

Revision of the genus *Promicrogaster* (Hymenoptera, Braconidae, Microgastrinae) from Area de Conservación Guanacaste, Costa Rica, with a key to all species previously described from Mesoamerica

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Abstract

The genus *Promicrogaster* (Hymenoptera, Braconidae, Microgastrinae) from Area de Conservación Guanacaste (ACG), Costa Rica, is revised. A key is provided to all new species as well as those previously described from Mesoamerica. A total of 21 species, all authored by Fernández-Triana & Boudreault, are described as **species nova**: *alexmartinezi*, *andreyvallejosi*, *brandondinartei*, *daniellopezi*, *daretrizoi*, *eddycastroi*, *eimyobandoae*, *fabiancastroi*, *fabriciocambroneri*, *hillaryvillafuerteae*, *kevinmartinezi*, *kiralycastilloae*, *leilycastilloae*, *liagrantae*, *luismendezi*, *monteverdensis*, *naomiduarteae*, *pablouzagai*, *ronycastilloi*, *sebastiancambroneri*, *tracyvindasae*. A species previously described from India is considered as **incertae sedis**. *Promicrogaster* is considered to be restricted to the New World, with the vast majority of the species found in the Neotropics and a few extending north to the Nearctic. Almost 60% of the known species in ACG are found in cloud forests at over 1,000 m altitude. All of the verified and authenticated host records for *Promicrogaster* are from caterpillars living more deeply inside plant tissue than simply in rolled leaf structures – although no host data from ACG is available.

Keywords

Promicrogaster, Microgastrinae, Neotropics, Area de Conservación Guanacaste, taxonomic revision, parasitoid wasps, DNA barcoding

Introduction

The genus *Promicrogaster* was described by Brues and Richardson (1913) to accommodate a single female specimen from Guyana, which they considered to be unique based on several morphological characters. Half a century later Muesebeck (1958) and Nixon (1965) added 10 more new species of *Promicrogaster*, all from the Neotropics. An additional species was described from India by Sathe and Bhoje (1998), but we consider that a *incertae sedis* (see below for details). The true diversity of the genus remains unknown, although Mason (1981) considered that, in spite of being rare in collections, it might have more than 100 species overall. The highest diversity is in the Neotropics but a few, undescribed species reach the Nearctic. Biological information for the genus is very scarce: two host records from concealed caterpillars in the Lepidoptera families Sesiidae and Tineidae (Davis 1996, Garcia and Montilla 2010), an unidentified caterpillars infesting bracket fungus (Muesebeck 1958, Mason 1981).

This paper revises the genus *Promicrogaster* in Area de Conservación Guanacaste (ACG), northwestern Costa Rica (Janzen et al. 2009, Janzen and Hallwachs 2011), as part of comprehensive studies on the fauna of Microgastrinae from that region (e.g. Fernández-Triana et al. 2013, 2014a–d). A key to all known species from Mesoamerica is also included, but the North and South American species are not dealt with in this paper.

Methods

Promicrogaster is a rarely collected genus (Mason 1981), and it is poorly represented in collections. This study is based on 120+ specimens, most of them collected in ACG, with a few additional specimens from other Mesoamerican countries available for study in the Canadian National Collection of Insects (CNC) in Ottawa. Some paratypes of the new species being described will be deposited in other collections with the following acronyms used: BMNH (The Natural History Museum, London, United Kingdom), INBio (Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica) and NMNH (National Museum of Natural History, the Smithsonian Institution, Washington DC, United States).

Four species of *Promicrogaster* had been described previously from Mesoamerica. The original descriptions and illustrations for three of them were sufficiently detailed to allow us to describe the new species with confidence. The only exception was *Promicrogaster apharea* Nixon, 1965 (Brazil and highlands of southwestern Mexico), which could not be reliably defined based on the original description alone, but in that case we examined the holotype.

Morphological terms and measurements of structures are mostly as used by Mason (1981), Huber and Sharkey (1993), Whitfield (1997), Karlsson and Ronquist (2012), and Fernández-Triana et al. (2014a). Mediotergites 1, 2, etc., are abbreviated as T1, T2, etc. Flagellomere 1 is the closest to pedicel while flagellomere 16 is the most apical one. Because the ovipositor in *Promicrogaster* is curved and crooked at the very apex, its length is difficult to measure accurately; the ovipositor length measurements provided for each new species are only intended as an approximation. In any case, the ovipositor and its sheaths are some of the longest observed in any Microgastrinae genera; they are usually two times longer than the metatibia length.

The dichotomous key and descriptions of the new species are based on the study of all available female specimens, so as to reflect intraspecific variation, but always include data from the holotype for the new species. Males of most species cannot be readily identified unless associated with females via rearing or molecular data.

The dichotomous key is mostly based on morphological characters, but in one couplet we used molecular characters to differentiate species that are morphologically similar to each other. In that case we used characteristic loci in the DNA barcoding region. The bases are numbered from the start of the COI gene according to the reference sequence U37541 (*Drosophila melanogaster*), and are only diagnostic within that couplet. The letters A, C, G, and T correspond to adenine, cytosine, guanine, and thymine respectively.

The descriptions include 21 characters that are commonly used in describing Microgastrinae (e.g., body measurements such as length of body and fore wing, ovipositor sheath; and also color of particular body areas). These characters follow a recent revision of the related genus *Sendaphne* (Fernandez-Triana et al. 2014d), so as to facilitate future comparisons between species in those two genera.

Photos were taken with a Keyence VHX-1000 Digital Microscope, using a lens with a range of 13–130×. Multiple images through the focal plane were taken of a structure and these were combined to produce a single in-focus image, using the software associated with the Keyence System.

Together with morphological studies, we also analyzed DNA barcodes (the 5' region of the cytochrome *c* oxidase I (COI) gene, Hebert et al. 2003) whenever available. DNA barcodes were obtained using DNA extracts prepared from single legs using a glass fibre protocol (Ivanova et al. 2006). Briefly, total genomic DNA was re-suspended in 30 µl 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 unsuccessful, smaller sequences were generated using internal primers. If each amplification worked, a composite sequence was generated, however in cases where only one read amplified, this shorter sequence was used. All information for the sequences associated with each individual specimen can be retrieved from the Barcode of Life Data System (BOLD) (Ratnasingham and Hebert 2007). A Neighbor-Joining tree based on Kimura 2-parameter was also generated (Fig. 160).

The new species described below received patronyms based on the winners of a school child nature awareness competition conducted by the Programa de Educación Biológica de ACG in the last half of 2015 (Kazmier 2015).

Results

Characterization of the genus *Promicrogaster*

Promicrogaster Brues & Richardson, 1913

Promicrogaster: Brues and Richardson 1913: 499.

Diagnosis. Glossa elongate and bilobate (Figs 4, 10, 16, 22, 28, 34, 40, 46, 70, 76, 82, 101, 107, 118, 130, 149). Lateral face of scutellum with polished area (=lunules) occupying most of the lateral face (Figs 12, 18, 24, 32, 36, 42, 62, 66, 72, 78, 84, 110, 114, 120, 126, 138, 147, 151). Propodeum clearly sculptured and usually with some carination (Figs 12, 18, 36, 42, 66, 90, 99, 114, 120, 132, 133, 157). Metacoxa very long, $0.8\text{--}1.0 \times$ metafemur length and $0.6\text{--}0.8 \times$ metatibia length (Figs 7, 15, 38, 45, 51, 57, 63, 74, 87, 106, 117, 129, 135, 146, 148, 154). Mediotergite 1 parallel-sided (Figs 8, 13, 19, 32, 60, 140) to slightly narrowing towards posterior margin (Figs 38, 44, 55, 67, 73, 85, 91, 105, 127, 132, 147). Mediotergite 2 transverse, its width at posterior margin $3.0\text{--}4.5 \times$ (rarely $2.0 \times$) its length medially. Ovipositor very long for a microgastrine wasp (approximately two times longer than metatibia length), strongly curved and with its apex sinuate (Figs 1, 5, 14, 15, 20, 26, 30, 37, 43, 50, 51, 56, 61, 63, 68, 69, 74, 86, 87, 92, 98, 104, 108, 116, 121, 123, 128, 139, 140, 144, 148, 154, 159). Fore wing usually with a small areolet, which is sometimes poorly defined (Figs 3, 17, 23, 29, 35, 47, 59, 65, 71, 77, 83, 89, 95, 108, 113, 119, 131, 137, 156); but some small species have no trace of areolet whatsoever (Figs 41, 102, 125, 150). Body and fore wing lengths ranging from 1.8–2.0 mm in the smallest species up to 4.9–5.3 mm in the largest species. Body length varying from slightly longer to slightly shorter than fore wing length.

