



Cryptic diversity of *Leurus* wasps (Hymenoptera: Ichneumonidae: Metopiinae), parasitoids of caterpillars in Area de Conservación Guanacaste, Costa Rica

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Abstract

As a consequence of COI barcoding hundreds of reared specimens of what appeared to be *Leurus caeruliventris*, a parasitoid of leaf-rolling Crambidae (Lepidoptera) from the Area de Conservación Guanacaste, northwestern Costa Rica, and matching them with their host caterpillars and morphological traits, we describe ten new sympatric species and redescribe *L. caeruliventris*. The new species, authored by Zuñiga & Valerio, are: *Leurus billeberhardi*, *L. henrytownesi*, *L. hugokonsi*, *L. iangauldi*, *L. jesusugaldei*, *L. marjorietalesae*, *L. maryjanewestae*, *L. pammitchellae*, *L. sondrawardae*, and *L. wahl*. We also provide an illustrated key to the eleven species and an ecological glimpse into the lives of these very similar wasp species.

Key words: DNA barcoding, cryptic species, parasitoid host records, wasp ecology, Crambidae

Introduction

Metopiinae wasps are solitary koinobiont endoparasitoids, primarily of leaf-rolling and web-building microlepidopterans; they oviposit into a late-instar host larva but parasitoid larval development does not begin until after the host pupates. The stout body of Metopiinae is probably an adaptation for pushing into the host's site of concealment. The female oviposits into a particular host tissue as opposed to the hemocoel, presumably to avoid the host's immune response (Broad *et al.* 2018 give a good summary of the biology). In a species where details of oviposition behavior have been observed (*Triclistis anthophilae* Aeschlimann), the wasp chases the host from its retreat, grasps it with its legs, bends the caterpillar's head downward and oviposits just behind the head into the supraesophageal ganglion (Shaw 2017).

A total of 14 genera and 130 species of this subfamily have been recorded from Costa Rica (Gauld & Sithole 2002). The most species-rich genus in the country is *Exochus* (50 species), whereas five genera are represented by just a single species. The genus *Leurus* is represented in the country by 11 species: *L. caeruliventris* (Cresson) plus ten species described by Gauld & Sithole (2002) from Costa Rica. *Forrestopius larryi* was recently transferred to *Leurus* (Alvarado & Palacio 2021), although its mandibles are narrower at the apex and the metasoma is more elongate. Three species (*L. caeruliventris*, *L. discus* and *L. pusillanimus*) have now been reared from Area de Conservación Guanacaste (ACG) in northwestern Costa Rica (<http://janzen.sas.upenn.edu>).

Some of the species originally described from Costa Rica by Gauld & Sithole (2002) have subsequently been reported from other parts of the neotropics: *L. pusillanimus* from Mexico (González-Moreno *et al.* 2010), and *L. discus*, *L. graciosus* and *L. nostrus* from Brazil (Moleiro *et al.* 2023). *Leurus caeruliventris* (Fig. 1), the type species of the genus, is the most widely distributed species in the genus, from southern Michigan (U.S.A.) to southern Brazil (Townes & Townes 1959). Gauld & Sithole (2002, p. 188) note that this species shows “a confusing range of variation”, but they decided to retain it as single species. Through long-term rearing of field-collected caterpillars in ACG and DNA barcoding of the reared wasps, we have detected cryptic species within *L. caeruliventris*. Neighbor-joining (NJ) analyses of DNA barcodes (COI) led to the subdivision of the several hundred *L. caeruliventris* specimens into 11 clusters of different DNA barcodes (Fig. 2). In most cases we found differences in hosts and subtle differences in color that coincide with these clusters. Here we describe ten new species and redescribe *Leurus caeruliventris*.



FIGURE 1. Type *Exochus caeruliventris* (Cresson) lateral habitus.

Material and methods

The material examined was collected during the inventories carried out by the National Biodiversity Institute (INBio, collections are now part of the Museo Nacional de Costa Rica) and by ACG (<http://janzen.bio.upenn.edu/caterpillars/database.lasso>). We use the term “*Leurus caeruliventris* complex” to refer to specimens that would have been identified as *L. caeruliventris* as defined by Gauld & Sithole (2002). Morphological terminology follows that of Gauld (1991) and Gauld & Sithole (2002). Photographs were taken with an Olympus SZ60 stereomicroscope and a Canon EOS 1220D digital camera. The specimens examined in this study are deposited in the following collections:

ANSP	Academy of Natural Sciences, Philadelphia, Pennsylvania, U.S.A.
EMUS	Entomology Museum, Utah State University, Logan, Utah, U.S.A.
MNCR	Museo Nacional de Costa Rica, Santo Domingo, Costa Rica
MZUCR	Museo de Zoología, Universidad de Costa Rica, San Pedro, Costa Rica
USNM	United States National Museum, Washington, D.C., U.S.A.

All specimens were reared from caterpillars with a rearing voucher code of the format “yy-SRNP-xxxxx”. The parasitoid specimens reared from those caterpillars are identified by a code of the format “DHJPARxxxxxxx”. A given pinned or pickled specimen bears both voucher codes. In the species description section, the following

format will be used to identify the parasitoid specimen(s) reared from a particular caterpillar: 06-SRNP-41643: DHJPAR0028681. Since only one individual *Leurus* emerges from a parasitized host pupa, there is only one DHJPARxxxxxxx voucher code per caterpillar host, but it needs to be different from that of the host because it is a different organism.

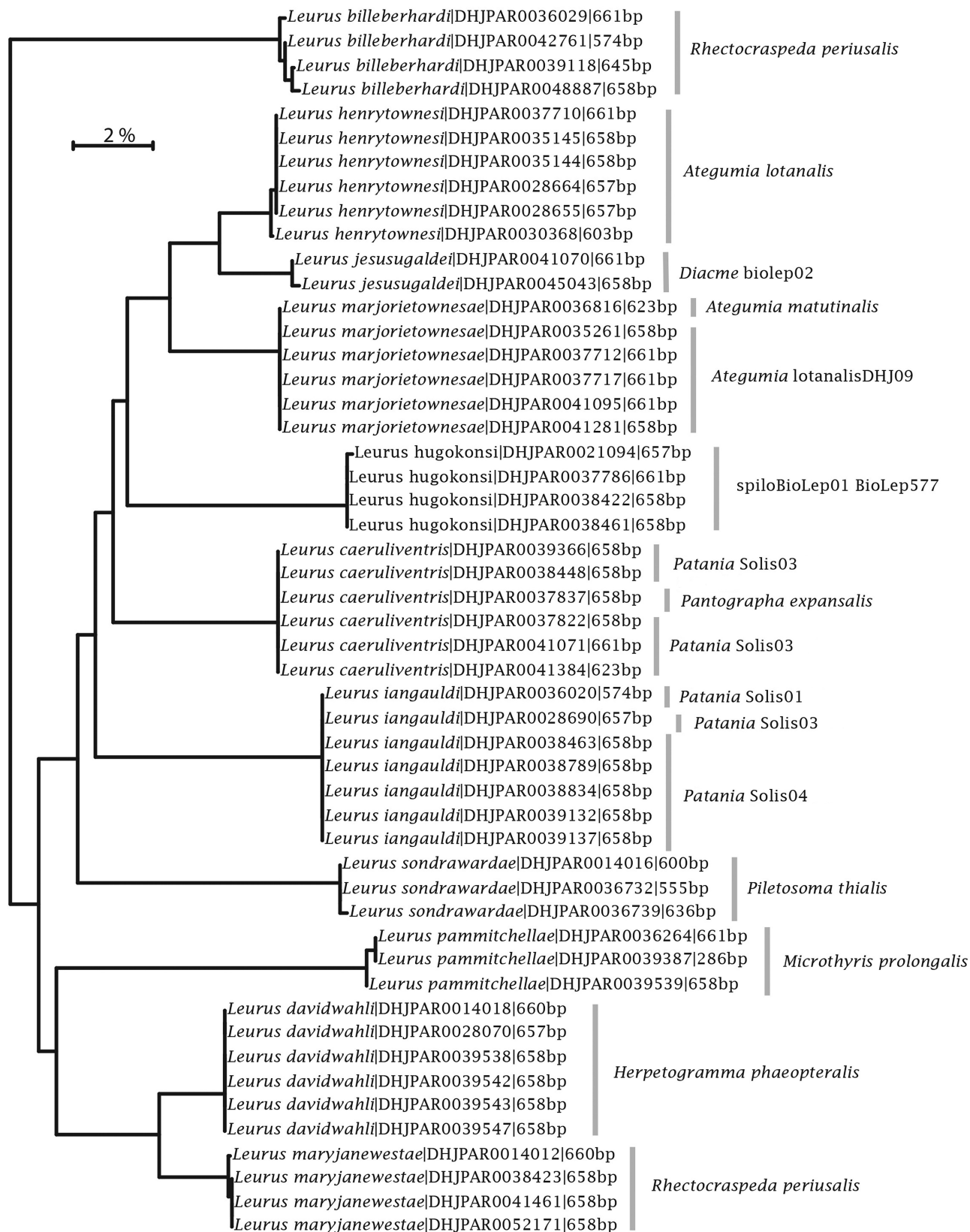
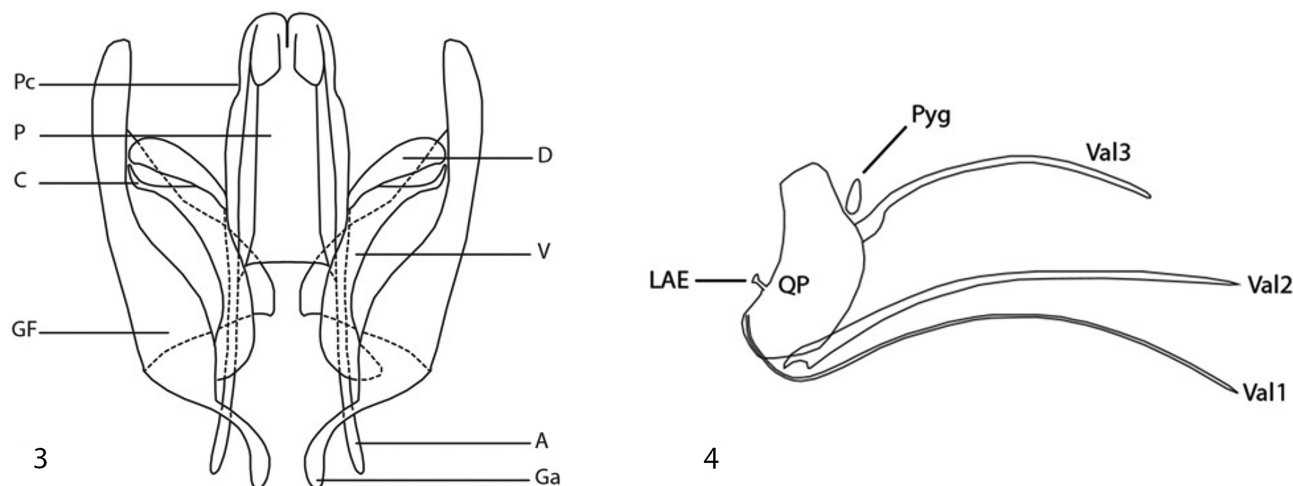


FIGURE 2. Neighbor-Joining tree based on Kimura 2-parameter distances using 296 COI gene sequences for species of *Leurus* and their known hosts.

DNA barcodes. Newly eclosed wasps were killed in the field by freezing, and stored in 95% ethanol, each in its own individual 2 ml tube (Janzen *et al.* 2009, Janzen & Hallwachs 2011), or on occasion, pinned and then oven-dried. All DNA barcodes were obtained using DNA extracts prepared from single legs using a glass fiber protocol (Ivanova *et al.* 2006). Extracts were re-suspended in 30 μ l of dH₂O, and a 658-bp region near the 5' terminus of the COI gene was amplified using standard primers (LepF1–LepR1) following established protocols (Smith *et al.* 2006, 2007, 2008). If the initial 658 bp amplification was not successful, composite sequences were generated using internal primers. Primer information for individual sequences can be retrieved from the Barcode of Life Data System (BOLD, <http://www.boldsystems.org>) (Ratnasingham & Hebert 2007), but primers are those detailed in Smith *et al.* (2008). Figure 2 shows a sample of representative barcodes for each species.

