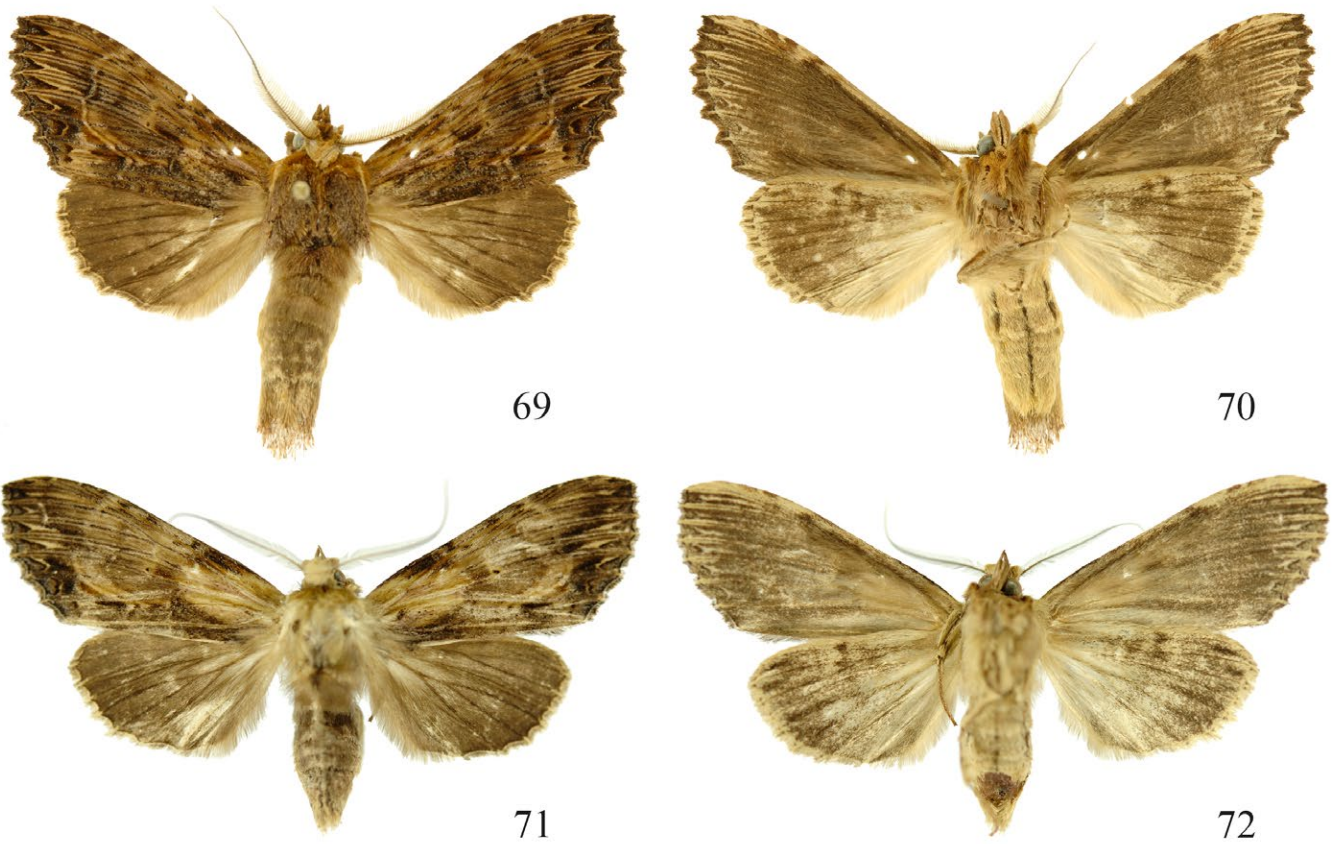
with a marking shaped like a question mark, STL formed by triangular dark brown marks, TL black, fringe dark brown; HW dorsal dark brown, fringe light brown with some dark brown scales. **Male genitalia** (Figs 73-76): T8 triangular wider than long, posterior margin very sclerotized with a narrow, curved and sclerotized central projection; ST8 antecostal apodeme short, robust and symmetrical, internal ridges present, posterior margin irregular, asymmetrical, sclerotized, serrated and setose, with two lateral projections, the left one curved and robust, the right one much smaller, with serrated and sharp edges (Fig. 75). Valvae symmetrical with membranous saccular margin, sclerotized apex and long bristles, costal margin sclerotized, uncus short, sclerotized, with three projections sclerotized at apex, socii small, setose and globular (Figs 73, 74); proximal part of phallus tube thin, distal part of phallus tube sclerotized, robust, with a dorsal projection sclerotized, broad at the base and narrow at the apex, vesica with two scobine patches (Fig. 76).

FEMALE (Figs 71, 72): Similar to male but larger and withish, FWL 25-27 mm. **Female genitalia** (Fig. 77): ST8 rectangular plate sclerotized with jagged and irregular margins; ductus bursae short; corpus bursae globular, with folds; signa small, elongated with two tiny ridges at the dorsal margin; papillae anales elongated with multiple setae.

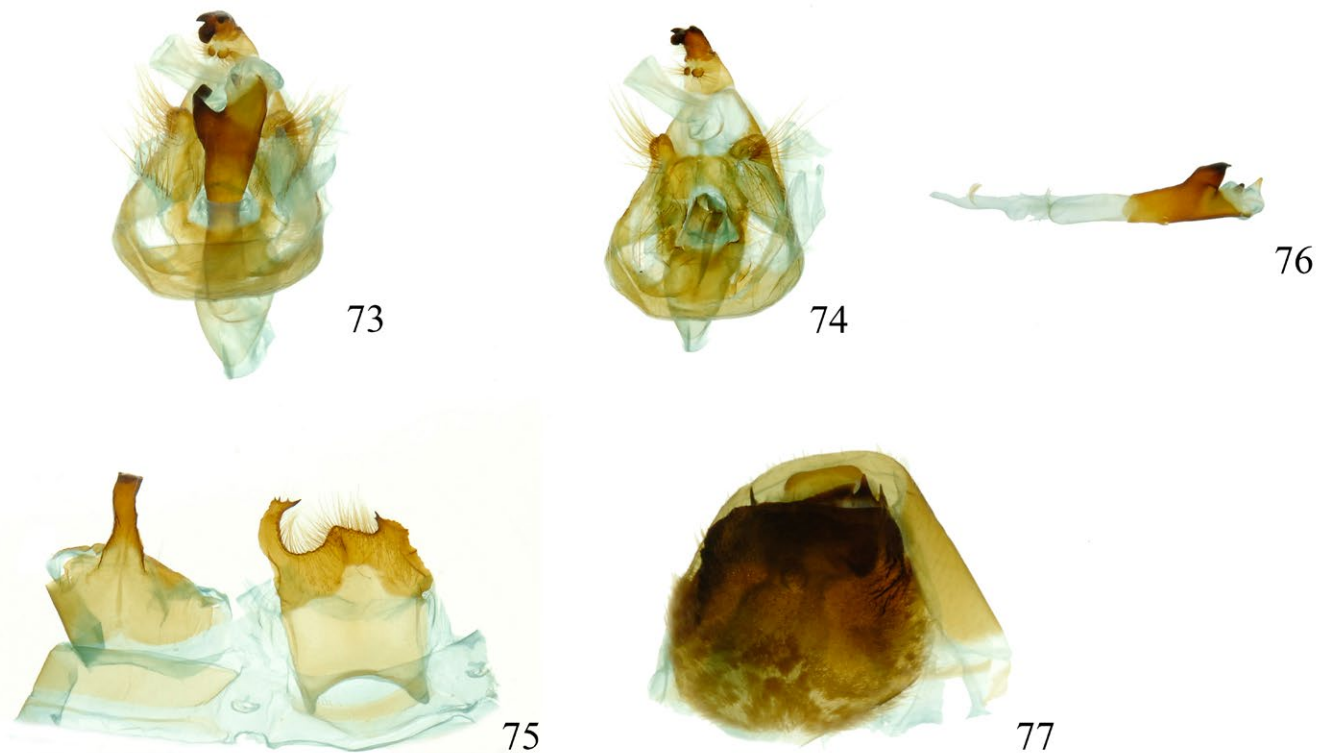
Etymology. *Xylodonta billhaberi* is named in honor of Bill Haber, in recognition of his contribution to the study of Costa Rican biodiversity.