Promicrogaster is a very distinctive genus as defined by the combination of elongate and bilobate glossa, large polished areas on lateral face of scutellum, and ovipositor shape and length. Within Microgastrinae, it can only be confused with *Sendaphne*, but the later has a much less transverse mediotergite 2, the apex of ovipositor is not sinuate, the propodeum is entirely or mostly smooth, and the first discal cell is much wider (e.g., Fernández-Triana et al. 2014d).

We consider the described '*Promicrogaster*' from India as incertae sedis (see below for a detailed discussion on that species). Thus, *Promicrogaster* as defined here is restricted to the New World, with the vast majority of the species found in the Neotropics and a few extending north to the Nearctic (Mason 1981, and unpublished data from the CNC collection). This pattern of distribution is remarkably similar to that found in other genera recently revised in the New World, such as *Pseudapanteles* and *Venanus* (Fernández-Triana et al. 2013, 2014b, 2014c). A total of 21 new species are described below, increasing the total known Mesoamerican species from 4 to 25, and the total number of described species for the genus from 11 to 32 (Table 1). We are aware of many additional undescribed species in collections, from North America (Canada/US) and South America, which will be dealt with in future papers.

As for habitat preference, 82% of the ACG species were collected in rain forests and cloud forests (with almost 60% restricted to cloud forests), while only 18% were found in dry forests. Around 40% of the species were found at low-mid elevation (0-500 m) whereas almost 60% of the species were collected at altitudes over 1,000 m. This strongly contrasts with the closely related genus *Sendaphne*, which has been mostly found at altitudes between 100–900 m with just a few species found in cloud forests (Fernandez-Triana et al. 2014d).

All of the verified and authenticated host records for *Promicrogaster* are from caterpillars living more deeply inside more or less woody plant material than simply in rolled leaf structures. It is possible that the sinuate ovipositor tip in all known species of *Promicrogaster* is an adaptation allowing the ovipositor to be steered through fissures in harder/more woody structures than mere leaf rolls (e.g., Quicke 2015).

Muesebeck (1958) described *Promicrogaster polyporicola* as reared from unidentified Lepidoptera larvae infesting a bracket fungus (*Fomes* sp.) in Panama. Davis (1996) reared an unidentified species of *Promicrogaster* from caterpillars of *Prosetomorpha fal-*

Table 1. Mesoamerican species of *Promicrogaster*. The presence of species in Area de Conservación Guanacaste is indicated below by adding 'ACG' after 'Costa Rica'. New country records for species previously described are marked with an asterisk (*).

Species	Distribution
<i>Promicrogaster alexmartinezi</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster andrevallejosii</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster apharea</i> Nixon, 1965	Brazil, Mexico
<i>Promicrogaster brandondinartei</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster daniellopezi</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster daretrioi</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster eddycastroi</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster eimybandoae</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster fabiancastroi</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster fabriciocambroneri</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster hillaryvillafuerteae</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster kevinmartinezi</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster kiralycastilloae</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster leilycastilloae</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster liagranta</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster luismendezi</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster miranda</i> Muesebeck, 1958	Panama, Trinidad (*)
<i>Promicrogaster monteverdensis</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG and other localities
<i>Promicrogaster munda</i> Muesebeck, 1958	Costa Rica, Honduras, Mexico, Panama (*)
<i>Promicrogaster naomiduarteae</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster pablouzagai</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster polyporicola</i> Muesebeck, 1958	Panama
<i>Promicrogaster ronycastilloi</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster sebastiancambroneri</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG
<i>Promicrogaster tracyvindasae</i> Fernandez-Triana & Boudreault, sp. n.	Costa Rica, ACG and other localities

cata (Tineidae) in Colombia; the larvae of this small moth are scavengers feeding on frass within the burrows made by larval Curculionidae in the stems of *Solanum qui-toensis* (Solanaceae: ‘Naranjilla’). Garcia and Montilla (2010) reared *Promicrogaster* as a parasitoid of cocoa fruit borers, *Carmenta* spp. (Sessidae) in Venezuela; *Carmenta* larvae mine through the pericarp of cocoa (Malvaceae: *Theobroma cacao*) fruit, and their damage leads to secondary phytopathogenic fungal infections (such as *Phytophthora* sp.) that cause the fruit to rot (e.g., Morrilo et al. 2009). The 21 species of *Promicrogaster* found in ACG have only been collected in Malaise traps. It is likely that those wasp species have not been reared yet because they are parasitizing small moth larvae concealed inside more or less woody plant or fungal tissues - the ACG inventory, while being the most comprehensive effort ever done to rear tropical caterpillars, has only focused on exposed feeders and rollers of green leaves.

Key to *Promicrogaster* species in Mesoamerica (female specimens)

- 1 Head entirely yellow-orange to orange-brown; anteromesoscutum and scutellar disc mostly orange-brown (Figs 129, 130, 133); antenna mostly orange-yellow (only apical 4–5 flagellomeres dark brown)
..... ***Promicrogaster pablouzagai* Fernández-Triana & Boudreault, sp. n.**
- Head entirely black to dark brown (except for clypeus and labrum orange-yellow in some species); anteromesoscutum and scutellar disc black; antenna dark brown to black (rarely some species with apical 5–7 flagellomeres yellow-white) **2**
- 2(1) Lighter coloured species; clypeus entirely or mostly yellow to orange-yellow (as in Figs 4, 107, 118); all sternites and hypopygium yellow to orange-yellow (as in Figs 3, 5, 7, 57, 61, 106, 108, 117, 121); metasoma dorsally with T1–T4 entirely (rarely mostly) yellow, orange or red (as in Figs 8, 60, 109, 110, 119, 120) **3**
- Darker coloured species; most sternites (usually) and hypopygium (partially to entirely) dark brown (as in Figs 14, 20, 26, 30, 43, 56); metasoma dorsally mostly dark brown to black (rarely some tergites with small areas orange to light brown) (as in Figs 13, 19, 25, 31, 38, 44, 48, 55); clypeus coloration variable, usually dark brown to black **6**
- 3(2) Propodeum with complete, raised, and strongly defined median carina (partially visible in Fig. 110); **and** T1 entirely smooth (Fig. 109); **and** malar distance more than half eye length (Fig. 107); **and** clypeus large and entirely orange-yellow (Fig. 107) [Panama, Trinidad]
..... ***Promicrogaster miranda* Muesebeck, 1958**
- Propodeum without a median carina but with central depression (Figs 62, 120, 122); **either** with T1 mostly rugose (Figs 119, 120) **and** with malar distance less than half eye length (Figs 4, 118); **or** with clypeus smaller and not entirely yellow-red (as in Fig. 58) [other Mesoamerican countries, mostly Costa Rica] **4**