Genitalia preparation and illustration. Female and male genitalia were examined in those species where a sufficient number specimens were available. The metasoma was detached from the body and left immersed in 18% KOH overnight or longer to remove soft tissue; the genitalia were then washed in distilled water to remove excess KOH, and then dried with successive baths of 70% and 100% ethanol before being slide-mounted in Euparal; the remainder of the metasoma was put into a gelatin capsule and this capsule is placed adjacent to the pin-mounted specimen, and numbered with the same DHJPAR voucher code. The mounted genitalia slides have been deposited with the pin-mounted specimens.

The terminology used for the male genitalia follows Teder (1998) (Fig. 3) while that for the female genitalia follows Gauld (1991) and Brajković *et al.* (2010), except for the term “lower-anterior extension”. This term is applied to an anterior prolongation of the lower part of the quadrate plate (Fig. 4). Imaging of the genital capsule was done with an Olympus BX41TF microscope with an Olympus PLAN N 10X/0.25/ ∞ -/FN22 lens, and an iPhone 8



FIGURES 3–4. Genitalia morphology. 3. Male genitalia (modified after Theder, 1998); abbreviations: P—phallus, PC—phallus constriction, GF—gonoforceps, D—digitus, C—cuspis, V—volsella, GA—gonocoxal arm, A—apodeme of phallus valves. 4. Female genitalia; abbreviations: LAE—lower-anterior extension of quadrate plate, Pyg—pygostyle, QP—quadrate plate, Val1—valve 1, Val2—valve 2, Val3—valve 3 / ovipositor sheath.

Diagnosis of the *Leurus caeruliventris* species complex (modified from Gauld & Sithole 2002, pp. 182–187).

Propodeum with lateromedial longitudinal carinae meeting each other at the posterior transverse carina, then behind this transverse carina continuing as a single broad ridge to posterior margin of propodeum. First metasomal tergite with lateromedial longitudinal carina well-developed and extending about 0.7 of length of tergite (always longer than 0.4 of length of tergite). Second metasomal tergite with laterotergite narrow and inconspicuous, less than 0.2 \times as wide as long (never broad and conspicuous). Fore wing with 3rs-m nearly always present, at least partially, and forming a complete or incomplete areolate. Body predominantly black, metasoma often with at least some metallic (usually blue) reflection; hind leg with femur extensively blackish or very dark blackish brown, tibia generally black with the basal part white.

Key to Costa Rican species of the *Leurus caeruliventris* complex

The following key is based solely on morphology, but in a few cases (couplets 7 and 9) we were unable to find morphological differences. Cryptic species therefore fall out together and the only apparent way they can be separated is via DNA.

1. Metasoma black, without any metallic reflection 2
– Metasoma with at least some metallic blue reflection (Fig. 1) 4
2. Tegula pale anteriorly, orangish posteriorly (Fig. 5). [Scape entirely yellowish.]
..... *L. marjoretownesae* Zúñiga & Valerio **sp. nov.**
- Tegula pale anteriorly, dark posteriorly (Fig. 10) 3
3. Mid femur black; dorsal surface of scape mostly dark (Fig. 10) *L. pammitchellae* Zúñiga & Valerio **sp. nov.** (in part)
– Mid femur with considerable orange; dorsal surface of scape yellowish orange *L. iangauldi* Zúñiga & Valerio **sp. nov.**
4. Tegula yellow or light colored both anteriorly and posteriorly (Fig. 6) *L. wahli* Zúñiga & Valerio **sp. nov.**
– Tegula dark posteriorly (Figs. 9–10) 5
5. Scape predominantly yellowish to light brown, especially on dorsal surface (Fig. 8) *L. caeruliventris* (Cresson)
– Scape mostly dark colored on dorsal surface (Fig. 10) 6
6. Hind tarsomeres 1–2 entirely white, or nearly so, sometimes slightly darkened at extreme apex (Fig. 13) 7
– Hind tarsomeres 1–2 mostly white, but dark in apical part (Figs. 11–12) 8
7. Dorsal surface of hind tibia with white extending more than half the length of the tibia, often to apex or nearly so (Fig. 7); most flagellomeres longer than wide . . . *L. billeberhardi* Zúñiga & Valerio **sp. nov.**, *L. maryjanewestae* Zúñiga & Valerio **sp. nov.**
– White on dorsal surface of hind tibia not extending more than half the length of the tibia; most flagellomeres as wide as long or wider than long *L. henrytownesi* Zúñiga & Valerio **sp. nov.**
8. Scape black with apex and ventral side white; tegula with anterior half white (Fig. 9)
..... *L. pammitchellae* Zúñiga & Valerio **sp. nov.** (in part)
– Scape brown, usually without distinct white marking on apex; tegula light colored anteriorly, but accounting for less than half the length of the tegula 9
9. Lateral surface of hind tibia with basal white extending no more than $0.25 \times$ length of tibia (Fig. 12)
..... *L. hugokonsi* Zúñiga & Valerio **sp. nov.**, *L. sondrawardae* Zúñiga & Valerio **sp. nov.**
– Lateral surface of hind tibia with basal white extending nearly $0.4 \times$ the length of the tibia (Fig. 13)
..... *L. jesugaldei* Zúñiga & Valerio **sp. nov.**

Leurus billeberhardi Zúñiga & Valerio, **sp. nov.**

(Fig. 7)

Diagnostic description. Female. Fore wing length, 5.2–5.6 mm (holotype 5.3 mm). Malar space $0.8\text{--}1.1 \times$ basal mandibular width; antenna with 23–24 flagellomeres, most flagellomeres quadrate, except for the first 2 and the last 2–3. **Coloration.** Antennal scape pale yellow to brownish, pedicel yellowish to light brown, flagellum dark brown; tegula light yellow anteriorly, brown posteriorly; metasoma black, with metallic blue iridescence. Trochanters yellowish orange to light brown; fore and mid femora predominantly black, hind femora entirely black; fore and mid tibiae pale yellow to orangish, hind tibiae pale yellow basally, black apically; fore tarsus pale yellow, mid tarsus pale yellow with last 1–2 segments orangish to light brown, hind tarsus with first 2–3 segments mostly pale with dark apices, last 2–3 segments all dark.

Male: Unknown

Material. Holotype. ♀. Deposited at EMUS. Specimen labels: 1. DHJPAR0042761. 2. Caterpillar Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservacion Guanacaste, Costa Rica, 11-SRNP-2012. Database information: Costa Rica, ACG, Alajuela Prov., Sector Rincon Rain Forest, Camino Albergue Oscar, 10.87741, -85.32363, 560m (Elda Araya) host *Rhectocraspeda periusalis* (Crambidae) feeding on *Piper sancti-felicis* (Piperaceae) coll. 16.v.2011, wasp eclosed 11.vi.2011. **Paratypes.** 3 ♀, (EMUS, MNCR). COSTA RICA, ACG database codes: 12-SRNP-1712: DHJPAR0048887 (♀); 10-SRNP-70339: DHJPAR0039118 (♀); 09-SRNP-56157: DHJPAR0036029 (♀).

Barcode. Holotype DHJPAR0042761 (574 bp)

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CGGCCATTAATTAATAATGACCAAATTTACAATTCTATTGTTACTATACATGCCTTTATTATAATTTCTTTATA  
GTTATACCAATTATGATTGGTGGATTTGGTAACTGACTCACCCCTTTAATATTAGGAGCCCCAGATATAGCTTTCC  
CTCGAATAAATAATATAAGATTTTGATTACTACCCCTTCCCTATTTTTATTAAATTGCAGGAAGAAATCCTAAACCA  
AGGTGCTGGAAGTGGTTGAACAGTATACCCCCACTTTCATCTAACACAAACCATGAAGGATTATCTGTTGACTTA
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AGAATTTTCTCTCTCCATTTAGCAGGTATATCTTCAATTATAGGTGCAATCAATTTTATTACAACATTTCTAAATA
TAAAAATTAATCATTAATAATTTGAGCAACTTTCTTTATTTATTTGATCAATTAATAATTACTACAATTTTACTTTT
ATTAGCAGTACCTGTTTTGGCAGGAGCAATTACCATGCTATTAACTGACCGTAATTTAATACTTCCTTTTTTGAC
CCTAGAGGGGGGGGAGACCCAATTTTATACCAACATTTATTT

Etymology. This species is named in honor of William Eberhard in recognition of his decades of study of the evolutionary biology of insect and spider reproduction, as well as the biology of pimpline ichneumonids parasitizing spiders.

Comments. While the female (male unknown) of *E. billeberhardi* appears to be morphologically identical to that of *E. maryjanewestae* at our level of inspection, and both species parasitize the same species of crambid leaf roller feeding on rain forest Piperaceae in the same part of ACG, they are about 9% different in their DNA barcodes (Fig. 2), and therefore we are describing them as new, sibling species. However, this is still a tentative conclusion. Close inspection of the four “barcodes” of *L. billeberhardi* reveals that all four are the same pseudogene. While it would be logical, from the host data, to conclude that they are pseudogenes of the barcodes of *L. maryjanewestae*, which appears to be morphologically identical to *L. billeberhardi*, in fact they appear to be pseudogenes of the barcodes of *L. wahl*. However, *L. wahl* is exclusively a parasite of *Herpetogramma phaeopteralis* (a grass-feeding rain forest crambid that is very different from the Solanaceae-feeding rain forest crambid host of *L. billeberhardi*). This story will unfold further with additional samples and exploration.

Hosts. *Leurus billeberhardi* is a very low density parasitoid, having been reared just four times from 490 wild-caught caterpillars of *Rhectocraspeda periusalis* (Walker) (Crambidae), its sole host species, from among a sample of 65,000+ wild-caught ACG Crambidae caterpillars.

***Leurus caeruliventris* (Cresson)**

(Figs. 1, 8, 17, 23)

Exochus caeruliventris Cresson, 1868: 38. Mexico: Cordoba (designated by Cresson, 1916: 22) (ANSP). Cresson mistakenly referred to the lectotype as a male, when in fact it is a female as indicated by Gauld & Sithole (2002).

Leurus caeruliventris (Cresson) Townes, 1946: 59

Diagnostic description. Female. Fore wing length 5.5–6.4 mm. Malar space 0.6–1.1 × basal mandibular width; antenna with 24–25 flagellomeres, most flagellomeres quadrate or transverse, except for the first two and the last, which are slightly longer than wide. Genitalia: setae on ovipositor sheaths extending basally for a distance equal to or greater than 0.3x the total length; setae more or less sparse throughout sheath width, setae somewhat broad and elongated; lower-anterior extension of quadrate plate short and broad, somewhat square-shaped at tip; setae on ventral edge of quadrate plate thin, normally large. **Coloration.** Antennal scape predominantly yellow, especially on dorsal surface, pedicel yellowish orange to light brown, flagellum orangish brown basally and becoming darker brown apically; tegula light yellow anteriorly, brown posteriorly; metasoma with metallic blue iridescence. Trochanters black; femora predominantly black; fore tibia pale yellow to orangish, mid and hind tibiae pale yellow basally, black apically; fore tarsus pale yellow with last segment more orangish, mid tarsus pale yellow with last 1–2 segments light brown, hind tarsus with first 2–3 segments mostly pale with dark apices, last 2–3 segments all dark. **Male.** Similar to female in size and color. Antenna with 25–26 flagellomeres. Genitalia: digitus completely lobate at base; volsella medial area deep, volsella tip (in lateral view) clearly rounded throughout; phallus apex slender, phallus constriction short; overall shape of phallus based on the width difference between the phallus apex and the phallus width: somewhat broad, phallus width clearly narrower than apex width; distal third of gonoforceps normally setose, setae somewhat sparse.