Specimens examined: 51 specimens (42 males, 9 females).

Type specimens: **HOLOTYPE MALE:** INBIOCRI001992457 (COI Barcoded), Costa Rica. Prov. Puntarenas, Est. La Casona, Res. Biol. Monteverde



Figs 69-72. *Xylodonta billhaberi*: 69, 70 Holotype male dorsal and ventral (INBIOCRI001992457) forewing length 24.11 mm; 71, 72 Paratype female dorsal and ventral (INB0003316636) forewing length 26.84 mm.



Figs 73-77. *Xylodonta billhaberi*: 73, 74 Paratype male genitalia (INBIOCRI002183263) 4.0 mm length; 75 male ST8 4.2 mm length, 76 phallus 3.6 mm length, 77 Paratype female genitalia (INBIOCRI000118759) 4.1 mm length.

10.298429 -84.792544, 1520 m, 3 - 17 September 1994, K. Martínez (MNCR). **PARATYPES:** 17 males, 7 females. Data for paratypes and other specimens examined are listed in Supplementary Information (Chacón *et al.*, 2017).

Diagnosis: ST8 antecostal apodeme short, robust and symmetrical, internal ridges present, posterior margin irregular, asymmetrical, sclerotized, serrated and setose, with two lateral projections, the left one curved and robust, the right one much smaller, with serrated and sharp edges (Fig. 75). Uncus short, sclerotized, with three projections sclerotized at apex, socii small, setose and globular (Figs 73, 74).

Distribution: *Xylodonta billhaberi* has been collected on both slopes of Cordillera de Tilarán, Cordillera Volcánica Central and Cordillera de Talamanca, in rain forest and cloud forest from 1000 to 1850 m in elevation (Fig. 129).

Natural history: This species has only been collected with light traps.

Remarks:

Genbank Accession: KX676312

DNA barcode of male holotype INB0003024963.

ASARD199-14|INB0003024963| *Xylodonta billhaberi* (*Xylodonta* Chacon24)|COI-5P

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CTATACTTTTAACTGATCGAAATTTAAATCTTCATTTTTTGTATCCTGCTGG
AGGAGGAGATCCAATTTTATATCAACATTTATTT
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Xylodonta rufitincta (Dyar, 1913)

(Figs 78-92)

Synonym: *Dasylophia blaizea* (Schaus, 1928), proposed by Becker (2014).

Original description of *Xylodonta rufitincta* (Dyar 1913) (Figs 88-92):

“Male. Thorax reddish brown; collar clayey yellow. Fore wing bright reddish brown, the color extending below vein 2 to the tornus, but a little lighter at base and defined by a faint curved dark line near middle of wing; this line seems to be incised at median vein and to run obliquely across median space to near base of wing, but is very faintly relieved; apex broadly blackish shaded, the veins black-lined, with dark gray streaks between them, separated from the veins by pale ochreous lines; a series of oblique black streaks on the margin, the two between veins 2 to 4, more distinct, more inwardly placed, and with ochreous crescents. Hind wing soiled white, the veins touched with gray outwardly and a gray shade at anal angle. Expanse, 40 mm.

Female. Ground color of wing more ochreous, with less red tint than in the male; basal area ochreous, rounded without, incised on median vein and powdered with dark scales, especially toward the base; outer area shaded with dark brown, the cloudings forming two ill-defined oblique bands, the apex wholly dark; veins black-lined beyond the cell; terminal markings faint, only the pale crescents between veins 2 to 4 showing. Hing wing soiled white, a terminal brown line, the fringe a little brown shaded. Expanse, 46-51 mm.

Cotypes. Two males, two females. No. 14466, USNM, Orizaba, Mexico, September, 1911 (R. Müller); Cordoba, Mexico, December 26-28, 1907 (F. Knab); May, 1906 (W. Schaus).”

Specimens examined: 17 specimens (16 males, 1 female).

Males: INB0003010819, INB0003010824 (dissected), INB0003010825: Costa Rica. Prov. Guanacaste, Santa Rosa National Park 10.856315 -85.611915, 300 m, December 1983, DH Janzen & W. Hallwachs (MNCR). 05-SRNP-61608 Costa Rica. Prov. Guanacaste, Sector Santa Rosa, Quebrada Puercos

10.85906 -85.5709, 155 m, 15 October 2005, Freddy Quesada (USNM). INB0003010820, INB0003010821: Costa Rica. Prov. Guanacaste, Santa Rosa National Park 10.856315 -85.611915, 30 m, April 1984, 300 m, D.H. Janzen & W. Hallwachs (MNCR). INB0003010822, INB0003010823, INB0003010826: Costa Rica. Prov. Alajuela, Finca San Gabriel, (16km ENE Quebrada Grande) 10.875173 -85.400711, 650 m, 11 November 1983, D.H. Janzen, W. Hallwachs (MNCR). INB0003010827: Costa Rica. Prov. Alajuela, Finca. La Campana, El Ensayo, 7 Km NW Dos Ríos 10.94834 -85.420173, 700 m, 15-17 March 1986, D.H. Janzen & W. Hallwachs (MNCR). 06-SRNP-100985 (COI Barcoded) Costa Rica. Prov. Alajuela, Sector San Cristóbal. Estación San Gerardo 10.88009, -85.38887, 575 m, 30 January 2006, F. Quesada & R. Franco (MNCR). 06-SRNP-109414 (dissected, COI Barcoded) Costa Rica. Prov. Alajuela, Sector San Cristóbal, Estación San Gerardo 10.88009, -85.38887, 575 m. 21 November 2006, F. Quesada & H. Cambroner (MNCR). 06-SRNP-103176 (COI Barcoded) Costa Rica. Prov. Alajuela, Sector San Cristóbal, Estación San Gerardo 10.88009 -85.38887, 575 m, 24 April 2006, S. Ríos & H. Cambroner (MNCR). 07-SRNP-111085 Costa Rica. Prov. Guanacaste, Sector Cacao, Estación Góngora 10.88449, -85.47306, 557 m, 11 November 2007, R. Franco & S. Ríos (MNCR). 06-SRNP-109043 (COI Barcoded) Costa Rica. Prov. Guanacaste, Sector Del Oro, Serrano 11.00023 -85.45621, 585 m, 20 November 2006, H. Cambroner & S. Ríos (MNCR). 09-SRNP-101658 (COI Barcoded) Costa Rica. Prov. Guanacaste, Sector Pitilla, Manta Miranda 11.00778 -85.42085, 539 m, 27 January 2009, R. Franco & S. Ríos (MNCR). **Female:** 08-SRNP-108302 (dissected, COI Barcoded) Costa Rica. Prov. Guanacaste, Sector Mundo Nuevo, Pozo # 3 10.76833 -85.37243, 634 m, 27 November 2008, F. Quesada & S. Ríos (MNCR).