- 4(3) Metasoma dorsally entirely yellow-orange (Figs 119, 120); T1 with coarse sculpture on 0.7 or more its length; T2 relatively narrow, its width at posterior margin more than $3.0 \times$ its length centrally (Figs 119, 120); scape entirely to mostly black to dark brown (partially visible in Fig. 118) [Costa Rica, Honduras, Mexico, Panama, mostly found at elevations over 1000m].
 ***Promicrogaster munda* Muesebeck, 1958**
- Metasoma dorsally with some red, brown or black coloration (Figs 8, 60); T1 smoother (Fig. 60), at most with sculpture on posterior 0.5 of its length (Figs 8); T2 broader, its width at posterior margin usually less than 3.0 its length centrally (Figs 8, 60, 62); scape mostly yellow (Fig 4, 58) [Costa Rica, ACG, dry forest, under 300m] **5**
- 5(4) Posterior margin of clypeus strongly concave (Fig. 58); lower face clearly elongate, malar distance at least $1.5 \times$ mandible width (Fig. 58); fore wing vein 1M transparent (Fig. 59); T1 shape more or less rectangular (width at middle length, anterior or posterior margin about the same); T1–T4 entirely orange-yellow, T5+ mostly dark brown to black (Fig. 60)..... ***Promicrogaster fabriciocambroneroi* Fernandez-Triana & Boudreault, sp. n.**
- Posterior margin of clypeus very slightly concave, almost straight (Fig. 4); lower face of normal length, malar distance $1.0 \times$ mandible width (Fig. 4); fore wing with vein 1M brown (Fig. 3); T1 narrowing towards posterior margin; T1 mostly red with black margins (posterior 0.3 of T1 black sometimes), T2–T4 red-orange or yellow-orange, T5+ yellow with small central band brown (Fig. 8).....
 ***Promicrogaster alexmartinezi* Fernandez-Triana & Boudreault, sp. n.**
- 6(2) Antenna with most flagellomeres 10–16 yellow-white (Figs 33, 87)..... **7**
- Antenna entirely dark brown to black (rarely with flagellomeres 1–4 lighter in colour than rest of antenna)..... **8**
- 7(6) Antenna with flagellomeres 11–16 yellow-white (Fig. 87); propleuron, anterior 0.5 of metacoxa, sternites and hypopygium dark brown (Figs 87, 89); ovipositor strongly down curved on posterior 0.2 (Fig. 92) [Costa Rica, ACG, cloud forest over 1000m].....
 ***Promicrogaster leilycastilloae* Fernandez-Triana & Boudreault, sp. n.**
- Antenna with flagellomeres 1–8 and 15–16 dark brown, and flagellomeres 9–14 (sometimes only 10–14) yellow white (Fig. 33); propleuron, metacoxa, sternites and hypopygium mostly yellow to orange-yellow (Figs 33, 37); ovipositor relatively straight (Fig. 37) [Costa Rica, ACG, mid-elevation rain forests, 500-800m].....
 ***Promicrogaster daretrizoi* Fernandez-Triana & Boudreault, sp. n.**
- 8(6) Fore wing without areolet (as in Figs 41, 53, 102, 125, 150), **and** hypopygium and sternites almost always entirely dark brown (at most hypopygium with small pale spot basally, and/or anterior 2-3 sternites yellow) (Figs 30, 43,

- 56, 100, 104, 128, 144, 153), **and** smaller size (body length 1.8–2.4 mm, fore wing length 2.0–2.6 mm) **9**
- Fore wing with small areolet (as in Figs 137), **and/or** hypopygium and sternites usually mostly to entirely yellow, **and/or** larger size (body and fore wing lengths usually 3.0–4.0 mm)..... **15**
- 9(8) Propodeum mostly sculptured (except for polished areas postero-laterally) (Figs 42, 54, 103, 105, 127, 128) **10**
- Propodeum mostly smooth (except for small striae around nucha) (Figs 32, 145, 147, 151)..... **13**
- 10(9) Smaller size, body length 2.0–2.1 mm, fore wing length 2.2 mm, metacoxa 0.45–0.46 mm; ocular–ocellar line 0.08–0.09 mm; T1 width/length 0.4–0.5 x; ten diagnostic characters in the DNA barcoding region: 79C, 235C, 346C, 364C, 386A, 415A, 421G, 562A, 607G, 622C **Promicrogaster fabiancastroi** Fernandez-Triana & Boudreault, **sp. n.**
- Larger size, body length 2.3–2.4 mm, fore wing length 2.4–2.6 mm, metacoxa 0.47–0.56 mm; ocular–ocellar line 0.11–0.15 mm (rarely 0.08); T1 width/length 0.5–0.7 x; different base pairs in the barcoding region : 79A or 79T, 235T, 346A or 346T, 364A or 364T, 386T, 415G, 421A or 421T, 562G or 562T, 607A or 607T, 622A or 622T **11**
- 11(10) Ocular–ocellar line shorter than interocellar distance (0.9 x); T1 posterior width 1.3 × T2 central length; T2 width 3.2 × its length centrally **Promicrogaster luismendezi** Fernandez-Triana & Boudreault, **sp. n.**
- Ocular–ocellar line longer than interocellar distance (1.4–1.6 x); T1 posterior width 1.8–2.0 × T2 central length; T2 width 3.5–4.9 × (usually more than 4.0 x) its length centrally..... **12**
- 12(11) T2 width 4.9 × its length centrally; T1 length 1.9 × its posterior width; larger species, fore wing length 2.6 mm, metacoxa length 0.6 mm, metafemur length 0.7 mm, metatibia 0.9 mm **Promicrogaster eddycastroi** Fernandez-Triana & Boudreault, **sp. n.**
- T2 width 3.5–4.0 × its length centrally; T1 length 1.5–1.7 × its posterior width; smaller species, fore wing length 2.3–2.4 mm, metacoxa length 0.5 mm, metafemur length 0.5–0.6 mm, metatibia 0.7–0.8 mm **Promicrogaster naomiduarteae** Fernandez-Triana & Boudreault, **sp. n.**
- 13(9) Pterostigma with anterior 0.3 or more white, most veins of fore wing transparent or white (Fig. 29) [Costa Rica, ACG, dry forest under 300m] **Promicrogaster daniellopezi** Fernandez-Triana & Boudreault, **sp. n.**
- Pterostigma entirely brown or at most with anterior 0.1 pale, fore wing with veins mostly brown (Figs 143, 150) [Costa Rica, ACG, cloud forests over 1,000m]..... **14**
- 14(13) Posterior 0.6 of T1 sculptured (Fig. 147); clypeus, procoxa, most of sternites and laterotergites brown (Figs 141, 142, 144)..... **Promicrogaster ronycastilloi** Fernandez-Triana & Boudreault, **sp. n.**

- Posterior 0.6 of T1 mostly smooth (at most with sculpture restricted to margins) (Fig. 152); labrum yellow-orange, procoxa yellow, sternites and laterotergites mostly to partially yellow (Figs 148, 149, 153) ***Promicrogaster sebastiancambroneri* Fernandez-Triana & Boudreault, sp. n.**
- 15(8) Posterolateral corners of anteromesoscutum orange (Fig. 138); hypopygium and sternites dark brown (Figs 137, 139); T1 hardly narrowing towards posterior margins; T1 relatively wide, its medial length barely longer than its width at anterior margin (Figs 138, 140) [Panama]
 ***Promicrogaster polyporicola* Muesebeck, 1958**
- Anteromesoscutum entirely black; hypopygium and sternites usually mostly to entirely yellow; T1 usually narrowing towards posterior margin; T1 relatively narrower, its medial length much longer than its width at anterior margin [Brazil, Costa Rica, Mexico] **16**
- 16(15) Propleuron almost entirely yellow (Figs 45, 69, 70, 76), except for anterior 0.2 near head yellow-white (rarely propleuron partially yellow, partially light-brown); hypopygium, sternites and most laterotergites entirely yellow (hypopygium may have a dark spot on posterior 0.1 or less) (Figs 50, 69, 74, 81, 86)..... **17**
- Propleuron almost entirely dark brown to black, except for anterior 0.2 near head yellow (Figs 9, 63, 111); hypopygium, sternites and laterotergites at least partially dark brown **19**
- 17(16) Metacoxa dark brown on anterior 0.6 (Fig. 86); tegula brown; propleuron partially yellow, partially light-brown (partially visible in Figs 81, 82)
 ... ***Promicrogaster kiralycastilloae* Fernandez-Triana & Boudreault, sp. n.**
- Metacoxa, tegula and propleuron entirely yellow (propleuron with anterior 0.2 near head yellow-white) (Figs 45, 46, 50, 69, 74, 76) **18**
- 18(17) T3 mostly yellow-white, with anterior 0.4 light brown, T4–7 brown anteriorly, white on posterior 0.3–0.5 (Figs 71, 73) [Costa Rica, ACG, cloud forest over 1,000m].....
 ... ***Promicrogaster kevinmartinezi* Fernandez-Triana & Boudreault, sp. n.**
- All tergites dark brown to black (Fig. 48) [Costa Rica, ACG, mid-elevation rain forest, 500m]
 ... ***Promicrogaster eimyobandoae* Fernandez-Triana & Boudreault, sp. n.**
- 19(16) Fore wing without areolet (Fig. 11)
 ... ***Promicrogaster andrevallejosi* Fernandez-Triana & Boudreault, sp. n.**
- Fore wing with small areolet **20**
- 20(19) Flagellomeres 1–4 yellow-brown, clearly paler than rest of entirely brown flagellomeres (partially visible in Figs 63, 64); orange-yellow areas on metapleuron posterior 0.4, T1 anterior 0.6, T3 anterior 0.5 and small spot on mesopleuron posteriorly (Figs 63, 66–68)
 ... ***Promicrogaster hillaryvillafuerteae* Fernandez-Triana & Boudreault, sp. n.**
- All flagellomeres same color (brown to dark brown); meso and metapleuron entirely dark brown to black, coloration of T1 and T3 variable but not as above **21**