Lectotype (ANSP). Examination based on photo (Fig. 1).

Material. Principal specimen used in diagnostic description: ♀. Deposited at EMUS. Specimen labels: 1. DHJPAR0014003. 2. Caterpillar Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservacion Guanacaste, Costa Rica, 04-SRNP-24763. Database information: Costa Rica, ACG, Guanacaste Prov., Sector del Oro, Quebrada Raiz, 11.02865, -85.48669, 280m (Lucia Rios) *Pleuroptya* Solis03 caterpillar feeding on *Laportea aestuans* (Urticaceae) coll. 22.ix.2004, wasp eclosed 10.x.2004. Conspecific specimens: 66 (♀), 12 (♂), (EMUS, MNCR, MZUCR, USNM). COSTA RICA, ACG database codes: 06-SRNP-41603:

DHJPAR0028676 (♀); 06-SRNP-41414: DHJPAR0028670 (♀); 06-SRNP-41410: DHJPAR0028667 (♀); 06-SRNP-2583: DHJPAR0028684 (♀); 06-SRNP-5796: DHJPAR0028663 (♀); 06-SRNP-41409: DHJPAR0028666 (♀); 06-SRNP-41596: DHJPAR0028668 (♀); 10-SRNP-35674: DHJPAR0041381 (♀); 06-SRNP-41632: DHJPAR0028672 (♀); 06-SRNP-41647: DHJPAR0028678 (♀); 06-SRNP-2584: DHJPAR0028679 (♀); 06-SRNP-41640: DHJPAR0028686 (♀); 06-SRNP-41629: DHJPAR0028688 (♀); 06-SRNP-41575: DHJPAR0028693 (♀); 06-SRNP-41620: DHJPAR0028696 (♀); 09-SRNP-6572: DHJPAR0038448 (♀); 10-SRNP-6862: DHJPAR0041534 (♀); 06-SRNP-23264: DHJPAR0021589 (♀); 06-SRNP-40802: DHJPAR0009646 (♀); 06-SRNP-40787: DHJPAR0009642 (♀); 06-SRNP-40800: DHJPAR0009640 (♀); 04-SRNP-26313: DHJPAR0013998 (♀); 04-SRNP-24119: DHJPAR0014001 (♀); 04-SRNP-24763: DHJPAR0014003 (♀); 04-SRNP-24770: DHJPAR0014006 (♀); 04-SRNP-26315: DHJPAR0014007 (♀); 06-SRNP-41419: DHJPAR0010099 (♀); 04-SRNP-24961: DHJPAR0009652 (♀); 09-SRNP-40496: DHJPAR0035194 (♀); 10-SRNP-40046: DHJPAR0037837 (♀); 09-SRNP-5602: DHJPAR0037693 (♀); 10-SRNP-2222: DHJPAR0039366 (♀); 10-SRNP-7441: DHJPAR0041071 (♀); 05-SRNP-24015: DHJPAR0028657 (♀); 05-SRNP-23991: DHJPAR0028660 (♀); 06-SRNP-41574: DHJPAR0028682 (♀); 06-SRNP-41644: DHJPAR0028685 (♀); 05-SRNP-23961: DHJPAR0028659 (♀); 05-SRNP-5803: DHJPAR0028658 (♀); 05-SRNP-23450: DHJPAR0028651 (♀); 06-SRNP-41573: DHJPAR0028694 (♀); 06-SRNP-41609: DHJPAR0028692 (♀); 05-SRNP-23958: DHJPAR0028656 (♀); 06-SRNP-41621: DHJPAR0028687 (♀); 06-SRNP-41593: DHJPAR0028695 (♂); 06-SRNP-41407: DHJPAR0028675 (♀); 05-SRNP-6858: DHJPAR0028665 (♀); 06-SRNP-41411: DHJPAR0028674 (♀); 10-SRNP-35675: DHJPAR0041384 (♀); 06-SRNP-41467: DHJPAR0028671 (♀); 06-SRNP-41597: DHJPAR0028691 (♀); 06-SRNP-41598: DHJPAR0028673 (♀); 06-SRNP-41605: DHJPAR0028689 (♀); 06-SRNP-2214: DHJPAR0028680 (♂); 00-SRNP-559: DHJPAR0014008 (♀); 02-SRNP-1204: DHJPAR0014009 (♀); 02-SRNP-1200: DHJPAR0014025 (♀); 02-SRNP-91: DHJPAR0014021 (♀); 06-SRNP-40768: DHJPAR0009641 (♀); 06-SRNP-40666: DHJPAR0009624 (♀); 04-SRNP-24786: DHJPAR0013999 (♂); 04-SRNP-25396: DHJPAR0014000 (♂); 04-SRNP-24766: DHJPAR0014004 (♂); 04-SRNP-24779: DHJPAR0014005 (♂); 02-SRNP-92: DHJPAR0028065 (♀); 10-SRNP-40005: DHJPAR0037822 (♂); 06-SRNP-41648: DHJPAR0028683 (♀); 06-SRNP-41574: DHJPAR0028682 (♂); 05-SRNP-23958: DHJPAR0028656 (♂); 05-SRNP-23991: DHJPAR0028660 (♂); 06-SRNP-40787: DHJPAR0009642 (♀); 04-SRNP-26506: DHJPAR0014002 (♀); 12-SRNP-41403: DHJPAR0048896 (♀); 12-SRNP-31262: DHJPAR0054414 (♀); 13-SRNP-1430: DHJPAR0052160 (♀); 13-SRNP-1429: DHJPAR0052146 (♀); 13-SRNP-350: DHJPAR0050742 (♀); 12-SRNP-1172: DHJPAR0048802 (♀); 13-SRNP-343: DHJPAR0051714 (♀); 13-SRNP-348: DHJPAR0050738 (♂); 13-SRNP-344: DHJPAR0050741 (♂).

Barcode. DNA barcode of female holotype DHJPAR0014003 (660 bp):

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GGTGCTTCTTTAAGAATTATTATTCGAATAGAACTTGGTACCCCTGGATCTCTAATTAATAATGACC
AAATTTATAATTCCATTGTAACACTATACATGCCTTCATTATAATTTCTTTATAGTAATACCAATTATAATTGGAGG
ATTTGGAAATTGACTCACTCCTTTAATGTTAGGGGCTCCAGATATAGCTTTCCCTCGAATAAATAATATAAGATTTTG
ATTATTACCTCCATCATTATTTTTTATTAATTTCTGGAAGAGTTTTTAAATCAAGGAGCTGGAACCTGGTTGAAC
AGTTTACCCTCCTTTATCATCTAATAACAAATCATGAAGGTTTATCAGTTGATTTAAGAATTTTTTCTCTCCATTT
AGCTGGAATATCCTCAATTATAGGTGCAATTAACCTTTATTACAACCTATTTTTAATAATAAAAATTAATTTTTAA
CTTTAGATCAACTTTCTTTATTTATTTGATCTATTTAAATTAACCACTATTTTACTTTTATTAGCAGTTCTGTTTT
AGCAGGAGCAATTACTATATTATTAACCTGATCGAAATTTAAATACTTCTTTTTTTTGACCCAAGAGGAGGAGGAGAC
CCTATTTTATAACCAACACTTATTT
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Etymology. This species is presumably called *L. caeruliventris* because of the bluish reflections on the metasoma.

Comments. *Leurus caeruliventris sensu stricto* can be recognized by the following combination of characteristics: metasoma with at least some metallic blue reflections; tegula light colored anteriorly, dark posteriorly; dorsal surface of scape mostly yellowish. The antennal flagellum of females tends to be quite orangish, especially in the basal half, while most other species treated here have a dark brown flagellum.

Leurus caeruliventris was described by Cresson in 1868 from a female collected at Cordoba, Veracruz, Mexico. Cordoba, at an intermediate elevation on Caribbean-facing slopes, has a climate and ecosystem almost identical to that of all of the species of *Leurus* newly described in this paper, except at a somewhat higher latitude. The lectotype was designated by Cresson (1916) and this specimen (deposited at ANSP; Fig. 1) is morphologically

identical to what we have designated as *Leurus caeruliventris*. This species was previously referred to as *Leurus caeruliventris*DHJ07 for a working species-level interim epithet. Townes & Townes (1959: 149) described a new subspecies, *L. caeruliventris borealis*, from Maryland in the U.S.A. (USNM, not examined), which was synonymized with *L. caeruliventris caeruliventris* (Cresson) by Gauld & Sithole (2002). Given the number of cryptic species that have been revealed by the present investigation of just ACG material, it is likely that *Leurus caeruliventris borealis* is a species distinct from *L. caeruliventris caeruliventris*. A re-examination of North American, as well as Mexican, “*L. caeruliventris*” is required to resolve this question.

Hosts. *Leurus caeruliventris* has been reared from two *Patania* (= *Pleuroptya*) Solis04 (Crambidae) caterpillars feeding on rain forest *Cecropia* (Urticaceae) and from 88 caterpillars of *Patania* Solis03 feeding on various species of Urticaceae (Table 1), from a sample of 4,400+ wild-caught *Patania* caterpillars feeding on Urticaceae. These two host caterpillars are also utilized by *L. iangauldi*. However, *L. caeruliventris* has also been reared from *Pantographa expansalis* (Lederer) (Crambidae), which also feeds on Urticaceae and has not yet been recorded as a host for any other ACG *Leurus* species.

TABLE 1. Rearing records of *Leurus* in Area Conservación Guanacaste. Host Lepidoptera are all Crambidae leaf rollers.

Leurus	Lepidoptera	Host plant species
<i>billeberhardi</i>	<i>Rhectocraspeda periusalis</i>	<i>Piper</i> 19051 (Piperaceae)
<i>caeruliventris</i>	<i>Pantographa expansalis</i>	<i>Cecropia insignis</i> , <i>C. obtusifolia</i> , <i>C. peltata</i> , <i>C. angustifolia</i> (= <i>polyphobia</i>), <i>Laportea aestuans</i> , <i>Myriocampa longipes</i> , <i>Urera caracasana</i> , <i>U. elata</i> , <i>U. eggersii</i> (Urticaceae)
	<i>Patania</i> Solis04	<i>Cecropia obtusifolia</i> , <i>C. insignis</i> , <i>C. peltata</i> , <i>C. polyphobia</i> , <i>Pourouma bicolor</i> , <i>Urera lianiformis</i> , <i>U. lianoides</i> (Urticaceae); <i>Hypolepis repens</i> (Dennstaedtiaceae)
	<i>Patania</i> Solis03	<i>Laportea aestuans</i> , <i>Myriocarpa longipes</i> , <i>Urera elata</i> , <i>U. cascarana</i> , <i>U. leaniformis</i> , <i>Bohemia cylindrica</i> (Urticaceae)
<i>henrytownesi</i>	<i>Ategumia lotanalis</i>	<i>Conostegia xalapensis</i> , <i>Miconia trinervia</i> , <i>Triolena hirsuta</i> , <i>Graffenrieda galeottii</i> (Melastomataceae)
	<i>Microthyris prolongalis</i>	<i>Ipomoea batatas</i> (Convolvulaceae)
<i>hugokonsi</i>	<i>spiloBioLep01 BioLep577</i>	<i>Maripea nicaraguensis</i> (Convolvulaceae)
<i>iangauldi</i>	<i>Patania</i> Solis04	<i>Cecropia insignis</i> , <i>C. obtusifolia</i> , <i>C. peltata</i> , <i>C. polyphobia</i> , <i>Pourouma bicolor</i> (Urticaceae)
	<i>Patania</i> Solis03	<i>Urera elata</i> (Urticaceae)
	<i>Patania</i> Solis01	<i>Pourouma bicolor</i> (Urticaceae)
<i>jesusgaldei</i>	<i>Diacme</i> biolep02	<i>Thelypteris nicaraguensis</i> (Thelypteridaceae)
<i>marjoretownesae</i>	<i>Ategumia lotanalis</i> , <i>A. matutinalis</i>	<i>Conostegia subcrustulata</i> , <i>Miconia lacera</i> , <i>Triolena hirsuta</i> (Melastomataceae)
<i>maryjanewestae</i>	<i>Rhectocraspeda periusalis</i>	<i>Piper</i> 19051 (Piperaceae)
<i>pammitchellae</i>	<i>Microthyris prolongalis</i>	<i>Ipomoea batatas</i> (Convolvulaceae)
<i>sondrawardae</i>	<i>Pileosoma thialis</i>	<i>Doliocarpus multiflorus</i> (Dilleniaceae)
<i>wahli</i>	<i>Herpetogramma phaeopteralis</i>	<i>Axonopus compressus</i> , <i>A. fissifolius</i> , <i>Paspalum nutans</i> (Poaceae)