Diagnosis: Posterior margin of ST8 sclerotized, with a deep mesal excavation and a pair of elongate, symmetrical forceps-like projections on each side, these denticulate near apices (Fig. 84). Valvae symmetrical, expanded at apices, apical margins serrate; uncus short and thin, heavily sclerotized, truncate at apex; socii tiny, setose, digitate (Figs 82, 83). Male FWL 18-21 mm (Figs 78, 79). Female FWL length 24 mm (Figs 80, 81).

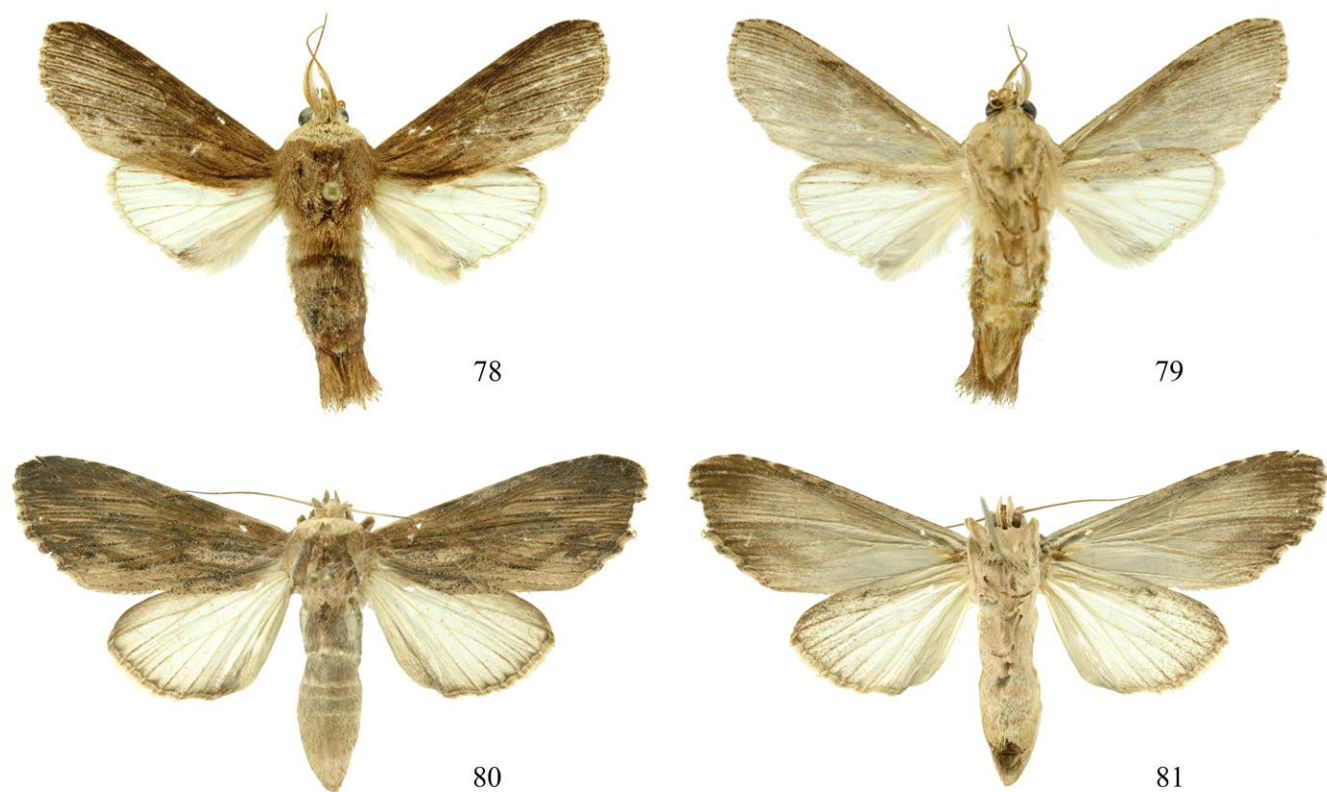
Female genitalia (Fig. 86, 87): ST8 a sclerotized rectangular plate; postvaginal plate heavily sclerotized, with triangular lateral margins; ductus bursae short and thin; corpus bursae kidney-shaped, signum small; papillae anales ovoid, setose.

Distribution: *Xylodonta rufitincta* has been collected with light traps in the dry forest and rain forest on both slopes of Cordillera Volcánica de Guanacaste, from 155 to 700 m elevation (Fig. 129).