- 21(20) Tegula and wing base dark brown to black (Fig. 114); clypeus black (same color as face) (Fig. 112); clypeus slightly protruding and labrum slightly depressed, giving the appearance of a circular opening between the margin of clypeus and mandibles (barely distinguishable in Fig. 112)
 ..*Promicrogaster monteverdensis* Fernandez-Triana & Boudreault, sp. n.
- Tegula and wing base yellow; clypeus entirely to partially orange-yellow or orange-brown (clearer than face) (Figs 16, 155); clypeus not protruding and labrum not depressed, not giving the appearance of a circular opening **22**
- 22(21) Flagellomere 15 length 1.6–1.7 × its width; *and* ovipositor tip strongly bent downwards; *and* clypeus entirely orange-yellow (different from dark brown to black face); *and* body length and fore wing length 4.0 mm; *and* T1 almost parallel-sided, very slightly narrowing towards posterior margin; *and* T2 mostly sculptured; *and* T3 with small yellow spot laterally [Brazil, Mexico]...
*Promicrogaster apharea* Nixon, 1965
- Flagellomere 15 length 1.0–1.3 × its width; *and/or* ovipositor tip less strongly bent downwards; *and/or* clypeus entirely to partially dark brown to black (same color than face); *and/or* body length and fore wing length less than 4.0 mm; *and/or* T1 clearly narrowing towards posterior margin; *and/or* T2 mostly smooth; *and/or* T3 entirely dark brown to black [Costa Rica] **23**
- 23(22) Metacoxa with anterior 0.3–0.6 black (Figs 15, 19) [Costa Rica, ACG, cloud forests over 1,000m]
 ..*Promicrogaster brandondinartei* Fernandez-Triana & Boudreault, sp. n.
- Metacoxa entirely yellow (at most with small dark spot on anterior 0.1 or less, barely visible) (Figs 95, 154, 156) [Costa Rica, ACG, dry forest or mid-elevation rainforests, 300–500m] **24**
- 24(23) T1 clearly narrowing towards posterior margin, its length 2.0 × its width at posterior margin; T2 mostly sculptured; T3 with yellow spots laterally (Figs 94, 99) *Promicrogaster liagranta* Fernandez-Triana & Boudreault, sp. n.
- T1 almost parallel-sided, very slightly narrowing towards posterior margin, its length 1.7 × its width at posterior margin; T2 mostly smooth; T3 entirely dark brown to black (partially visible in Figs 156–158).....
*Promicrogaster tracyvindasae* Fernandez-Triana & Boudreault, sp. n.

Taxonomic treatment of species

Promicrogaster saraswatti Sathe & Bhoje, 1998, incertae sedis

Promicrogaster saraswatti Sathe & Bhoje, 1998: 105. Original description.

Holotype. Female, depository unknown. INDIA, Maharashtra, Kolhapur. Holotype not examined.

Comments. There are several issues that will require further study to clarify the status and identity of this species. First, all other *Promicrogaster* specimens that we have seen in collections (from either described or undescribed species) are restricted to the New World, and all published evidence (e.g., Mason 1981, Whitfield 1997) does not support this genus to be present in India. Second, *Promicrogaster saraswatti* was described by Sathe and Bhoje (1998) as a parasitoid of *Phytomyza atricornis* Meigen (Diptera: Agromyzidae), which is very suspicious, as all authenticated records of Microgastrinae are from Lepidoptera (e.g., Shaw and Huddleston 1991, Whitfield 1997, Quicke, 2015). Third, Sathe and Bhoje (1998) recorded in their paper the body size of the parasitoid wasp to be 4.64 mm and the wasp cocoon to be 4.5 mm; this is in strong contrast to a much smaller size for its supposed host: larvae of *Phytomyza atricornis* are only known to reach a maximum length of 3.5 mm and their puparia are even smaller at 2.1–2.5 mm (Cohen 1936). All of that points towards this species not being *Promicrogaster* but some other Microgastrinae (impossible to tell based on the unclear original description, which lacked any illustration); and the parasitoid's biology might well have also been misunderstood and should be considered as highly questionable. To complicate things further, no details about the institution storing the holotype and 33 paratypes (reportedly from the same locality and data as holotype) were provided by the authors. Because the original description of *P. saraswatti* is the only source of information currently available, this species remains unrecognizable.

***Promicrogaster alexmartinezi* Fernandez-Triana & Boudreault, sp. n.**

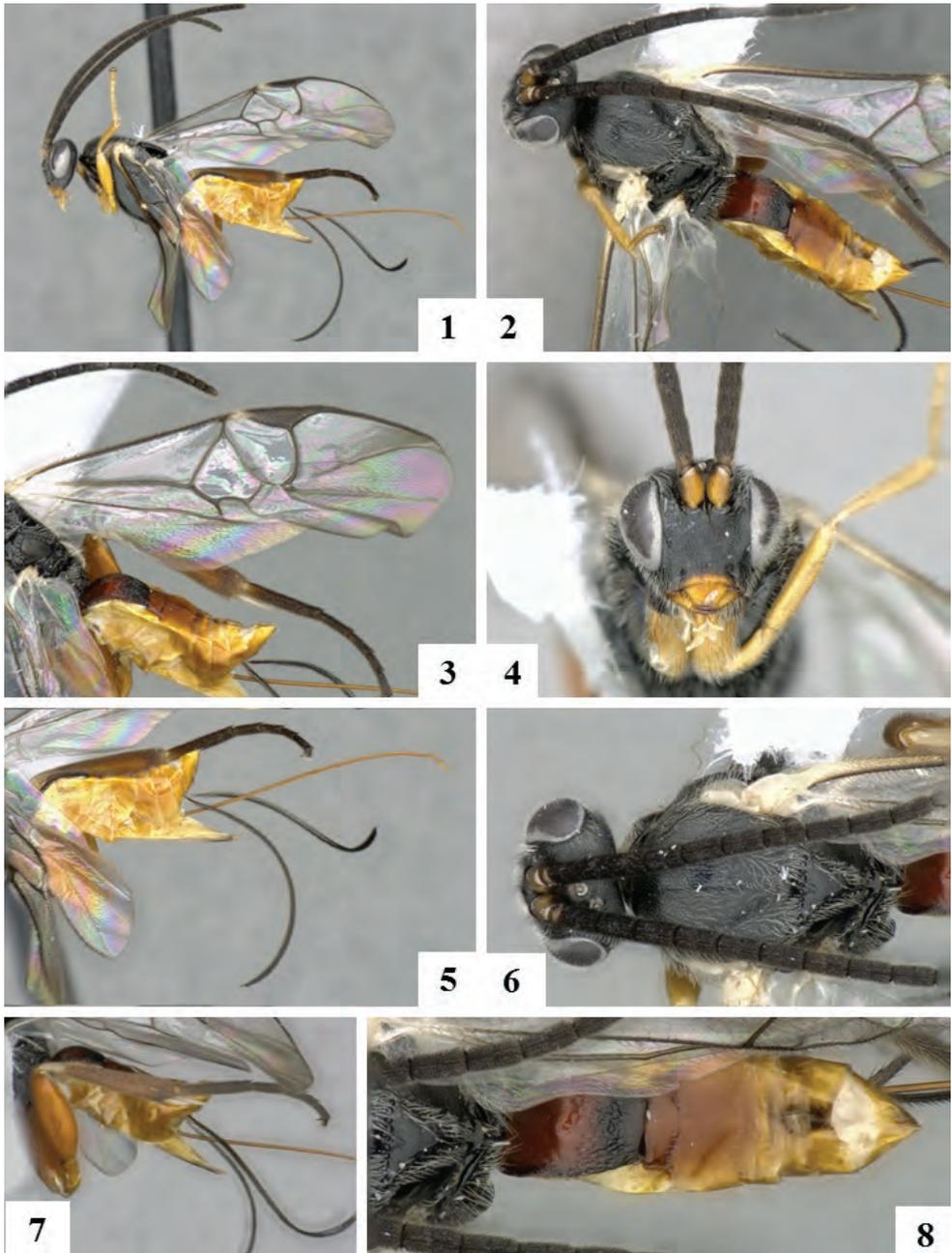
<http://zoobank.org/2392E300-06B5-44CB-B4DE-D54F90EF21E1>