***Leurus henrytownesi* Zuñiga & Valerio, sp. nov.**

(Figs. 12, 19, 25)

Diagnostic description. Female. Fore wing length 5.5–5.9 mm (holotype 5.3 mm). Malar space 1.2–1.3 × basal mandibular width; antenna with 24–25 flagellomeres, these being mostly quadrate (slightly transverse in central flagellomeres) except first 1–2 and last 1–2, which are longer than wide. Genitalia: setae on ovipositor sheaths extending basally for a distance greater than 0.3x the total length, constrained to ventral edge, setae sparse, thin and elongated; lower-anterior extension of quadrate plate elongated and broad, lobate at tip, setae on ventral edge

of quadrate plate conspicuously large, broad. **Coloration.** Antennal scape dark brown dorsally, yellow ventrally; pedicel dark brown; flagellum dark brown. Tegula light colored anteriorly, black posteriorly. Metasoma with metallic blue iridescence. Trochanters brown; femora black, fore femur with yellow at apex and some orange on anterior surface; fore tibia yellow, mid and hind tibiae black with yellow at extreme base; fore tarsus yellow with last segment orange, mid tarsus yellow with last 2 segments brown, hind tarsus entirely white without dark apices.

Male. Similar to female in size and color, but with scape, pedicel and base of flagellum yellowish orange; tegula orange posteriorly in some specimens; front and sometimes mid femur all orange, without any black. Antenna with 25–26 flagellomeres. Genitalia: volsella medial area deep, volsella tip (in lateral view) clearly flat; phallus apex somewhat stout, phallus constriction short; overall shape of phallus based on the width difference between the phallus apex and the phallus width: somewhat thin, straight looking; distal third of gonoforceps normally setose, setae somewhat sparse.

Material. Holotype. ♀. Deposited at EMUS. Specimen labels: 1. DHJPAR0030368. 2. Caterpillar Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservation Guanacaste, Costa Rica, 09-SRNP-20115. Database information: Costa Rica, ACG, Guanacaste Prov., Sector Del Oro, Montecristo, 11.01373, -85.42531, 525m (Lucia Ríos) *Ategumia lotanalis* (Crambidae) caterpillar feeding on *Miconia trinervia* (Melastomataceae) coll. 08.i.2009, wasp eclosed 07.ii.2009. **Paratypes** 19 ♀, 5 ♂, (EMUS, MNCR, MZUCR, USNM). COSTA RICA, ACG database codes: 05-SRNP-43402: DHJPAR0028653 (♀); 05-SRNP-43401: DHJPAR0028662 (♀); 09-SRNP-40871: DHJPAR0035145 (♀); 09-SRNP-40997: DHJPAR0035144 (♀); 09-SRNP-69902: DHJPAR0037719 (♀); 10-SRNP-81654: DHJPAR0041094 (♀); 05-SRNP-43396: DHJPAR0028654 (♀); 05-SRNP-42214: DHJPAR002865505 (♂); 05-SRNP-43403, DHJPAR0028664 (♀); 03-SRNP-10404: DHJPAR0028071 (♀); 09-SRNP-20818: DHJPAR0036798 (♀); 09-SRNP-80169: DHJPAR0037710 (♂); 11-SRNP-44169, DHJPAR0045717 (♀); 11-SRNP-81003, DHJPAR0045716 (♀); 09-SRNP-43156, DHJPAR0037810 (♀); 13-SRNP-69406, DHJPAR0051709 (♀); 09-SRNP-80158, DHJPAR0037711 (♀); 09-SRNP-80170, DHJPAR0037732 (♀); 12-SRNP-77300, DHJPAR0050887 (♀); 13-SRNP-2437, DHJPAR0069209 (♀); 12-SRNP-71337, DHJPAR0049680 (♀); 11-SRNP-69288, DHJPAR0042379 (♂); 12-SRNP-81899, DHJPAR0050852 (♂).

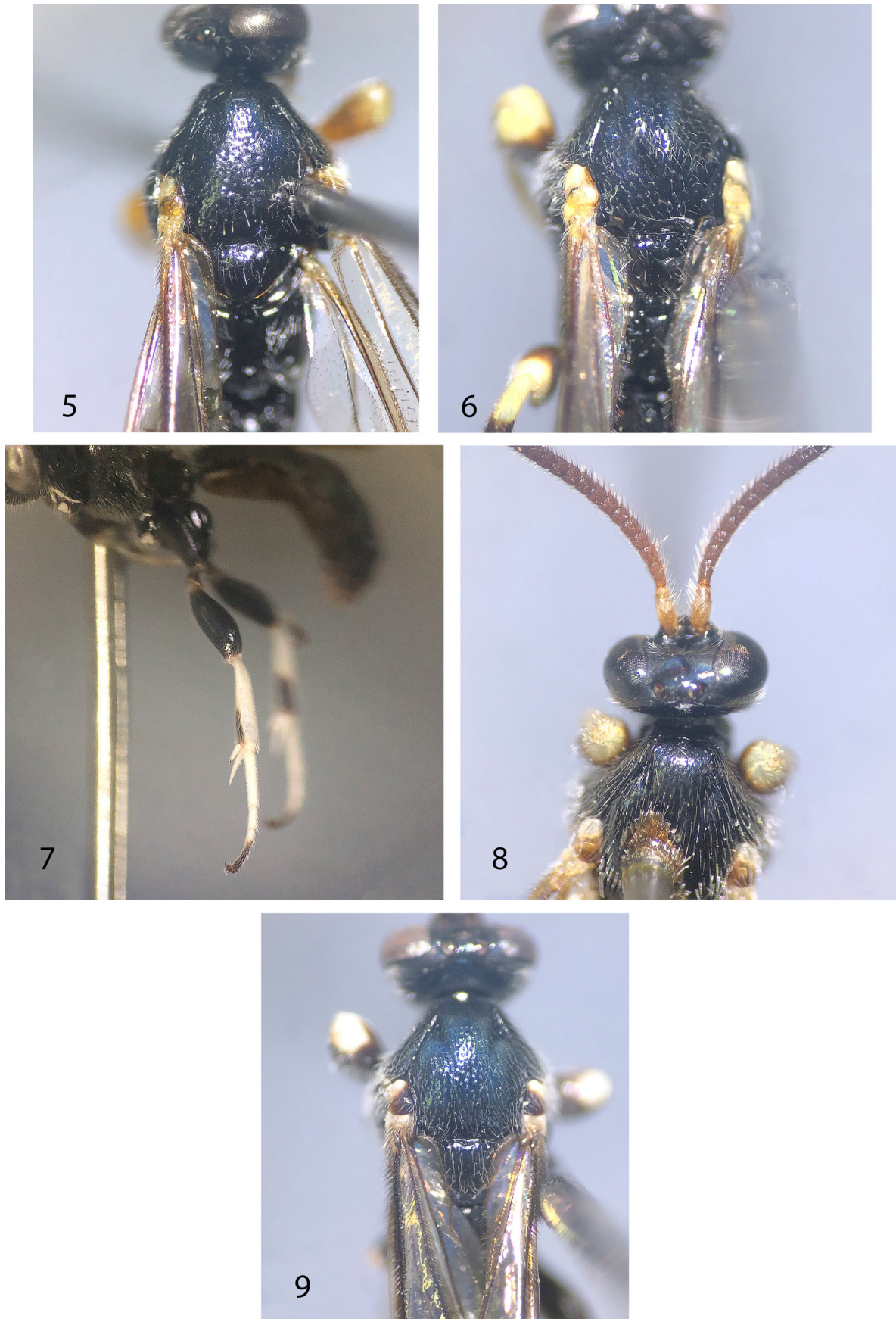
Barcode. DNA barcode of female holotype DHJPAR0030368 (603bp):

```
TATTCTATATTTTATTTTGGGAATTTGAGCTGGTATAAATTGGGGCCTCTTTAAGTATTATTATTTCG
AATAGAAGTAGGAACCCCGGNCTCTAATTAATAATGATCAAATTTACAATTCTATTGTAACATAACATGCTTTT
ATTATAATTTTCTTTATAGTTATAACCAATTATAATTGGGGGATTTGGAAATTGACTCACCCCTTTAATATTAGG
AGCTCCAGATATAGCTTTCCCTCGTATAAATAATATAAGATTTTGATTATTACCTCCATCATTATTTTTT
ATTAATTTCTGGGAGAATTTTAAATCAAGGAGCAGGGACTGGTTGAACAGTTTACCCTCCTTTATCATCTAATATT
AATCATGAAGGGATATCAGTTGATTTAAGAATTTTTCCCTTCATTTAGCTGGTATATCCTCAATTATAGGAGC
AATCAATTTTATTACAACATTTTTAATAAAAAATTAATTATTAACCTTAGACCAACTTTCTTTATTTATCTG
ATCAATTTAAATTAATACTACTATTTTACTTTTACTAGCAGTCCCTGTTTTAGCAGGAGCAATCACTATATTATTA
CTGATCGTAATTTAAACAC
```

Etymology. This species is dedicated to the late Henry Townes, co-founder and funder of the American Entomological Institute, life-long researcher, pioneer in developing the systematics of the world Ichneumonidae, and identifier of the first ichneumonid reared by DHJ in ACG in 1978 (*Thyreodon atriventris* DHJPAR0000487), while the nascent institute resided in Ann Arbor, Michigan (now at EMUS).

Comments. *Leurus henrytownesi* can be distinguished by the combination of metallic blue metasoma, scape dark colored at least dorsally, tegula light anteriorly dark posteriorly, and male front femur without any black markings. It can also be distinguished by its distinctive barcode and by its hosts.

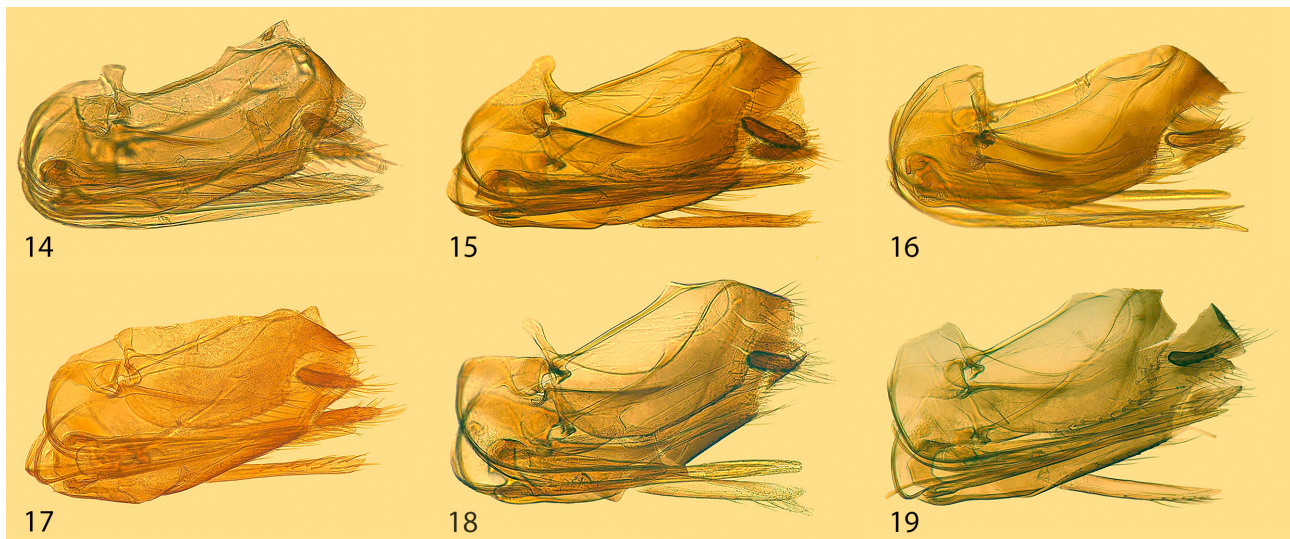
Hosts. This species has been reared 26 times from *Ategumia lotanalis* (Crambidae) feeding on four species of rain forest Melastomataceae (Table 1), most frequently the common second growth shrub *Conostegia xalapensis*. This host crambid is the same as that of *L. marjorietownesae*, but the host plants are mostly different (Table 1; see discussion of hosts under *L. marjorietownesae*). *Leurus henrytownesi* has also been reared from *Microthyris prologalis* (Guenée) (Crambidae) feeding on sweet potato (Convolvulaceae: *Ipomoea batatas*), the same crambid and host plant utilized by *L. pammitchelli*.