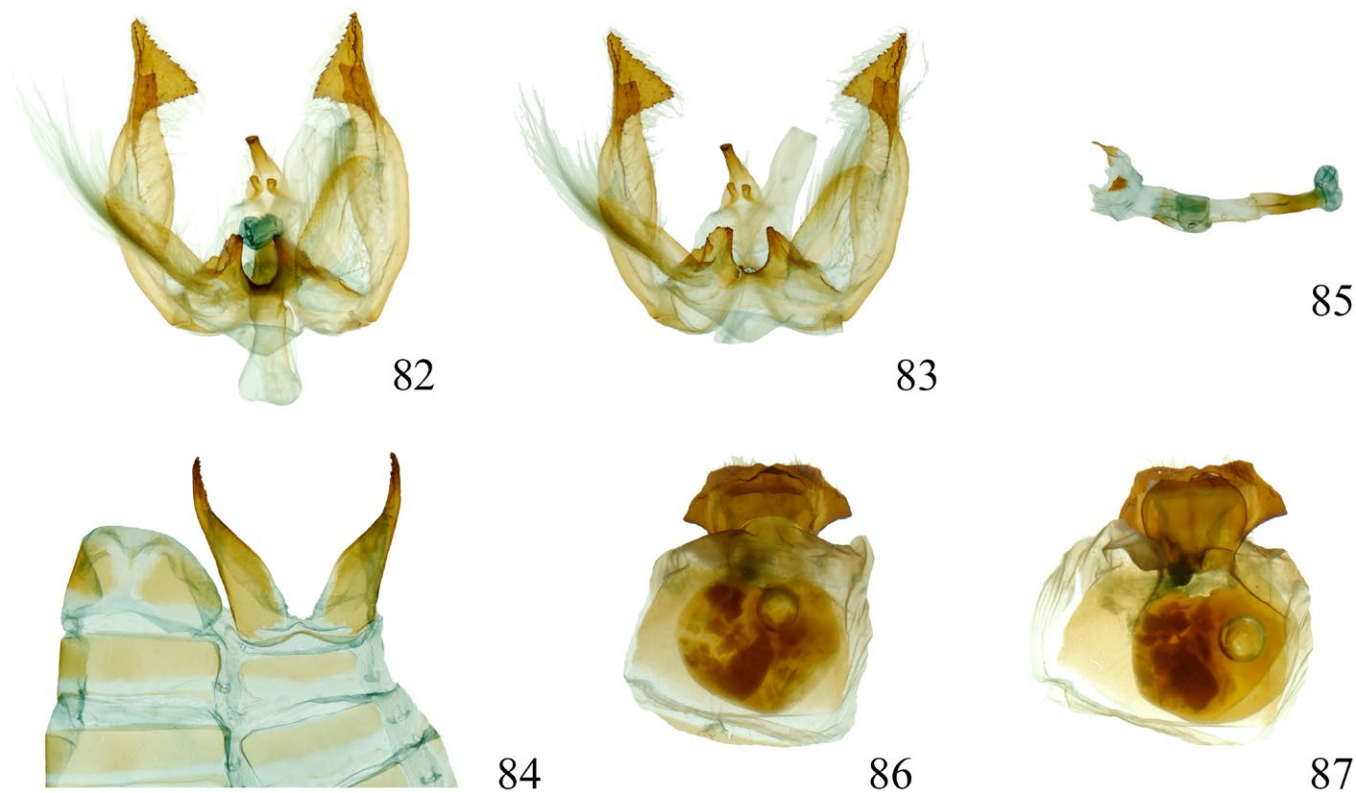
Natural history: Larva light brown with yellow spots scattered throughout the body, the sides have lines black with white, segmented, light brown head.

Food plants: Only one record 05-SRNP-61608 in Fabaceae: *Diphyssa americana* (Mill.) M. Sousa.

Remarks: Lectotype male *D. rufitincta* Dyar on genitalia Slide by ELT USNM 38,284, type locality Orizaba, Mexico, R. Muller Collector. Lectotype Designated 2014 by Alexander Schintlmeister. Type No. 14466 USNM. Bar code USNM 00991145. The lectotype genitalia are identical to those of voucher specimen 06-SRNP-109414 (Figs 88-92). Our analysis of type photographs suggests that *D. blaizea* (Fig. 93) is not synonymous with *X. rufitincta*; in the female lectotype of *D. blaizea*, the pattern of coloration and the marks on the forewings are different from those of the female type of *X. rufitincta* (Figs 80,81). The lectotype of *D. blaizea* was not dissected. This species has the wings unusually long and narrow; the hairwhorls at the antennal bases are short and do not become confluent to form the high vertical tufts characteristic of the genus. The type specimens show wing pattern variation. The male from Orizaba is described in the original description above. The male from



Figs 78-81. *Xylodonta rufitincta*: 78, 79 Male dorsal and ventral (INBIOCRI001073543) forewing length 19.63 mm; 80, 81 Female dorsal and ventral (08-SRNP-108302) forewing length 24.67 mm.



Figs 82-87. *Xylodonta rufitincta*: 82, 83 male genitalia (06-SRNP-109414) 4.1 mm length; 84 male ST8 5.1 mm length, 85 phallus 3.5 mm length, 86, 87 female genitalia (08-SRNP-108302) 4.5 mm length.



Figs 88-92. *Dasylophia rufitincta* (Male Lectotype No. 14466 USNM): 88, 89 Male dorsal and ventral; 90 male genitalia; 91 phallus; 92 male ST8.

Córdoba is much less distinctly marked. Its color is similar, but the dark apical shading is less noticeable. Of the females, the one collected by Mr. Knab we consider typical. The other is larger and darker, with the shading heavy and extensive crossing the basal light space and almost wholly obscuring the lunate submarginal marks.

Genbank Accession: JQ604928

DNA barcode of male 06-SRNP-109414

BLPBC391|06-SRNP-109414| *Xylodonta rufitincta*

(*Dasylophia rufitincta*)|COI-5P

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ATTACAGCATTTTATTACTTCTTTCATTACCAGTATTAGCAGGAGCTATTA
CTATACTTTTAAACGATCGAAATTTAAATACATATTTTTTGATCCTGCAGG
AGGAGGAGATCCTATTTTATATCAACATTTATTT
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Fig. 93. *Dasylophia blaizea* (Lectotype No. 33308 USNM 00991493 USNMMENT) Female dorsal.

Xylodonta angustipennis (Schaus, 1911)
(Figs 94-98)

Original description of *Dasylophia angustipennis* (Schaus 1911) (Figs 94, 95): "Male. Frons and collar buff-brown; vertex and thorax reddish brown; patagia violaceous brown; tufts at base of antennae greyish brown. Abdomen above greyish brown, with dark irrorations terminally. Fore wings brown; base of costa and inner margin buff; a very oblique reddish-brown shade from costa across middle of cell, incurved and finely dentate to inner margin, followed by a fine geminate fuscous line from vein 2, sharply oblique towards base from submedian fold, punctiform at fold and vein 2; postmedial space below 4 to tornus shaded with grey; veins 4-7 dark brown; geminate fuscous and brown streaks from cell to termen and subterminal buff streaks between veins 4-8; traces of a curved postmedial line, followed by a white and black spot between 2 and 3; a subterminal lunular buff line edged with reddish brown between 2 and 4. Hind wings white; veins terminally, inner margin broadly, and apex slightly irrorated with fuscous.

Expanse 46 mm.

Hab. El Sitio, Juan Viñas 9.893979 -83.746212, 1.165 m. (Fig. 129)

Wings longer and narrower than usual."

Diagnosis: Posterior margin of ST8 sclerotized, posterior margin denticulate, symmetrical, with a shallow, U-shaped mesal excavation and a pair of short, acute posterolateral projections (Fig. 98). Valvae symmetrical, narrow, simple, each with a tiny hook at apex; uncus rounded and spatulate; socii sclerotized, elongate and curved upwards (Fig. 96); proximal portion of phallus tube wide, distal portion sclerotized, with two small, acute lateral projections (Fig. 97).

Remarks: In Costa Rica, this species is so far known exclusively from the syntypes, deposited in the USNM. Genitalia Slide By ELT USNM 38283, Type No 1775 USNM. May, Sitio, CR, Collection Wm Schaus. Lectotype of *Dasylophia angustipennis* designated by Alexander Schintlmeister in 2014. Barcode USNMENT 00991420.