Figs 1–8

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Santa Rosa, Area Administrativa, 295m, 10.83764, -85.61871. DNA Voucher code: DHJPAR0031827.

Paratype. 1♀ (CNC), same locality as holotype. DNA voucher code: DHJPAR0031814.

Description. Head: mostly black, clypeus, labrum and mandibles yellow. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: white. Metasoma (dorsally): T1 mostly red with black margins (posterior 0.3 of T1 black sometimes), T2–T4 red-orange or yellow-orange, T5+ yellow with small central band brown. Metacoxa: Orange. Malar distance: 0.3 × eye length. Fore wing areolet: present. T1 sculpture: mostly smooth, with posterior 0.3 sculptured. T2 sculpture: mostly smooth. Ocular–ocellar line: 0.14 mm. Interocellar distance: 0.12 mm. Posterior ocellus diameter: 0.11 mm. Body length: 4.20–4.97 mm. Fore wing length: 4.17–4.83 mm. Ovipositor length: 2.40–3.50 mm. Metacoxa length: 1.10–1.41 mm. Metafemur length: 1.11–1.32 mm. Metatibia length: 1.44–1.89 mm. T1 length/width at posterior margin: 0.56–0.73mm/0.32–0.40 mm. T2 length/width at posterior margin: 0.18–0.20 mm/ 0.42–0.63 mm.



Figures 1–8. *Promicrogaster alexmartinezi* sp. n. holotype.

Distribution. Known only from the holotype locality in ACG, dry forest, Costa Rica.

Comments. The female holotype is larger and slightly darker than the paratype.

Etymology. *Promicrogaster alexmartinezi* is named in honor of 13-year-old Alex Geovanny Martínez López from the Colonia Bolaños school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

***Promicrogaster andrevallejosi* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/42C8D3E2-34E6-424B-B594-F3CEB5AC3FB0>

Figs 9–14

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Sendero Cima, 1460m, 10.93328, -85.45729. DNA Voucher code: DHJPAR0034152.

Description. Head: mostly black, labrum and mandibles yellow-orange. Flagellomeres: dark brown to black. Mesosoma color: black. Tegula: dark brown. Metasoma (dorsally): black to dark brown. Metacoxa: dark brown on anterior 0.5, yellow on posterior 0.5. Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: absent. T1 sculpture: mostly sculptured. T2 sculpture: mostly sculptured. Ocular–ocellar line: 0.15 mm. Interocellar distance: 0.06 mm. Posterior ocellus diameter: 0.08 mm. Body length: 3.46 mm. Fore wing length: 3.34 mm. Ovipositor length: 2.18 mm. Metacoxa length: 0.76 mm. Metafemur length: 0.89 mm. Metatibia length: 1.06 mm. T1 length/width at posterior margin: 0.45mm/ 0.27 mm. T2 length/width at posterior margin: 0.14 mm/ 0.44 mm.

Distribution. Known only from the holotype locality in ACG, cloud forest, Costa Rica.

Etymology. *Promicrogaster andrevallejosi* is named in honor of 11-year-old Andrey Vallejos López from the La Garita Vieja school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

Comments. The ovipositor was too curved and the metacoxa was partially hidden in the available specimen, so those measurements should be considered as approximate.

***Promicrogaster apharea* Nixon, 1965**

Promicrogaster apharea Nixon, 1965: 234. Original description.

Holotype. Female, BMNH (examined). MEXICO, Guerrero, Omilteme, 2400 m.

Distribution. Mexico, Brazil. The two Mexican specimens were collected at altitudes of 1,400 and 2,400 m respectively, whereas the Brazilian specimen was collected at around 500 m (Nixon 1965).

Comments. The relatively long flagellomere 15, as well as body length and fore wing length over 4.0 mm are the most useful characters to separate the species from a



Figures 9–14. *Promicrogaster andrevallejosi* sp. n. holotype.

few Costa Rican species that are otherwise similar morphologically (e.g., *P. brandondinartei*, *P. liagranta* and *P. tracyvindasae*). *P. apharea* is only known from three female specimens, as mentioned in the original description Nixon (1965). The strange geographic and ecological distribution reported suggests it might actually comprise two different species, one from Mexico and one from Brazil. Because we only examined the holotype we cannot conclude about that.

***Promicrogaster brandondinartei* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/BC14B161-CE15-4AA2-B24C-E9019D20759E>

Figs 15–26

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Sendero Arenales, 1080m, 10.92471, -85.46738. DNA Voucher code: DHJPAR0031290.

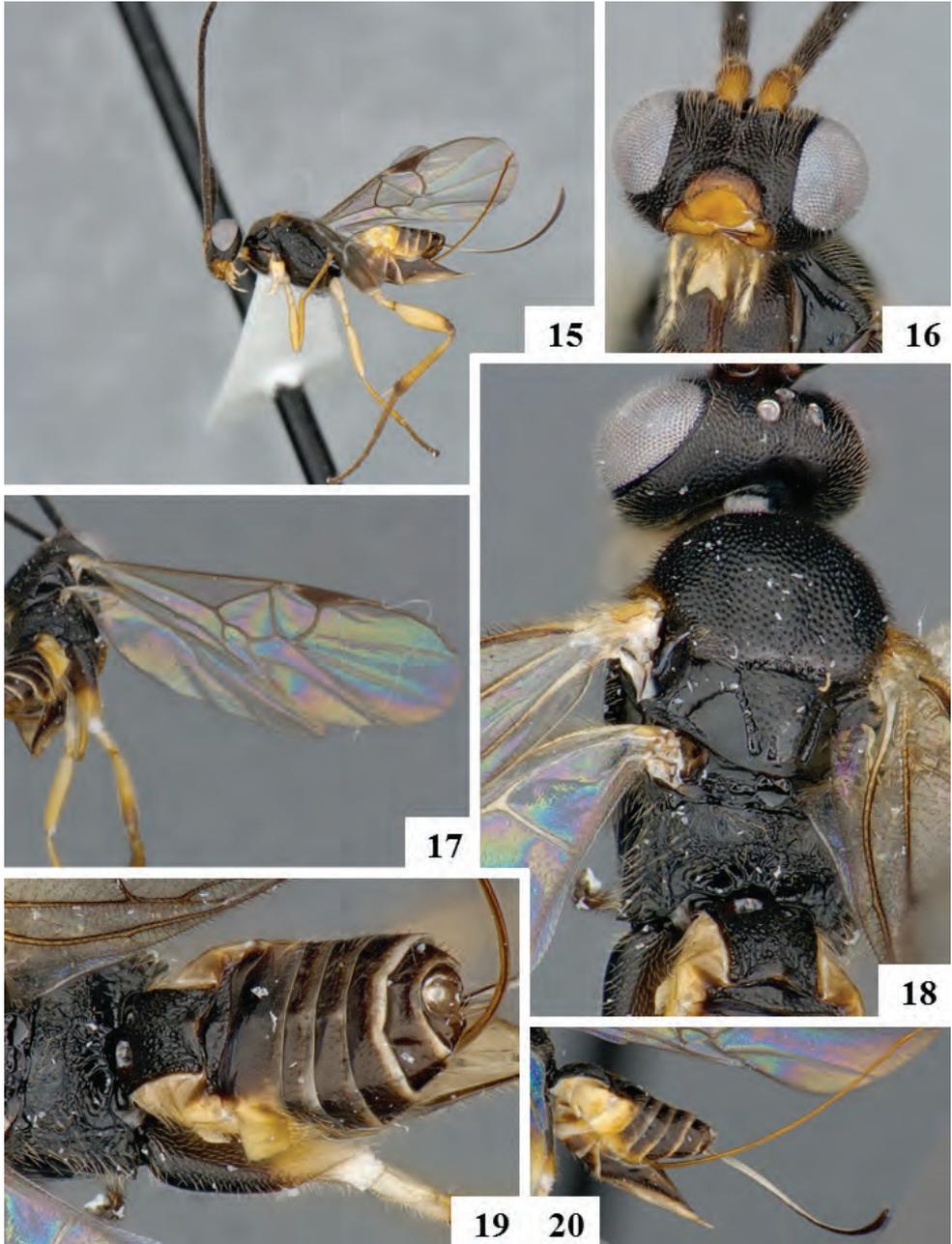
Paratypes. 1♀ (NMNH), same locality as holotype; 2♀ 1♂ (CNC), Costa Rica, Guanacaste, ACG, Sector Cacao, Sendero Circular, 1185m, 10.92714, -85.46683; 1♂ (CNC). Panama, Cerro Campana, 850m, 8° 40' N 79° 55' W. DNA Voucher codes: CNCHYM 01985, DHJPAR0031203, DHJPAR0031206, DHJPAR0031258, DHJPAR0031326.