FIGURES 5–9. *Leurus* spp. 5. *L. marojoretownesae* (DHJPAR0037758) mesoscutum, dorsal view. 6. *L. wahl* (DHJPAR0039547) mesoscutum, dorsal view. 7. *L. billeberhardi*. (DHJPAR0039118), legs, dorso-lateral view. 8. *L. caeruliventris* (DHJPAR0009640) mesoscutum, dorsal view. 9. *L. pammitchellae* (DHJPAR0039539) mesoscutum, dorsal view.



FIGURES 10–13. *Leurus* spp. 10 *L. jesusaldei* (DHJPAR0041070), mesoscutum, dorsal view. 11. *L. sondrawardae* (DHJPAR0036732) hind legs, lateral view. 12. *L. henrytownesi*. (DHJPAR0036798) hind legs, lateral view. 13. *L. jesusaldei* (DHJPAR0041070) hind legs, lateral view.



FIGURES 14–19. *Leurus* female genitalia in lateral view. 14 *L. wahl*i (DHJPAR0028068). 15 *L. iangauldi* (DHJPAR0021570). 16 *L. marjoretownesae* (DHJPAR0041281). 17 *L. caeruliventris* (DHJPAR0021589). 18 *L. hugokonsi* (DHJPAR0038461). 19 *L. henrytownesi* (DHJPAR0028653).

***Leurus hugokonsi* Zuñiga & Valerio, sp. nov.**

(Figs. 18, 24)

Diagnostic description. Female. Fore wing length 5.2–5.8 mm (holotype 5.4 mm). Malar space $1.1 \times$ basal mandibular width; antenna with 23 flagellomeres, the latter transverse except the first 2–3 and the last 2–3. Genitalia: setae on ovipositor sheaths extending basally for a distance equal to or greater than $0.3 \times$ total length, constrained to ventral edge, setae sparse, thin and elongated; lower-anterior extension of quadrate plate elongated and broad, lobate at tip, setae on ventral edge of quadrate plate thin, normally large. **Coloration.** Scape, pedicel, and flagellum predominantly black. Tegula entirely black, or with just anterior margin white. Metasoma with metallic blue and purple iridescence. Trochanters and femora mostly black, front femur with yellow at apex; front tibia yellow, mid and hind tibiae mostly black but yellow at base; fore tarsus pale yellow with last 3 segments more orangish, mid tarsus pale yellow with last 3 segments light brown, hind tarsus with first segment white except dark at extreme apex, remaining segments mostly all black.

Male. Similar to female in size and color, but with more white on anterior part of tegula (at least in some specimens); front femur orangish on anterior surface; hind tarsus with second segment mostly white, black at apex. Antenna with 23–26 flagellomeres.

Genitalia: digitus completely lobate at base; volsella medial area deep, volsella tip (in lateral view) mainly rounded but somewhat flat; phallus apex slender, phallus constriction short; overall shape of phallus based on the width difference between the phallus apex and the phallus width: somewhat broad, phallus width evidently narrower than apex width; distal third of gonoforceps normally setose, setae somewhat sparse.

Material. Holotype. ♀. Deposited at EMUS. Specimen labels: 1. DHJPAR0021094. 2. Caterpillar Voucher: D.H.Janzen & W.Hallwachs, DB: <http://janzen.sas.upenn.edu>, Area de Conservación Guanacaste, COSTA RICA, 07-SRNP-2881. Database information: Costa Rica, ACG, Alajuela Prov., Sector San Cristobal, Sendero Vivero, 10.86739, -85.38744, 730m (Elda Araya) spiloBioLep01 BioLep577 (Crambidae) feeding on *Maripa nicaraguensis* (Convolvulaceae), coll. 22.vi.2007, wasp eclosed 19.vii.2007. **Paratypes.** 9 ♀, 1 ♂, (EMUS, MNCR, MZUCR, USNM). COSTA RICA, ACG database: 09-SRNP-72625: DHJPAR0038422 (♂); 09-SRNP-73434: DHJPAR0037786 (♀); SRNP-73433: DHJPAR0038461 (♀); 11-SRNP-42694: DHJPAR0045047 (♀); 11-SRNP-42664: DHJPAR0045048 (♀); 11-SRNP-42697: DHJPAR0045046 (♀); 11-SRNP-42700: DHJPAR0045045 (♀); 11-SRNP-42951: DHJPAR0045041 (♀); 09-SRNP-73434: DHJPAR0037786 (♀); 11-SRNP-42705: DHJPAR0045044 (♀).

Barcode. DNA barcode of female holotype DHJPAR0021094 (657 bp):

ATTTTATACTTCATTTTTGGAAATTTGAGCGGGTATAATTGGAGCATCTTTAAGTCTTATTATTTCG
AATAGAATTAGGAACCCCGGGTCTTTGATTAATAATGATCAAATTTATAATTCTATTGTGACTATACATGCCTTT

ATTATAATTTCTTTATAGTAATACCAATTATAATTGGTGGATTTGGAAATTGACTTGTTCCCTTAATACTAGG
AGCTCCAGATATAGCTTTCCCTCGTATAAATAATATAAGATTTGGTTGTTACCCCCATCATTATTTTTATTAA
TTTCTGGAAGTATCTTAAATCAAGGTGCTGGGACTGGTTGAACAGTATATCCTCCTCTATCATCTAATATTAATC
ATGAAGTTTTATCAGTTGATTTAAGAATTTTTCCCTCCATTTAGCTGGTATATCTTCAATTATAGGTGCAATT
AATTTTATTACAAC TATTTTAAATATAAAAATTAAATTTAATTTAGATCAACTTTCTTTATTTATCTGATCT
ATTAAAATCACTACTATTTTACTTTTATTAGCTGCCCTGTTTTAGCTGGAGCAATCACCATATTATTAAC TG
ATCGTAATTTAAATACTTCTTTCTTTGACCCTAGGGGAGGGGGGACCCAATTTTATACCAACATTTATTT

Etymology. This species is dedicated to Hugo Kons formerly of the American Entomological Institute in recognition of his dedicated efforts to curate the Hymenoptera collection and aid in the resolution of Ichneumonidae taxonomic problems.

Comments. Morphologically, we were unable to distinguish *L. hugokonsi* from *L. sondrawardae*. Both have metallic blue on the metasoma, the scape dark colored (at least dorsally) and without white on the apex, the tegula entirely or at least 90% black, hind tarsomeres 1–2 with dark apices, and hind tibia with white base not extending more than $3 \times$ length of tibia. However, *L. hugokonsi* can be distinguished by its distinctive barcode, and by its host caterpillar which it shares with no other species of *Leurus*.

Hosts. *Leurus hugokonsi* has been reared ten times from a sample of 211 caterpillars of spiloBioLep01 BioLep577 (Crambidae, Spilomelinae) reared from two species of the rain forest vine *Maripa* (Convolvulaceae).

Leurus iangauldi Zuñiga & Valerio, sp. nov.

(Figs. 15, 21)

Diagnostic description. Female. Fore wing length, 5.2–5.6 mm (holotype 5.2 mm). Malar space $0.8\text{--}1.1 \times$ basal mandibular width; antenna with 23–24 flagellomeres, most flagellomeres quadrate, except for the first 2 and the last 2–3. Genitalia: setae on ovipositor sheaths extending basally for a distance greater than $0.3x$ the total length, more or less sparse throughout sheath width; lower-anterior extension of quadrate plate short and broad, somewhat square at tip, setae on ventral edge of quadrate plate thin, normally large. **Coloration.** Antennal scape pale yellow to orangish, pedicel yellowish orange to light brown, flagellum dark brown; tegula light yellow anteriorly, brown posteriorly; metasoma black, without any metallic blue iridescence. Trochanters yellowish orange to light brown; fore and mid femora predominantly orange, hind femora predominantly black; fore tibia pale yellow to orangish, mid and hind tibiae pale yellow basally, black apically; fore tarsus pale yellow with last segment more orangish, mid tarsus pale yellow with last 1–2 segments orangish to light brown, hind tarsus with first 2–3 segments mostly pale with dark apices, last 2–3 segments all dark.

Male. Similar to female in size and color. Antenna with 22–23 flagellomeres. Genitalia: digitus completely lobate at base; volsella medial area shallow, volsella tip (in lateral view) mainly rounded but somewhat flat; phallus apex slender; overall shape of phallus based on the width difference between the phallus apex and the phallus width: somewhat broad, phallus width clearly narrower than apex width; distal third of gonoforceps normally setose, setae somewhat sparse.

Material. Holotype. ♀. Deposited at EMUS. Specimen labels: 1. DHJP0036020. 2. Caterpillar Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservación Guanacaste, Costa Rica, 09-SRNP-69785. Database information: Costa Rica, ACG, Alajuela Prov., Sector Rincon Rain Forest, Cafecito, 10.94404, -85.31738, 455 m, (Noe Castillo) caterpillar feeding on *Pourouma bicolor* (Urticaceae), coll 11.viii.2009, wasp eclosed 27.viii.2009. **Paratypes.** 13 ♀, 8 ♂, (EMUS, MNCR, MZUCR, USNM). COSTA RICA, ACG database codes: 06-SRNP-41643: DHJP0028681 (♀); 06-SRNP-42818: DHJP0021540 (♀); 06-SRNP-42815: DHJP0021550 (♀); 06-SRNP-42822, DHJP0021529 (♀); 06-SRNP-42820: DHJP0021570 (♀); 06-SRNP-41638: DHJP0028690 (♀); 01-SRNP-4060: DHJP0014022 (♀); 01-SRNP-4772: DHJP0014013 (♀); 01-SRNP-4295: DHJP0028072 (♀); 10-SRNP-40127: DHJP0038463 (♂); 10-SRNP-40128, DHJP0039132 (♂); 10-SRNP-40125: DHJP0039137 (♂); 06-SRNP-42817, DHJP0021572 (♂); 01-SRNP-4112: DHJP0014024 (♀); 02-SRNP-7322, DHJP0014017 (♂); 06-SRNP-44060: DHJP0016996 (♀); 10-SRNP-69022, DHJP0038789 (♂); 10-SRNP-69023: DHJP0038834 (♀); 06-SRNP-42813, DHJP0021559 (♂); 02-SRNP-7332: DHJP0014014 (♂); 00-SRNP-14124, DHJP0014023 (♀). 13-SRNP-40334: DHJP0050743 (♀); 11-SRNP-81742: DHJP0046788 (♀); 06-SRNP-42816: DHJP00121189 (♀).