Xylodonta guarana (Schaus, 1892)
(Figs 99-107; Figs 123-128)

Original description of *Oedemasia guarana* (Schaus, 1892) (Fig. 128):

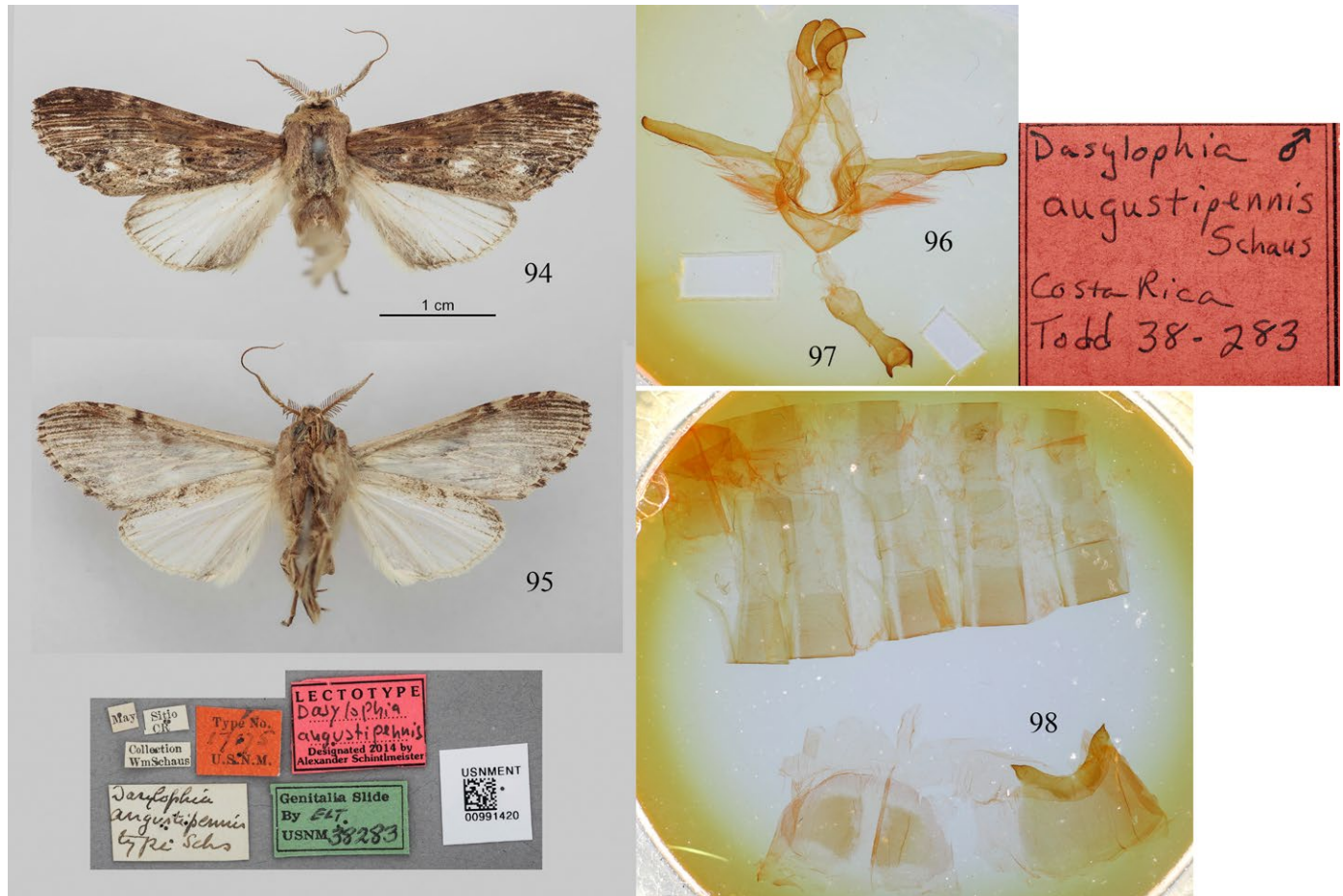
"Primaries fawn-colour; a large basal space without markings; the median space shaded with brown, beyond which is a transverse, slightly curved, narrow, white band, divided by a blackish line; the outer third of the wing dark cinereous, except a small fawn-colored space on the outer margin below the apex, a submarginal row of blackish marks, and a marginal row of similar but smaller spots; the inner angle whitish. Secondaries brownish grey; the fringe luteous. Head and thorax fawn-colour. Abdomen dorsally brown.

Expanse 44 mm.

Hab. Corcovado, Rio Janeiro"

Specimens examined: 30 specimens (21 males, 9 females).

Males: INBIOCRI000747766 Costa Rica. Prov. Guanacaste, Santa Rosa Nat. Pk. 1083641 -85.615491, 300 m, 3-6 November 1979, D.H. Janzen (MNCR). 87-SRNP-1251 Costa Rica. Prov. Guanacaste, Sector Santa Rosa, Quebrada Duende 10.83663 -85.61144 280 m, 5 December 1987, Gusaneros. 90-SRNP-2399 Costa Rica. Prov. Guanacaste, Sector Santa Rosa, Sendero Natural 10.83575 -85.61253, 290 m, 5 December 1990, Gusaneros (USNM). 90-SRNP-2485 Costa Rica. Prov. Guanacaste, Sector Santa Rosa, Sendero



Figs 94-98. *Dasylophia angustipennis* (Lectotype No. 1775 USNM 00991420 USNMENT): 94, 95 Male dorsal and ventral; 96 Male genitalia (38283 Todd), 97 phallus, 98 male ST8.