Description. Head: mostly black, labrum and mandibles light brown to yellow. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: brown. Metasoma (dorsally): dark brown to black. Metacoxa: yellow. Malar distance: less than 0.2 × eye length. Fore wing areolet: present. T1 sculpture: mostly sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.15 mm. Interocellar distance: 0.10 mm. Posterior ocellus diameter: 0.08 mm. Body length: 3.54 mm. Fore wing length: 3.70 mm. Ovipositor length: 2.89 mm. Metacoxa length: 0.85 mm. Metafemur length: 0.97 mm. Metatibia length: 1.27 mm. T1 length/width at posterior margin: 0.50 mm/ 0.31 mm. T2 length/width at posterior margin: 0.11 mm/ 0.47 mm.

Distribution. Costa Rica (ACG, cloud forest), Panama.

Etymology. *Promicrogaster brandondinartei* is named in honor of 12-year-old Brandon Josué Dinarte Barrientos from the Huacas school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

Comments. There are two barcode divergent groups within what we call *Promicrogaster brandondinartei* (Fig. 160). The holotype (DHJPAR0031290, from the barcode BIN BOLD:ABZ2999) and three of the paratypes (DHJPAR0031203, DHJPAR0031258, DHJPAR0031206, from the barcode BIN BOLD:AAM9535) form two sequence clusters that are not monophyletic within the genus. A fourth paratype specimen (DHJPAR0031326) is represented by a short sequence that clusters with the holotype. These two BINS are separated by 2.3 % sequence divergence, four amino acid differences and are derived from specimens collected from Malaise traps placed at different elevations along Volcán Cacao (Arenales and Circular at approximately 1,000m and 1,200m respectively). This may suggest that there are multiple species



Figures 15–20. *Promicrogaster brandondinartei* sp. n. holotype.



Figures 21–26. *Promicrogaster brandondinartei* sp. n. paratype.

within this name. However, the trace files for the BIN associated with the holotype (BOLD:ABZ2999) contain ambiguities at the bases associated with the amino acid changes between the two BINS, a potential signal of co-amplification of a pseudogene or numt (Zhang and Hewitt 1996). Since the specimens are morphologically indistinguishable, we consider it likely that the barcode records for *P. brandondinartei* contain variation derived from a pseudogene rather than representing a true mitochondrial variant. However, clearly delineating between the hypotheses of morphologically cryptic species-level variation (two BINS) or pseudogene-derived barcode variation within *brandondinartei* will require further collections and specimens to be barcoded.

***Promicrogaster daniellopezi* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/79CB6DA4-9678-408D-810F-DB276467FF2E>

Figs 27–32

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Santa Rosa, Area Administrativa, 295m, 10.83764, -85.61871. DNA Voucher code: DHJPAR0031641.

Paratype. 1♀ (CNC), same locality as holotype. DNA voucher code: DHJPAR0031819.

Description. Head: mostly black, labrum and mandibles light brown to yellow. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: dark brown. Metasoma (dorsally): black to dark brown. Metacoxa: mostly black to dark brown (posterior 0.1–0.2 yellow). Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: present. T1 sculpture: mostly sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.10 mm. Interocellar distance: 0.05 mm. Posterior ocellus diameter: 0.03 mm. Body length: 1.81 mm. Fore wing length: 2.02 mm. Ovipositor length: 1.47 mm. Metacoxa length: 0.31 mm. Metafemur length: 0.47 mm. Metatibia length: 0.58 mm. T1 length/width at posterior margin: 0.27 mm/ 0.13 mm. T2 length/width at posterior margin: 0.04 mm/ 0.24 mm.

Distribution. Known only from the holotype locality in ACG, dry forest, Costa Rica.

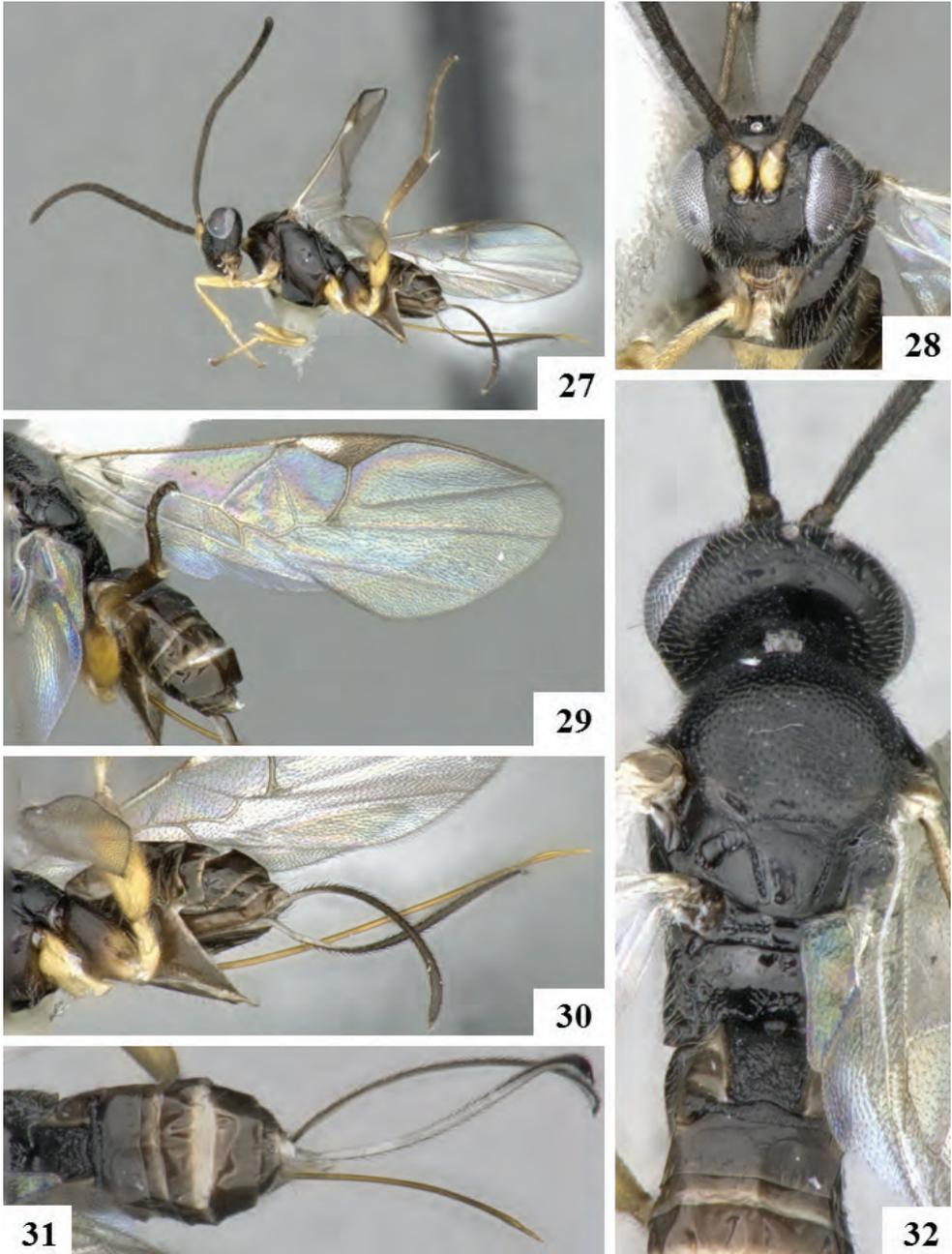
Etymology. *Promicrogaster daniellopezi* is named in honor of 13-year-old Migdonio Daniel López Martínez from the Colonia Bolaños school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