Barcode. DNA barcode of female holotype DHJP0036020 (574 bp):

TGGATCTTTAATTAATAATGATCAAATTTATAATTCTATTGTAACATACATGCCTTTATTATAATTTTCTTT
ATAGTAATACCTATTATGATTGGTGGATTTGGAAATTGATTAACCCCTAATATTAGGGGCCCCAG
ATATAGCTTTCCCCGAATAAATAATATAAGATTTTGATTACTACCCCTCATTATTTTTATTAAATTTCTG
GGGTATTTTAAATCAAGGGGCTGGGACTGGCTGAACAGTTTACCCCTTTTATCATCCAATGTAA
ATCATGAAGGATTATCAGTTGATCTAAGAATTTTCTCCCTTCAATTTAGCTGGAATATCATCAATCATAGGGCAATT
AATTTTATTACAACCATTTTAAATATAAAAATTAATTTATTATCTTTAGAACAACTTTCTTTATTTATTTGATCT
ATTAATAATTACCCTATTTTACTTTTACTAGCAGTCCCTGTTTTAGCAGGAGCAATTACTATATTATTAACAG
ATCGCAATTTAAATACTTCTTTTTTTGACCCTAGTGGAGGAGGAGACCCAATTTTATACCAACTTATTT

Etymology. This species is named in recognition of the late Ian Gauld for his massive contributions to our understanding of the Ichneumonidae of the world, the Hymenoptera of Costa Rica, and very specifically, the Ichneumonidae of ACG since 1989.

Comments. *Leurus iangauldi* is the only species in the *L. caeruliventris* complex having the mid femur orangish colored; *L. sondrawardae* is somewhat similar in this respect, but has the mid femur more brownish. *Leurus iangauldi* is similar to *Leurus marjorietownesae* in having the metasoma black, without any noticeable metallic reflections, but the tegula of the former is dark colored posteriorly (as opposed to orange). The color of the scape and the tegula of *L. iangauldi* is similar to that of *L. caeruliventris*, but the former differs by having a black metasoma without metallic reflections and by its orangish mid femur. It is also distinguished from all other species of ACG *Leurus* by its DNA barcode.

Hosts. *Leurus. iangauldi* has been reared 28 times from 4,300 caterpillars of the three species of ACG *Patania* (Crambidae, Spilomelinae) that feed on the leaves of *Pourouma*, *Cecropia*, and *Urera* (Urticaceae) (Table 1). It shares two of its host caterpillar species with *L. caeruliventris*, but the latter species has not yet been recorded from *Patania Solis01*, a specialist on *Pourouma*.

Leurus jesusalgaldei Zuñiga & Valerio, sp. nov.

(Figs. 10, 13)

Diagnostic description. Female. Fore wing length, 5.2–5.6 mm (holotype 5.3 mm). Malar space 0.8–1.1 × basal mandibular width; antenna with 23–24 flagellomeres, most flagellomeres quadrate, except for the first 2 and the last 2–3. **Coloration.** Antennal scape brownish dorsally but lighter colored ventrally, pedicel yellowish to light brown, flagellum dark brown; tegula light yellow anteriorly, brown posteriorly; metasoma black, with metallic blue iridescence. Trochanters yellowish orange to light brown; fore and mid femora predominantly black, hind femora entirely black; fore and mid tibiae pale yellow to orangish, hind tibiae pale yellow basally, black apically; fore tarsus pale yellow, mid tarsus pale yellow with last 1–2 segments orangish to light brown, hind tarsus with first 2–3 segments mostly pale with dark apices, last 2–3 segments all dark.

Male: Unknown

Material. Holotype. ♀. Deposited at EMUS. Specimen labels: 1. DHJPAR0045043. 2. Caterpillar Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservacion Guanacaste, Costa Rica, 11-SRNP-2363. Database information: Costa Rica, ACG, Alajuela Prov., Sector San Cristobal, Finca San Gabriel, 10.87766, -85.39343, 645m (Elda Araya) *Diacme* BioLep02 (Crambidae) caterpillar feeding on *Thelypteris nicaraguensis* (Thelypteridaceae), coll. 21.vi.2011 wasp eclosed 17.vii.2011. **Paratypes.** 1 ♀, (MNCR), COSTA RICA, ACG database code: 10-SRNP-44944: DHJPAR0041070 (♀).

Barcode. DNA barcode of female holotype DHJPAR0045043 (658 bp):

GATTCTATATTTTATTTTGGAAATTTGAGCTGGTATAAATTGGTGCCTCTTTAAGTATTATTATTTCG
AATAGAAGTACGGGACCCCGGAGCTCTAATTAACAACGATCAAATTTACAATTCTATTGTAACATAC
ATGCTTTTATTATAATTTTCTTTATAGTTATACCAATTATAAATTGGGGGATTTGGAAATTGACTTACCCCTTT
AATATTAGGGGCTCCAGATATAGCTTTCCCTCGTATAAATAAATAAGATTTTGGTTATTACCTCC
ATCATTATTCTTATTAATTTCTGGAAGAATCTTAAATCAAGGGGCAGGGACTGGTTGAACAGTTTACCCCTCCTTT
ATCATCTAATATTAATCATGAAGGACTATCAGTTGATTTAAGAATTTTTTCCCTTCAATTTAGCTGGT
ATTCCCTCAATTATAGGGGCAATCAATTTTATTACAATTTTTAATATAAAAATTAATTTATTGGCCTT
AGACCAACTTTCTTTATTTATCTGATCTATTAAAATTAATTTACTTACTTTTACTTAGCAGTCCCTG

TTTTAGCGGGGGCAATCACTATATTATTAATACTGATCGTAATTTAAATACTTCTTTTTTTTGACCCAAGTGG
AGGGGGGACCCAATTTTATACCAACTTA

Etymology. This species is named in recognition of Jesus Ugalde, formerly of the Instituto Nacional de Biodiversidad (INBio) of Costa Rica, in recognition of his many years of Hymenoptera curation and administration of the national biodiversity inventory.

Comments. Like *L. hugokonsi* and *L. sondrawardae*, *L. jesusugaldei* has metallic blue on the metasoma, the scape dark colored (at least dorsally) and without white on the apex, the tegula entirely or at least 90% black, and hind tarsomeres 1–2 with dark apices. However, *L. jesusugaldei* differs by having slightly more white at the base of the hind tibia, extending about $4.0 \times$ length of tibia (as opposed to no more than $3.0 \times$ length of tibia). It can also be distinguished by its barcode and hosts, being the only *Leurus* species parasitizing a fern-feeding caterpillar.

Hosts. *Leurus jesusugaldei* appears to occur at a very low density, with just two reared specimens; however, the inventory has only been able to rear 173 of its distinctive fern-feeding crambid caterpillars, *Diacme biolep02*. Both caterpillars were feeding on *Thelypteris nicaraguensis*, but the sample size is not large enough to hazard a guess as to whether the wasp is also specialized on this particular plant, of the many species of ferns utilized by *Diacme Solis02*.

Leurus marjoretownesae Zuñiga & Valerio, sp. nov.

(Figs. 16, 22)

Diagnostic description. Female. Fore wing length 5.1–5.5 mm (holotype 5.2 mm). Malar space $0.8\text{--}1.1 \times$ basal mandibular width; antenna with 26–27 flagellomeres, these being quadrate except for the first 2–3 and last 2–3. Genitalia: setae on ovipositor sheaths extending basally for a distance less than $0.3x$ the total length, more or less sparse throughout sheaths width, setae sparse, thin and elongated; lower-anterior extension of quadrate plate elongated and thin, somewhat lobate at tip, setae on ventral edge of quadrate plate thin, normally large. **Coloration.** Antennal scape and pedicel yellow; flagellum yellowish at base, brown at apex. Tegula whitish anteriorly, orange posteriorly. Metasoma black. Trochanters yellow; front femur yellow to orange, mid femur mostly black but yellow at apex, hind femur all black; front tibia yellow, mid and hind tibiae yellow at base, black at apex; front tarsus yellow with last segment orange, mid tarsus yellow with last 2 segments brown, hind tarsus with segments 1–3 yellow except light brown at apices, segments 4–5 light brown.

Male. Similar to female in size and color. Antenna with 26 flagellomeres. Genitalia: digitus $2/3$ lobate at base, otherwise elongate, somewhat acute; volsella medial area deep, volsella tip (in lateral view) clearly flat; phallus apex somewhat stout, phallus constriction short; overall shape of phallus based on the width difference between the phallus apex and the phallus width: somewhat thin, straight in appearance; distal third of gonoforceps conspicuously setose.

Material. Holotype. ♀. Deposited at EMUS. Specimen labels: 1. DHJPAR0036816. 2 Caterpillar Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservacion Guanacaste, Costa Rica, 09-SRNP-72684. Database information: Costa Rica, ACG, Prov., Guanacaste, Sector Pitilla, Estación Quica, 10.99697, -85.39666, 470m (Dinia Martinez) *Ategumia matutinalis* (Crambidae) caterpillar feeding on *Miconia lacera* (Melastomataceae) coll. 23.ix.2009, wasp eclosed 125.x.2009. **Paratypes.** 20 ♀, 5 ♂, (EMUS, MNCR, MZUCR, USNM). COSTA RICA, ACG database codes: 09-SRNP-40709: DHJPAR0035261 (♀); 09-SRNP-43588: DHJPAR003842 (♀); 02-SRNP-6303: DHJPAR0014020 (♀); 09-SRNP-69907: DHJPAR0037722 (♀); 10-SRNP-81107: DHJPAR0041095 (♂); 09-SRNP-69851: DHJPAR0037717 (♀); 10-SRNP-80312: DHJPAR0041281 (♀); 09-SRNP-69847: DHJPAR0037718 (♀); 09-SRNP-72785: DHJPAR0037788 (♀); 09-SRNP-80103: DHJPAR0037712 (♂); 09-SRNP-80261: DHJPAR0041284 (♀); 05-SRNP-6298: DHJPAR0028661 (♀); 07-SRNP-41144: DHJPAR0021655 (♀); 09-SRNP-73809: DHJPAR0038427 (♀); 05-SRNP-6297: DHJPAR0028652 (♀); 09-SRNP-32729: DHJPAR0037758 (♀); 08-SRNP-70147: DHJPAR0027735 (♂); 09-SRNP-69909: DHJPAR0037721 (♂); 09-SRNP-40709: DHJPAR0035261 (♀); 09-SRNP-69848: DHJPAR0037720 (♀); 11-SRNP-81170: DHJPAR0045775 (♀); 13-SRNP-75204: DHJPAR0050875 (♀); 13-SRNP-75114: DHJPAR0050878 (♀); 13-SRNP-70368: DHJPAR0052174 (♀); 12-SRNP-67267: DHJPAR0050376 (♀); 12-SRNP-69657: DHJPAR0048870 (♀); 13-SRNP-76776: DHJPAR0052751 (♀); 13-SRNP-75702, DHJPAR0051710 (♂).

Barcode. DNA barcode of female holotype DHJPAR0036816. (623bp):

TAATTGGTGCTTCTTTAAGTATTATTATTTCGAATAGAACTAGGAACCCCCGGGTCTCTAATTAATAA
TGATCAAATTTATAATTCTATTGTAACCTATACATGCTTTTATTATAATTTTTTTTATAGTTATACCAATTATAA
TTGGGGGATTTGGAAATTGACTCACCCCTTAATATTAGGAGCCCCAGATATAGCTTTTCTCGTATAA
ATAATATAAGATTTTGATTATTACCTCCATCATTATTTTTTATTAATTTCTGGAAGAATTTTAAATC
AAGGGGCAGGAACCTGGTTGAACAGTTTACCCTCCTTTATCATCTAATATTAACCATGAAGGACTATC
AGTTGATTTAAGAATTTTTTCCCTTCATTTAGCGGGAATATCCTCAATTATAGGGCAATTAATTTATTACAACT
ATTTTTAATATAAAAAATTAATTTTTAACCTTAGATCAACTTTCTTTATTTATTTGATCTATTAAAATTA
ACTATTTTACTTTTATTAGCAGTCCCTGTTTTGGCAGGAGCAATCACTATATTATTAAGTATCGTAACTTAA
ATACTTCTTTTTTTGACCCAAGTGGGGGAGGTGACCCAATTTTATACCAACATTTATTT

Etymology. This species is named in honor of the late Marjorie Townes for her steadfast and high quality support of Henry Townes, and her role in the founding and development of the American Entomological Institute and its outstanding collection of Hymenoptera.