Natural 10.83575 -85.61253, 290 m, 9 December 1990, Gusaderos (USNM). 03-SRNP-30072 Costa Rica. Prov. Guanacaste, Sector Del Oro, Quebrada Lajosa 11.03306 -85.42876, 400 m, 5 November 2003, Dunia García (USNM). 05-SRNP-60573 Costa Rica. Prov. Guanacaste, Sector Santa Rosa, Área Administrativa 10.83764 -85.61871, 295 m, 21 September 2005, Petra Carlsson (USNM). 05-SRNP-24199 Costa Rica. Prov. Guanacaste, Sector Del Oro, Sendero Puertas 11.01087 -85.48817, 400 m, 12 October 2005, Elieth Cantillano (USNM). 05-SRNP-66561 Costa Rica. Prov. Guanacaste, Sector Mundo Nuevo, Quebrada Tibio Perla 10.76261 -85.42979, 330 m, 15 January 2006, José Alberto Sánchez (USNM). 05-SRNP-66561 Costa Rica. Prov. Guanacaste, Sector Mundo Nuevo, Quebrada Tibio Perla 10.76261 -85.42979, 330 m, 15 January 2006, José Alberto Sánchez (USNM). 07-SRNP-24344 Costa Rica. Prov. Guanacaste, Sector Del Oro, Río Chon 11.04118 -85.44170, 320 m, 29 November 2007, Lucía Ríos (USNM). 07-SRNP-24346 Costa Rica. Prov. Guanacaste, Sector Del Oro, Río Chon 11.04118 -85.44170, 320 m, 29 November 2007, Lucía Ríos (USNM). Male: 08-SRNP-21930 Costa Rica. Prov. Guanacaste, Sector Del Oro, Quebrada Lajosa 11.03306 -85.42876, 400 m, 5 August 2008, Roster Moraga (USNM). INBIOCRI000016781 Costa Rica. Prov. Puntarenas, R.B. Carara, Estac. Quebrada Bonita 9.774233 -84.608124, 50 m, August 1989, R. Zuñiga (MNCR). INBIOCRI000707338 (dissected, COI barcoded), INBIOCRI000707382 (dissected), INBIOCRI000684174 (dissected, COI barcoded), INBIOCRI000707381(COI barcoded), Costa Rica. Prov. Puntarenas, R.B. Carara, Estac. Quebrada Bonita 9767453 -84608119, 50 m, June 1992, J. C. Saborio (MNCR). INBIOCRI000964830 Costa Rica. Prov. Puntarenas, R.B. Carara, Estac. Quebrada Bonita 9767453 -84608119, 50 m, September 1992, J. C. Saborio (MNCR). INBIOCRI000246466 (dissected, COI barcoded) Costa Rica. Prov. Puntarenas, R.B. Carara, Estac. Quebrada Bonita 9767453 -84608119, 50 m, June 1990, E. Rojas (MNCR). INBIOCRI000804657 Costa Rica. Prov. Puntarenas, R.B. Carara, Estac. Quebrada Bonita 9767453 -84608119, 50 m, May 1992 J. C. Saborio (MNCR). INBIOCRI000241530 Costa Rica. Prov. Puntarenas, Res. Biol. Carara, Est. Quebrada Bonita 9.774233 -84.608124, 50 m, July 1990, E. Bello & E. Rojas (MNCR). INBIOCRI000016781 Costa Rica. Prov. Puntarenas, Res. Biol. Carara, Est. Quebrada Bonita 9.774233 -84.608124, 50 m, August 1989 R. Zuñiga (MNCR). INBIOCRI000819377 Costa Rica. Prov. Alajuela, R.N.V.S., Caño Negro 10.893812 -84.788847, 20 m, 8 August 1992, K. F. Flores (MNCR). **Females:** 07-SRNP-111836 (COI Barcoded) Costa Rica. Prov. Guanacaste, Sector Mundo Nuevo, La Perla (Tajo) 10.76734 -85.43014, 394 m 13 November 2007. H. Cambroner & F. Quesada. 07-SRNP-111842 (COI Barcoded) Costa Rica. Prov. Guanacaste, Sector Mundo Nuevo. La Perla (Tajo) 10.76734 -85.43014, 394 m, 13 November 2007. H. Cambroner & F. Quesada (MNCR). 93-SRNP-6135 Costa Rica. Prov. Guanacaste, Sector Santa Rosa, Área Administrativa 10.83764 -85.61871, 295 m, 3 October 1993. Gusaderos (USNM). 96-SRNP-10159 Costa Rica. Prov. Guanacaste, Sector Santa Rosa, Área Administrativa 10.83764 -85.61871, 295 m, 27 September 1996. Gusaderos (USNM). INBIOCRI000747766 Costa Rica. Prov. Puntarenas, Res. Biol. Carara, Est. Quebrada Bonita 9.774233 -84.608124, 50 m, 28 August 1992, R. Guzmán (MNCR). INBIOCRI000241532 (dissected) Costa Rica. Prov. Puntarenas, Res. Biol. Carara, Est. Quebrada Bonita 9.774233 -84.608124, 50 m, July 1990, E. Bello & E. Rojas (MNCR). INBIOCRI000046665 Costa Rica. Prov. Puntarenas, Res. Biol. Carara, Est. Quebrada Bonita 9.774233 -84.608124, 50 m, August 1989, R. Zuñiga (MNCR). INBIOCRI002006747 (dissected, COI barcoded) Costa Rica. Prov. Guanacaste, P.N. Barra Honda 10.168217 -85.373656, 100 m. August 1994, M. Reyes (MNCR).

Diagnosis: Surface of male ST8 pilose, posterior margin of ST8 sclerotized, denticulate, symmetrical, with a wide V-shaped mesal excavation and a pair of long, blunt posterolateral apodemes, anterior apodemes long and acute (Fig. 105). Valvae symmetrical, sclerotized, apices slightly curved and acute, costal margin bearing a pair of short, blunt processes; uncus sclerotized, short, slightly flattened and blunt, pubescent; socii sclerotized, comprising a pair of thin, short projections (Figs 103, 104); proximal portion of phallus tube wide, distal portion sclerotized, bearing a greatly elongate, hook-shaped process (Fig. 106). Male FWL 16-19 mm (Figs 99, 100). Female FWL 19-22 mm (Figs 101, 102).

Distribution: *Xylodonta guarana* has been collected with light traps in the dry forest and rain forest on the western slope of

Cordillera Volcánica de Guanacaste and in the lowlands of Llanura de los Guatusos and the Central Pacific, from 20 to 400 m elevation (Fig. 129).

Natural history: (Figs 123-127) 34 rearing records: ACG locations: Sector Del Oro (n=6), Sector Mundo Nuevo (n=7), Sector Santa Rosa (n=21).

Food plants: Exclusively Fabaceae: *Platymiscium parviflorum* (n=32), *Platymiscium pinnatum* (Jacq.) Dugand (n=2).

Parasitoids: 10 records from 34 wild-caught caterpillars over 27 years of dry and rain forest searches. Encyrtidae (n=1); Eulophidae: *Euplectrus hugokonsi* (n=4), *Euplectrus magdae* (n=1); Tachinidae: *Belvosia woodleyi* (n=2) DHJPAR0016472, DHJPAR0016473; *Sphaerina* Janzen 21 (n=1) DHJPAR0034864; *Winthemia* Wood 24 (n=1) DHJPAR0009197.

Remarks:

The lectotype of *D. guarana* was designated in 2014 by Alexander Schintlmeister. Type locality is Rio de Janeiro. Type No. 11198, Barcode USNMENT 00991744. The lectotype has not been dissected. Jim Miller identified voucher specimen 87-SRNP-1251 in 2008 by visual comparison with *Dasylophia guarana* USNM specimens, including the type. Subsequently, all *X. guarana* specimens from Costa Rica have been identified by comparing them with the voucher identified by Miller.