***Promicrogaster daretrizoi* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/F91D4DBE-0D0C-457E-9CF2-FD82F92E6523>

Figs 33–38

Holotype. Female, CNC. COSTA RICA, Alajuela, Area de Conservación Guanacaste, Sector San Cristobal, Bosque Trampa Malaise, 815m, 10.86280, -85.38460. DNA Voucher code: DHJPAR0025899.



Figures 27–32. *Promicrogaster daniellopezi* sp. n. holotype.



Figures 33–38. *Promicrogaster daretrizoi* sp. n. holotype.

Paratypes. 12♀, 37♂ (CNC, NMNH, BMNH, INBio). Costa Rica, Alajuela, ACG, same locality than holotype; Sector San Cristóbal, Río Blanco Abajo, 10.9, -85.373, 500m; Sector San Cristóbal, Potrero Argentina, 10.89, -85.388, 520m; Sector San Cristóbal, Estación San Gerardo, 10.88, -85.389, 575m; Sector Rincón Rain Forest, Vado Río Francia, 10.901, -85.289, 400m. DNA Voucher codes: DHJPAR0025506, DHJPAR0024792, DHJPAR0025676, DHJPAR0025820, DHJPAR0025821, DHJPAR0025872, DHJPAR0025873, DHJPAR0025874, DHJPAR0025908, DHJPAR0025945, DHJPAR0025953, DHJPAR0025963, DHJPAR0025968, DHJPAR0025971, DHJPAR0025973, DHJPAR0025980, DHJPAR0025986, DHJPAR0025989, DHJPAR0025999, DHJPAR0026006, DHJPAR0026009, DHJPAR0026010, DHJPAR0026011, DHJPAR0026015, DHJPAR0026023, DHJPAR0026025, DHJPAR0026041, DHJPAR0026044, DHJPAR0026057, DHJPAR0026072, DHJPAR0026077, DHJPAR0027603, DHJPAR0027604, DHJPAR0027611, DHJPAR0027615, DHJPAR0027617, DHJPAR0027624, DHJPAR0027630, DHJPAR0027634, DHJPAR0027638, DHJPAR0027640, DHJPAR0027642, DHJPAR0027643, DHJPAR0027662, DHJPAR0027665, DHJPAR0027674, DHJPAR0027677, DHJPAR0027694, DHJPAR0027702.

Description. Head: mostly black, labrum and mandibles yellow. Flagellomeres: flagellomeres 1–8 and 15–16 dark brown, flagellomeres 9–14 (sometimes only 10–14) yellow white. Mesosoma: black. Tegula: dark brown. Metasoma (dorsally): black to dark brown. Metacoxa: mostly orange-yellow but with small brown spot dorsally. Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: present. T1 sculpture: mostly sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.10–0.11 mm. Interocellar distance: 0.06–0.08 mm. Posterior ocellus diameter: 0.05–0.06 mm. Body length: 2.49–2.75 mm. Fore wing length: 2.55–2.86 mm. Ovipositor length: 1.67–1.90 mm. Metacoxa length: 0.63–0.72 mm. Metafemur length: 0.73–0.81 mm. Metatibia length: 0.89–1.01 mm. T1 length/width at posterior margin: 0.32–0.40 mm/mm. T2 length/width at posterior margin: 0.06–0.10 mm/0.15–0.33 mm.

Distribution. Costa Rica (ACG, mid-elevation rain forest).

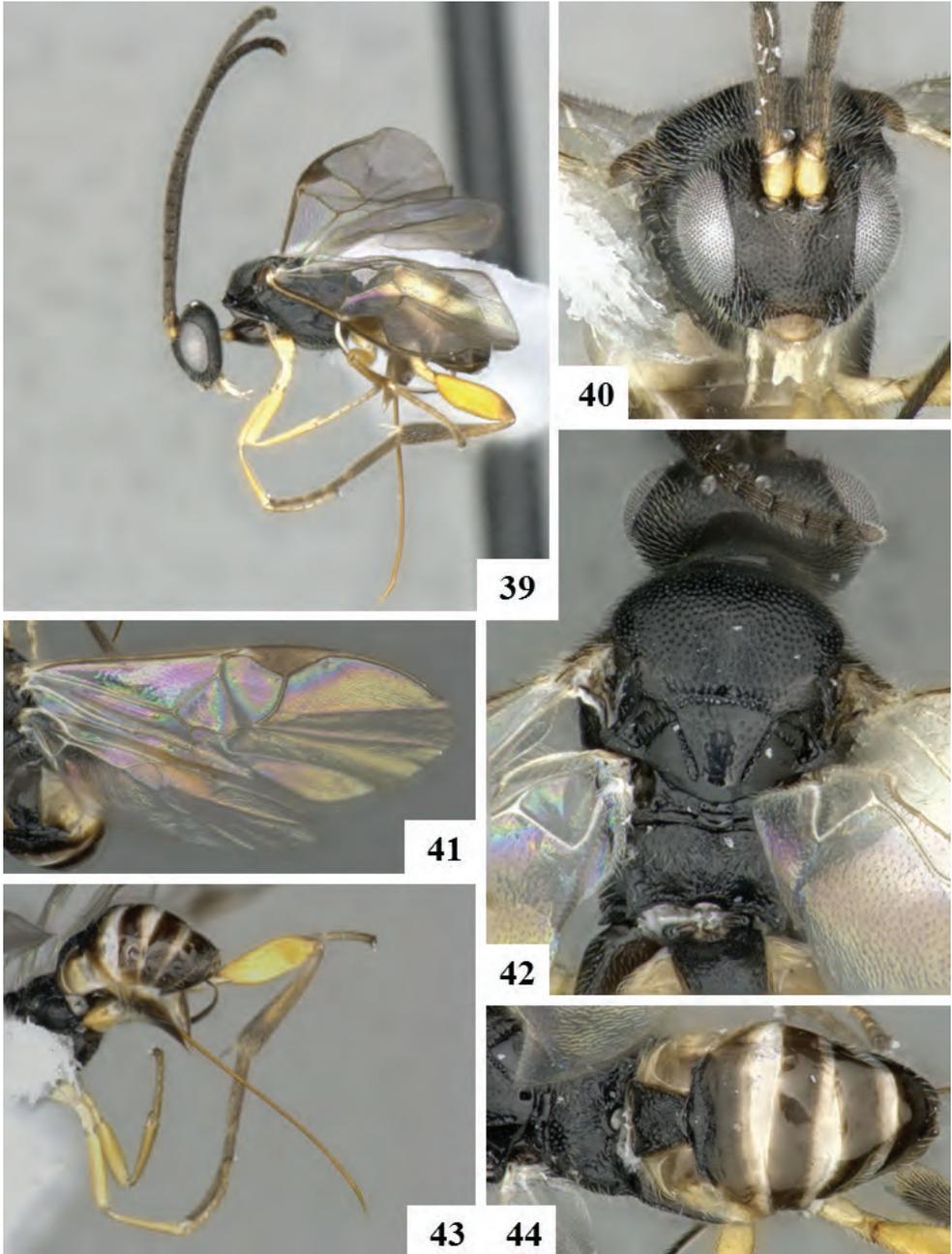
Etymology. *Promicrogaster daretrizoi* is named in honor of 12-year-old Daret Rizo Alemán from the Colonia Bolaños school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

***Promicrogaster eddycastroi* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/B2C0A188-C887-489F-A07F-5B0AF33180E9>

Figs 39–44

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Sendero Arenales, 1080m, 10.92471, -85.46738. DNA Voucher code: DHJPAR0031320.