Comments. *Leurus marjorietownesae*, like *L. iangauldi* and *L. pammmitchellae*, has a black metasoma without metallic blue reflections. However, *L. marjorietownesae* differs by having the tegulae pale colored anteriorly and orange posteriorly (as opposed to dark brown posteriorly).

Hosts. This species, like *L. henrytownesi*, parasitizes caterpillars of *Ategumia lotanalis* (Crambidae) feeding on rain forest Melastomataceae foliage. *Leurus henrytownesi* parasitizes caterpillars on melastomes with small and insolated leaves, while *L. marjorietownesae* parasitizes caterpillars on melastomes with large and often shaded leaves. *L. marjorietownesae* has been reared 29 times from *Ategumia lotanalis* and *A. matutinalis* feeding on five species of Melastomataceae.

Leurus maryjanewestae Zuñiga & Valerio, sp. nov.

Diagnosis description. Female. Fore wing length, 5.2–5.6 mm (holotype 5.2 mm). Malar space 0.7–1.1 × basal mandibular width; antenna with 23–24 flagellomeres, most flagellomeres quadrate, except for the first 2 and the last 2–3. **Coloration.** Antennal scape pale yellow to brownish, pedicel yellowish to light brown, flagellum dark brown; tegula light yellow anteriorly, brown posteriorly; metasoma black, with metallic blue iridescence. Trochanters pale to light brown; fore and mid femora predominantly black, hind femora entirely black; fore and mid tibiae pale yellow to orangish, hind tibia predominantly white, black apically; fore tarsus pale yellow, mid tarsus pale yellow with last 1–2 segments orangish to light brown, hind tarsus with first 2–3 segments mostly pale with dark apices, last 2–3 segments all dark.

Male: Unknown.

Material. Holotype. ♀. Deposited at EMUS. Specimen labels: 1. DHJPAR0052171. 2. Caterpillar Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservacion Guanacaste, Costa Rica, 13-SRNP-2266. Database information: Costa Rica, ACG, Guanacaste Prov., Sector San Cristobal, Sendero Palo Alto, 10.88186, -85.3822, 570m (Carolina Cano), Rhexocraspeda periusalis (Crambidae) caterpillar feeding on *Piper sancti-felicis* (Piperaceae), coll. 30.x.2013. wasp eclosed 18.xi.2013. **Paratypes.** 6 ♀, (EMUS, MNCR). COSTA RICA, ACG database codes: 10-SRNP-44150: DHJPAR0041461 (♀); 09-SRNP-5377: DHJPAR0038423 (♀); 02-SRNP-6303: DHJPAR0014020 (♀); 02-SRNP-1978: DHJPAR0014012 (♀); 12-SRNP-1713: DHJPAR0048898 (♀); 13-SRNP-69202: DHJPAR0051726 (♀).

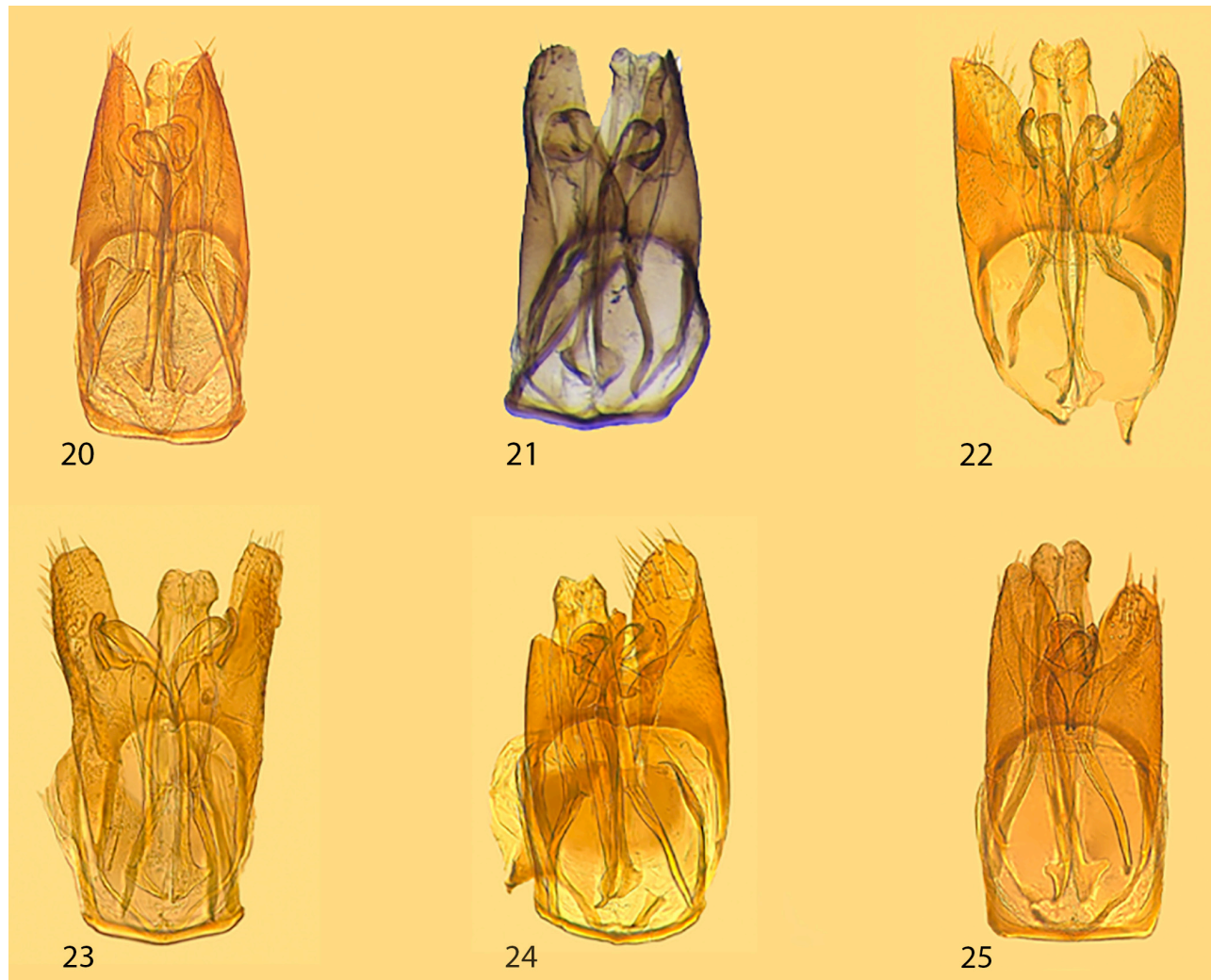
Barcode. DNA barcode of female holotype DHJPAR0052171 (658 bp):

AATTTTATACTTCATTTTTGGAATTTGGGCAGGAATAATTGGTGCTTCACTTAGTATTATTATCCG
AATAGAATTAGGAACCCAGTTCCTTAATTAATAATGACCAAATTTATAATTCTATTGTCACTATACATGCCTTT
ATTATAATTTTTTTTATAGTTATGCCAATTATAATTGGAGGATTTGGAAATTGACTTAATCCTTTAATATTAGG
AGCCCCAGATATAGCATTCCCACGAATAAATAATATAAGATTCTGATTATTACCCCATCCTTATTTTTATTAA
TTTCTGGTAGAATCTTAAATCAAGGGCAGGAACCTGGTTGAACAGTTTACCCTCCATTGTCTTCTAATACAAATC
ATGAAGGATTATCAGTTGATTTAAGAATCTTCTCTCCATTTAGCTGGAATATCTTCAATTATAGGAGCAATT
AACTTTATCACAACCTATTTTAAATATAANAATTAATTTAATTTAGATCAACTTTTCAATTTTATTTGATCC
ATTAAAATTAATACTATTTTACTTTTATTAGCAGTCCCTGTTTTAGCAGGAGCAATCACCATATTTAACTG
ACCGTAACTTAAATACCTCTTTTTTTGACCCTAGAGGAGGAGGAGACCCAATTTTATACCAACATTTATTT

Etymology. This species is dedicated to Mary Jane West-Eberhard, in recognition of her decades of research on the evolution of insects and their social behavior, with special emphasis on Hymenoptera.

Comments. *Leurus maryjanewestae* is morphologically indistinguishable from *Leurus billeberhardi* at the level of examination currently possible, and parasitizes the same species of caterpillar feeding on the same species of shrub (Table 1) in the same rain forest, but the two species have very different DNA barcodes (Fig. 2).

Hosts. This species has been reared seven times from a sample of 490 caterpillars of *Rhectocraspeda periusalis* collected in the wild between 1997 and 2013.



FIGURES 20–25. *Leurus* male genitalia in dorsal view. 20 *L. wahli* (DHJPAR0028069). 21. *L. iangauldi* (DHJPAR0039132). 22. *L. marjorietaownesae* (DHJPAR0037712). 23. *L. caeruliventris* (DHJPAR0037822). 24. *L. hugokonsi* (DHJPAR0038422). 25. *L. henrytownesi* (DHJPAR0028655).

***Leurus pammitchellae* Zuñiga & Valerio, sp. nov.**

(Fig. 9)

Diagnostic description. Female. Fore wing length, 5.2–5.6 mm (holotype 5.2 mm). Malar space $0.8\text{--}1.1 \times$ basal mandibular width; antenna with 23–24 flagellomeres, most flagellomeres quadrate, except for the first 2 and the last 2–3. **Coloration.** Antennal scape black with apex white, pedicel yellowish to light brown, flagellum brownish; tegula light yellow anteriorly, brown posteriorly; metasoma black, with metallic blue iridescence or black. Trochanters pale to light brown; fore and mid femora predominantly black, hind femora entirely black; fore tibiae pale yellow to orangish, mid and hind tibiae predominantly black whit apex white; fore tarsus pale yellow, mid tarsus pale yellow with last 1–2 segments orangish to light brown, hind tarsus with first 2–3 segments mostly pale with dark apices, last 2–3 segments all dark.

Male: Unknown.

Material. Holotype. ♀. Deposited at EMUS. Specimen labels: 1. DHJPAR0039387. 2. Caterpillar Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservation Guanacaste, Costa Rica, 10-SRNP-2437. Database information: Costa Rica, ACG, Alajuela Prov., Sector Rincon Rain Forest, Sendero Albergue Crater, 10.84886, -85.328, 980m (Osvaldo Espinoza), *Microthyris prolongalis* (Crambidae) caterpillar feeding on *Ipomoea batatas* (Convolvulaceae), coll. 16.v.2010, wasp eclosed 10.vi.2010. **Paratypes.** 2 ♀, (EMUS, MNCR). COSTA RICA, ACG database codes: 10-SRNP-2938: DHJPAR0036264 (♀); 10-SRNP-2422: DHJPAR0039539 (♀).