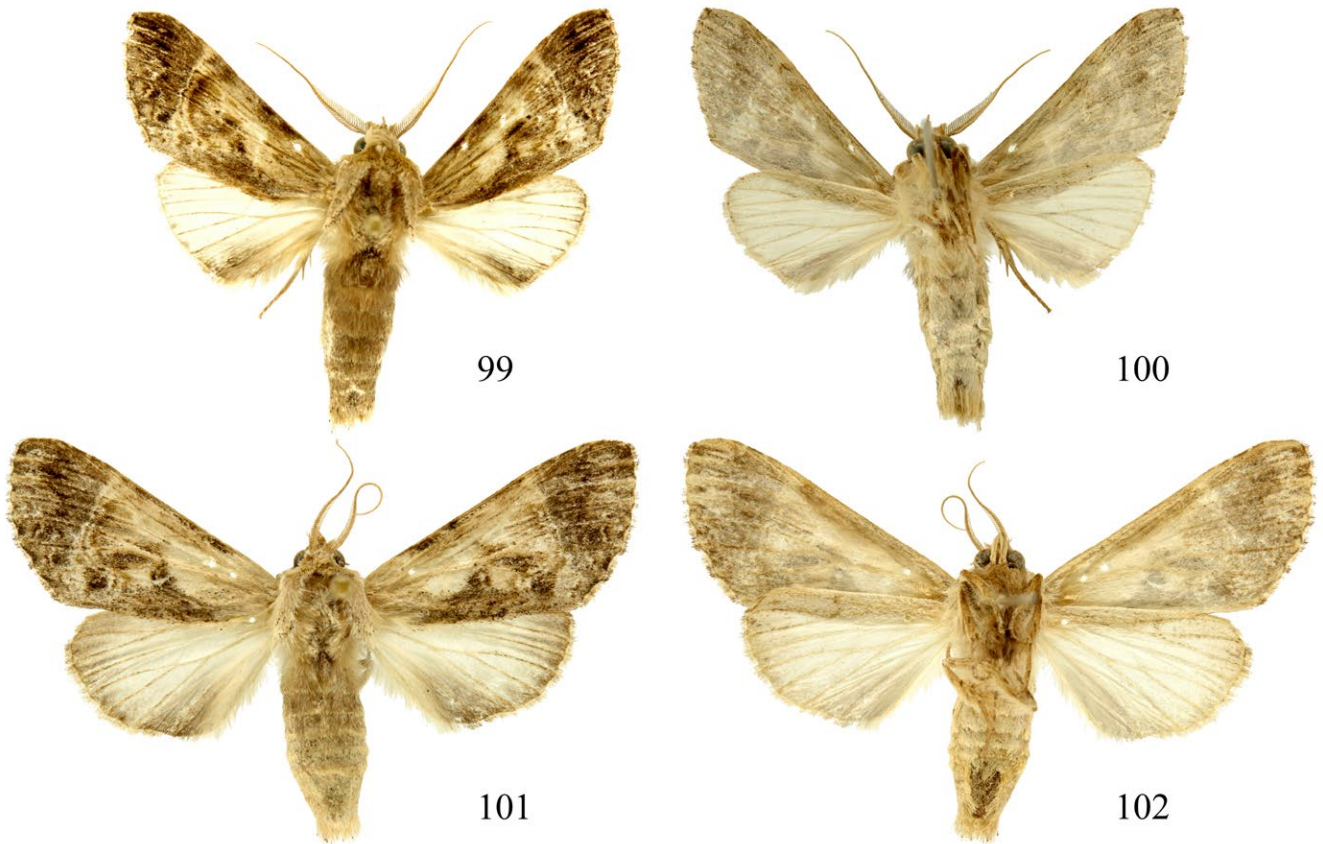
Genbank Accession: JQ563958

DNA barcode of male BLPCH657-08|07-SRNP-111842|*Xylodonta guarana* (*Dasylophia guarana*)|COI-5P

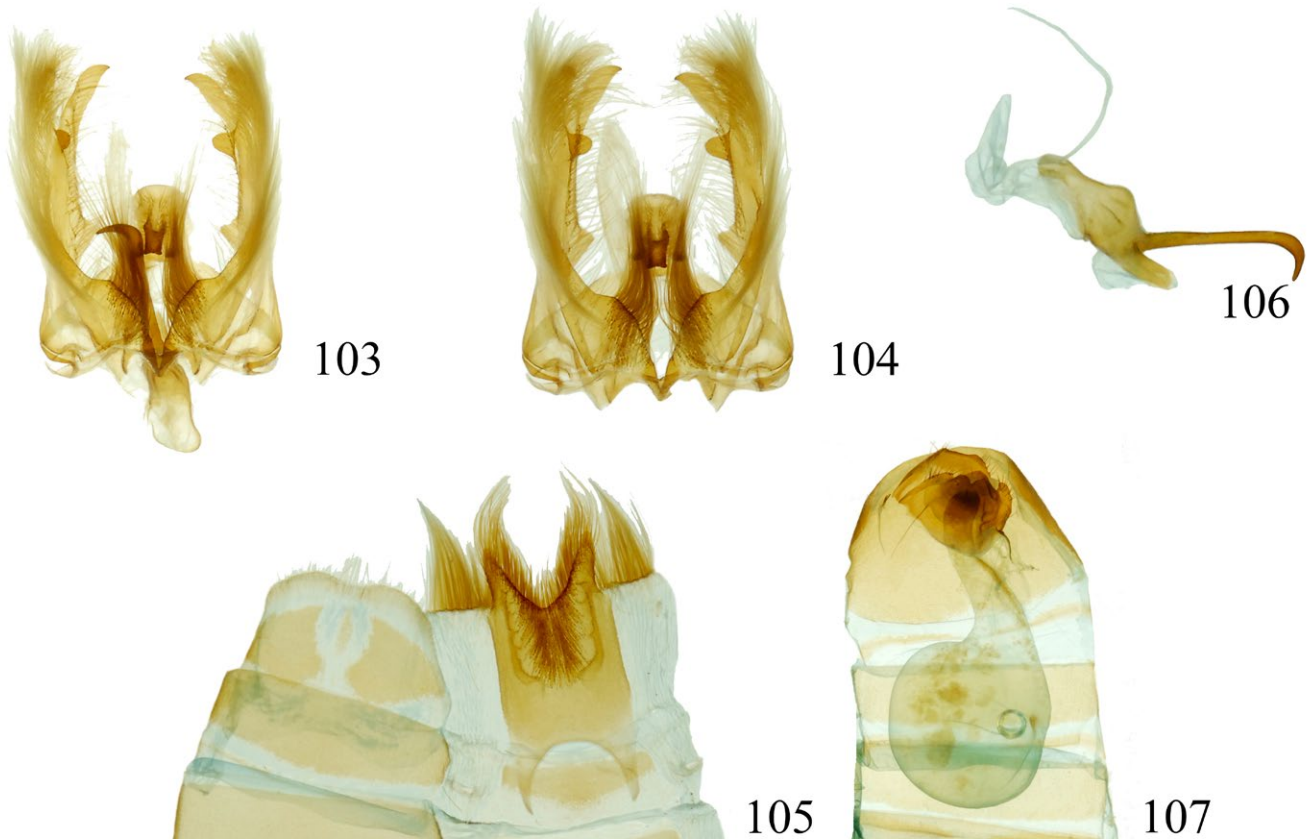
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ACKNOWLEDGMENTS

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Figs 99-102. *Xylodonta guarana*: 99, 100 Male dorsal and ventral (INBIOCRI000707381) forewing length 17.71mm; 101, 102 Female dorsal and ventral (INBIOCRI002006747) forewing length 20.29 mm.



Figs 103-107. *Xylodonta guarana*: 103, 104 male genitalia (INBIOCRI000707382) 4.5 mm length; 105 male ST8 4.4 mm length, 106 phallus 2.5 mm length, 107 female genitalia (INBIOCRI000241532) 7.5 mm length.



Figs 108-111. *Xylodonta terrena*: 108, penultimate instar 03-SRNP-3393, 109, 89-SRNP-86, 110, 88-SRNP-514, 111, 89-SRNP-86.



Figs 112-116. Final instars of *Xylodonta markvanputteni*, 112, 99-SRNP-5630, 113, 01-SRNP-22946, 114, 99-SRNP-5630, 115, 99-SRNP-5630, 116, 94-SRNP-9721.

adults and genitalia and the plates. Finally, we want to thank Jim Miller for his profound revision of the manuscript. His comments and suggestions enriched this paper.

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Figs 117-122. Final instars of *Xylodonta patrickgoodwilliei*; 117, penultimate instar 01-SRNP-2231, 118, penultimate instar 01-SRNP-2231, 119, 01-SRNP-2231, 120, 06-SRNP-40459, 121, 06-SRNP-40459, 122, 06-SRNP-40459.



Figs 123-127. Final instars of *Xylodonta guarana*; 123, 08-SRNP-21930, 124, 08-SRNP-21930, 125, 90-SRNP-2105, 126, 08-SRNP-21930, 127 Larvae parasitized by *Euplectrus hugokonsi* (Eulophidae), 90-SRNP-2084.

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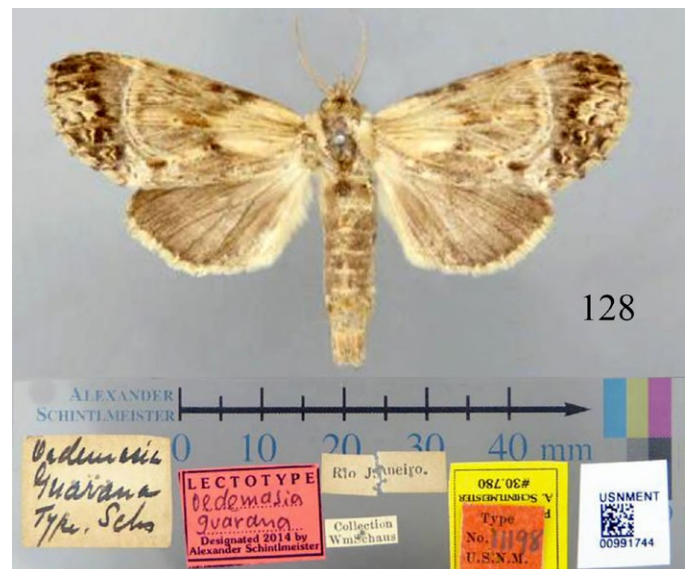


Fig. 128. *Oedemasia guarana* (Lectotype No. 11198 USNM 00991744 USNMMENT) Male dorsal.

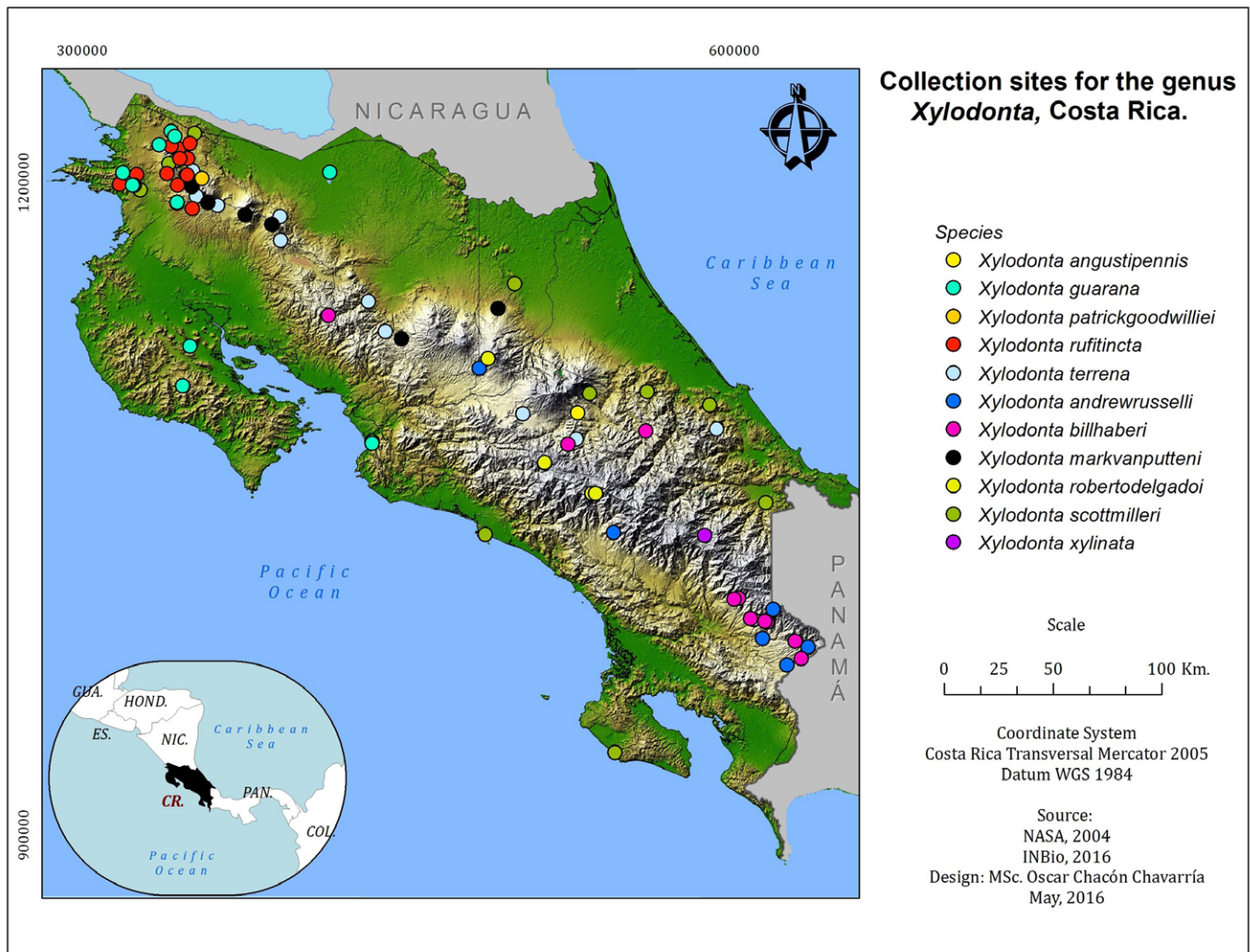


Fig. 129. Map of Costa Rican collection sites for the eleven species of *Xylodonta* discussed here.