Barcode. DNA barcode of female holotype DHJPAR0039387 (286 bp):

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TATATTTGGTGCATCAATTAGAATAATTATTCGTATAGAATTAGGAACCCCTAGTTCATTAATTAATAATGACC
AAATTTATAACTCTATAGTTACTATACATGCTTTTATTATAATTTTTTTTATAGTGATACCAATTATAATTG
GGGATTTCGGAAATTGACTTATTCCCTTAATATTAGGAGCCCCAGACATGGCCTTTCCACGATTAATAATAATAAG
ATTTTGACTTTTACCCCTTCATTATTTTTTATTAATTTTCAGGAAGCATTTTAAATCAAGGAGCT
```

Etymology: This species is named in honor of the late Pamela Mitchell, in recognition of her life of dedicated support of the study of Costa Rican Ichneumonidae by the Gauld and Mitchell team.

Comments. *Leurus pammitchellae* is distinctive not only for its morphology, but also for its very different barcode and its host specificity to a very common leaf roller of herbaceous convolvulaceous vines growing in full sun in the ACG rain forest.

Hosts. While the three rearing records from 505 wild-caught caterpillars of *Microthyris prolongalis* make it appear to be exceptionally rare, it may not be when the taxonomy of the moth is fully worked out; in ACG, “*M. prolongalis*” constitutes at least two different species of crambids feeding on seven species of Convolvulaceae, and we note that all three *L. pammitchellae* were only from the 346 rearings on *Ipomoea batatas*.

Leurus sondrawardae Zuñiga & Valerio, sp. nov.

(Fig. 11)

Diagnostic description. Female. Fore wing length, 5.2–5.6 mm (holotype 5.2 mm). Malar space 0.8–1.1 × basal mandibular width; antenna with 23–24 flagellomeres, most flagellomeres quadrate, except for the first 2 and the last 2–3. **Coloration.** Antennal scape brown, pedicel brown, flagellum brownish; tegula predominantly black, light yellow anteriorly; metasoma black, with metallic blue iridescence or completely black. Trochanters pale to light brown; fore femora pale to light orange, hind femora entirely black; fore tibia pale yellow to brownish, mid and hind tibiae entirely black; fore tarsus pale yellow, mid tarsus pale yellow with last 1–2 segments orangish to light brown, hind tarsus pale with all dark apices dark.

Male: Unknown.

Material. Holotype. ♀. Deposited at EMUS. 1. DHJPAR0036739. 2. Caterpillar Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservation Guanacaste, Costa Rica, 09-SRNP-42662. Database information: Costa Rica, ACG, Alajuela Prov., Sector Rincon Rain Forest, Quebrada Escondida, 10.89928, -85.27486, 420m (Anabelle Cordoba), *Piletosoma thialis* (Crambidae) caterpillar feeding on *Doliocarpus multiflorus* (Dilleniaceae) coll. 22.ix.2009, wasp eclosed 19.x.2009. **Paratypes.** 2 ♀, (EMUS, MNCR). COSTA RICA, ACG database codes: 02-SRNP-720715, DHJPAR0014016 (♀); 09-SRNP-42108, DHJPAR0036732 (♀).

Barcode. DNA barcode of female holotype DHJPAR0036739 (636 bp):

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GGCCCTTTACTTTATTTTTGGCATTGAGCTGGAATAATTGGAACCTCTCTAAGAATCATTATTTCG
AATAGAATTAGGAACCCCGGCTCTTTAATTAATAATGACCAAATTTATAATTCTATCGTCACTATAC
ATGCCTTTATCATAATTTTTTTTATAGTAATACCAATTATGATTGGGGGATTTGGTAATTGACTTGCTCCATT
AATATTGGGGGCCCCAGATATAGCTTTCCACGAATAAATAATATAAGATTTTGATTATTACCCCATC
ATTATTCTTATTAATTTTCAGGAAGAATCCTAAATCAAGGGGCCGGAAGTGGATGAACAGTATATCCACCTTTATC
ATCTAATACTAATCATGAAGGATTATCAGTTGATTTAAGAATTTTTTCCCTTCATTTAGCAGGCATGTCCTCAATT
ATAGGGGCAATCAACTTCATTACAACCTATTTTTAATATAAAAAATTAATTATTAACCTTTAGACCAACTTTTCATT
ATTTATTTGATCTATTAATAACTACTACTATTCTTCTACTACTTGCAGTCCCTGTTTTAGCAGGGGCAATCACT
ATATTATTAACAGATCGTAACTTAA TACCTCTTTTTTTGACCCAAGAGGGGGCGGAGACCC
```

Etymology: This species is named in honor of the late Sondra Ward, formerly of the Natural History Museum in London, for her invaluable assistance in the study of Ichneumonidae.

Comments. We were unable to distinguish *L. sondrawardae* morphologically from *L. hugokonsi*. Both species have metallic blue on the metasoma, the scape dark colored (at least dorsally) and without white on the apex, the tegula entirely or at least 90% black, hind tarsomeres 1–2 with dark apices, and hind tibia with white base not extending more than $3.0 \times$ length of tibia. However, *L. sondrawardae* has a very distinctive and different DNA barcode, and it parasitizes a very different species of caterpillar feeding on a different family of host plants.

Hosts. *Leurus sondrawardae* has been reared from *Piletosoma thialis* Dyar (Crambidae) feeding on the rainforest liana, *Doliocarpus multiflorus* (Dilleniaceae). No other species of the *L. caeruliventris* complex in ACG utilizes this caterpillar genus or this host plant family.

Leurus wahli Zuñiga & Valerio, sp. nov.

(Figs. 6, 14, 20)

Diagnostic description. Female. Fore wing length 5.5–5.6 mm (holotype 5.4 mm). Malar space $1.0\text{--}1.1 \times$ basal mandibular width; antenna with 24–25 flagellomeres, all except first and last segment transverse (wider than long). Genitalia: setae on ovipositor sheaths extending basally for a distance equal to or less than $0.3x$ the total length, setae constrained to ventral edge, sparse, setae thin and elongated; lower-anterior extension of quadrate plate elongated and thin, somewhat lobate at tip, setae on ventral edge of quadrate plate thin, normally large. **Coloration.** Scape yellow and brown; pedicel dark brown; flagellum dark brown to black. Tegula entirely yellow. Metasoma with metallic blue iridescence. Trochanters mostly light brown, front femur with basal $2/3$ black and apical $1/3$ yellow, mid femur similar but only extreme apex yellow, hind femur all black; front tibia yellow, mid and hind tibiae with basal half yellow and apical half black; fore tarsus pale yellow with last 3 segments more orangish, mid tarsus pale yellow with last 3 segments light brown, hind tarsus with first 2–3 segments mostly pale with dark apices, last 2–3 segments all dark.

Male. Similar to female in size and color; scape often entirely yellow. Antenna with 26–30 flagellomeres. Genitalia: digitus completely lobate at base; volsella medial area deep, volsella tip (in lateral view) mainly rounded but somewhat flat; phallus apex slender, phallus constriction elongate; overall shape of phallus based on the width difference between the phallus apex and the phallus width: somewhat thin, straight looking; distal third of gonoforceps normally setose, setae somewhat sparse.

Material. Holotype. ♀. Deposited at EMUS. Specimen labels: 1. DHJPAR0014018. 2. Caterpillar Voucher: D. H. Janzen & W. Hallwachs, DB: <http://Janzen.sas.upenn.edu>, Area de Conservation Guanacaste, Costa Rica, 04-SRNP-45922. Database information: Costa Rica, ACG, Guanacaste Prov., Sector Cacao, Estación Gongora, 10.88700, -85.47443, 570m (Mariano Pereira), caterpillar feeding on *Paspalum nutans* (Poaceae) coll. 14.vi.2004 wasp eclosed 23.vi.2004. **Paratypes.** 10 ♀, 2 ♂, (EMUS, MNCR, MZUCR, USNM). COSTA RICA, ACG database codes: 10-SRNP-30927: DHJPAR0039538 (♂); 10-SRNP-31119: DHJPAR0039542 (♀); 10-SRNP-31091: DHJPAR0039543 (♀); 04-SRNP-45845: DHJPAR0028066 (♀); 04-SRNP-45874: DHJPAR0028067 (♀); 04-SRNP-45919: DHJPAR0029447 (♀); 04-SRNP-45894: DHJPAR0028068 (♀); 04-SRNP-45876: DHJPAR0014019 (♀); 10-SRNP-41191: DHJPAR0039547 (♀); 04-SRNP-45899: DHJPAR0028070 (♀); 04-SRNP-45895: DHJPAR0028069 (♂); 09-SRNP-5377: DHJPAR0038423 (♀); 12-SRNP-55938: DHJPAR0050005 (♀).

Barcode. DNA barcode of female holotype DHJPAR0014018 (660 bp):

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ATTTTATACTTCATTTTTGGAATTTGAGCAGGAATAATTGGTGCTTCACTTAGTATTATTATCCGT
ATAGAATTAGGAACCCCGAGTTCCCTTAATTAATAATGATCAAATTTATAATTCTATTGTCACTATAACATGCCTTT
ATTATAATTTTTTTTTATAGTTATACCAATTATAATTGGAGGATTTGGAAATTGACTTATTCCCTTTAATATTAGG
AGCCCCAGATATAGCATTCCCACGAATAAATAATATAAGATTCTGATTGTTACCCCATCCTTATTTTTATTAA
TTTCTGGTAGAATATTAAATCAAGGTGCAGGTACTGGTTGAACAGTTTACCCTCCTTTATCTTCTAATACAAATC
ATGAAGGATTATCAGTTGATTTAAGAATTTCTCTCTTCATTTAGCTGGTATATCTTCAATTATAGGTGCAATT
AATTTTTATTACAACAATTTAAATATAAAAATTTAATTTAATTAACCTTTAGATCAACTTTTCAATTTATTTGATCC
ATTAAAATTAATACTACTATTTTACTTTTACTAGCAGTCCCTGTTTTAGCAGGAGCAATTACCATATTATTAACCTG
ACCGTAACTTAAATACCTCTTTTTTTGACCCTAGAGGAGGAGGGATCCAATTTTATACCAACATTTATTTN
```

Etymology. This species is named in honor of David B. Wahl, formerly curator of the American Entomology Institute (Gainesville, Florida), presently curator at Utah State University, in recognition of his decades of study of ichneumonid systematics.

Comments. *Leurus wahl* is the only species having the combination of metallic blue metasoma and a completely yellow tegula. It is also the only *Leurus* encountered to date parasitizing a grass-feeding caterpillar.

Hosts. *Leurus wahl* has been reared 15 times from a sample of 440 caterpillars of the rain forest *Herpetogramma phaeopteralis* (Guenée) (Crambidae) feeding on three species of Poaceae (Table 1).

Conclusion

In ACG species of *Leurus* are unambiguously parasitoids of leaf-rolling spilomeline Crambidae. Any rearing record elsewhere that is not from this higher taxon of caterpillar is highly suspect as to the caterpillar identification, which is always difficult unless done comparatively in the field with living caterpillars and their food plants, and with multiple samples. The very high degree of host-specificity displayed by ACG *Leurus* is commonplace among many other groups of ACG parasitoids (e.g., *Apanteles* in the Braconidae, Fernandez-Triana *et al.* 2014a,b). Its ecological significance will be addressed later when the very large number of undescribed species in other genera and families have formal names with which to discuss them and their biology. These wasps are so similar that it would be impossible to tease apart their parasitization biology without the use of DNA barcodes and host records to recognize different species, even though most of them can indeed be distinguished by subtle differences in color pattern, especially if the DNA barcodes and host records are available to guide the identification and subsequent confirmation process.

Acknowledgments

We would like to thank Juan Mata (GDFCF) for his help in creating the figures, as well as Isidro Chacon (GDFCF) for his useful comments during the development of this manuscript. For the photo of the lectotype we thank Jason Weintraub and H. C. Onody of the Academy of Natural Sciences, Philadelphia. The entire ACG Parataxonomist Program (Janzen & Hallwachs 2011) found the caterpillars, reared them for their parasitoids, and managed the specimens within their databases. Area de Conservación Guanacaste and the Guanacaste Dry Forest Conservation Fund protected and maintained the rain forests in which the caterpillars and their parasitoids live. The Instituto Nacional de Biodiversidad (INBio) and Museo Nacional provided laboratory facilities. The study was financially supported by INBio, the Wege Foundation, NSF grants BSR 9024770 and DEB 9306296, 9400829, 9705072, 0072730, and 0515699 to DHJ, the JRS Foundation, the Guanacaste Dry Forest Conservation Fund, the University of Pennsylvania, and Permian Global, UK.

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