Figures 39–44. *Promicrogaster eddycastrói* sp. n. holotype.

Description. Head: mostly black, labrum and mandibles light brown to yellow. Flagellomeres: dark brown. Mesosoma: black. Tegula: brown. Metasoma (dorsally): black to dark brown. Metacoxa: mostly black to dark brown (posterior 0.1–0.2 yellow). Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: absent. T1 sculpture: anterior 0.5 smooth, posterior 0.5 sculptured.

T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.11 mm. Interocellar distance: 0.08 mm. Posterior ocellus diameter: 0.06 mm. Body length: 2.29 mm. Fore wing length: 2.65 mm. Ovipositor length: 1.77 mm. Metacoxa length: 0.56 mm. Metafemur length: 0.68 mm. Metatibia length: 0.89 mm. T1 length/width at posterior margin: 0.30 mm/ 0.16 mm. T2 length/width at posterior margin: 0.08 mm/ 0.39 mm.

Distribution. Known only from the holotype locality in ACG, cloud forest, Costa Rica.

Etymology. *Promicrogaster eddycastroi* is named in honor of 12-year-old Eddy Alfredo Castro Detrinidad from the Huacas school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

***Promicrogaster eimyobandoae* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/8E3614AC-D86A-42FF-B97C-796C4841755F>

Figs 45–50

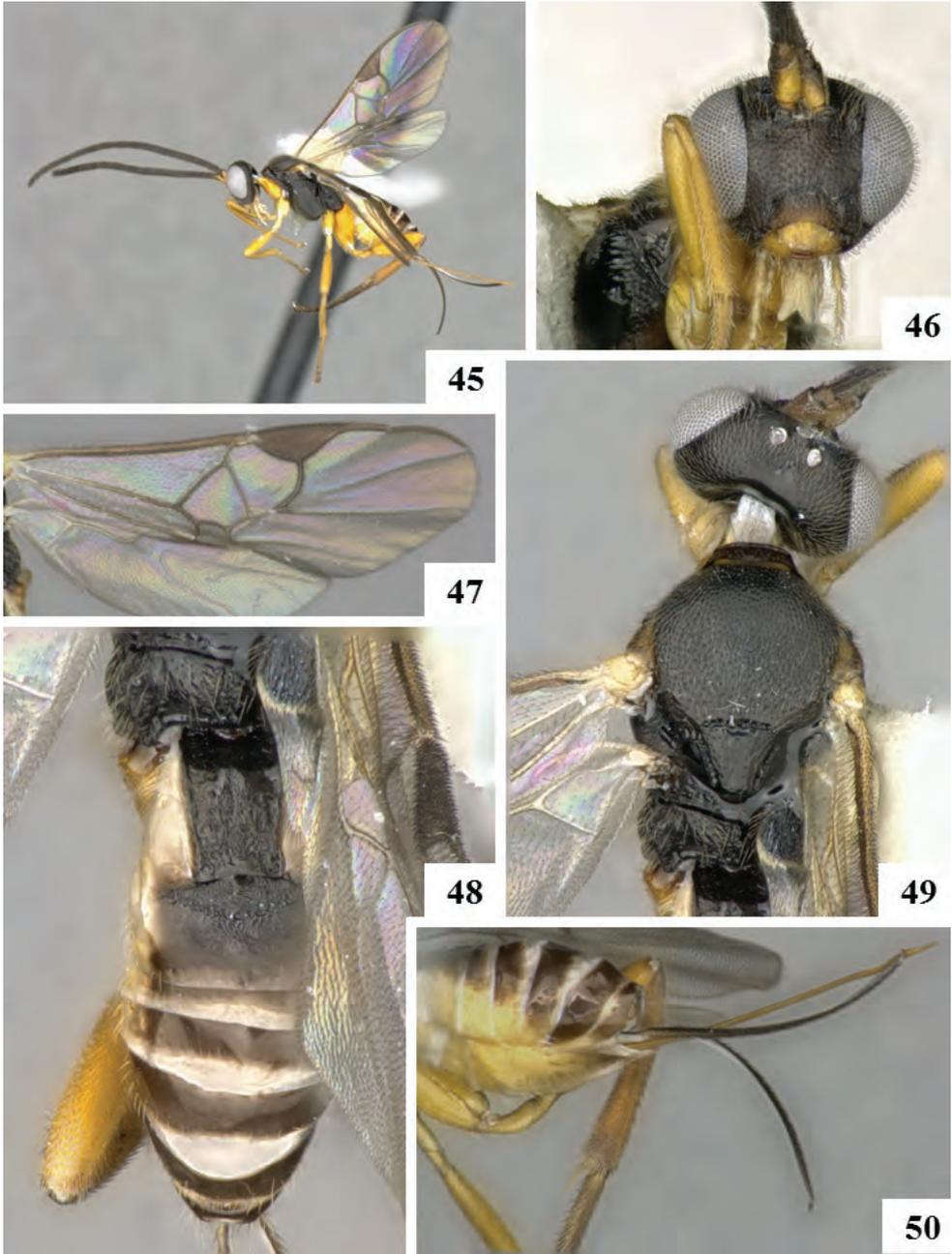
Holotype. Female, CNC. COSTA RICA, Alajuela, Area de Conservación Guanacaste, Sector San Cristobal, Potrero Argentina, 520m, 10.89021, -85.38803. DNA Voucher code: DHJPAR0027520.

Paratypes. 1♀, 1♂ (CNC), same locality as holotype. 1♂ (CNC), ACG, Sector San Cristobal, Rio Blanco Abajo, 500m, 10.90037, -85.37254. DNA voucher codes: DHJPAR0025577, DHJPAR0025685, DHJPAR0026587.

Description. Head: mostly black, labrum and mandibles light brown to yellow. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: brown. Metasoma (dorsally): black to dark brown. Metacoxa: orange-yellow. Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: present. T1 sculpture: mostly sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.10 mm. Interocellar distance: 0.08 mm. Posterior ocellus diameter: 0.06 mm. Body length: 2.78–2.80 mm. Fore wing length: 2.73–2.80 mm. Ovipositor length: 1.69–1.84 mm. Metacoxa length: 0.63 mm. Metafemur length: 0.69–0.71 mm. Metatibia length: 0.87–0.92 mm. T1 length/width at posterior margin: 0.32 mm/ 0.15–0.23 mm. T2 length/width at posterior margin: 0.11 mm/ 0.32–0.37 mm.

Distribution. Costa Rica (ACG, mid-elevation rain forest).

Etymology. *Promicrogaster eimyobandoae* is named in honor of 12-year-old Eimy Yuleisi Obando Zelaya from the La Garita Vieja school for her growing enthusiasm for understanding and protecting the wild nature that occurs in her homeland.



Figures 45–50. *Promicrogaster eimyobandoae* sp. n. holotype.

***Promicrogaster fabiancastroi* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/726D9560-5CEE-46B6-BEF3-6355FC7FA78F>

Figs 51–56

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Sendero Arenales, 1080m, 10.92471, -85.46738. DNA Voucher code: DHJPAR0031313.

Paratype. 1♀ (CNC), same locality as holotype. DNA voucher code: DHJPAR0031314.

Description. Head: mostly black, labrum and mandibles light brown to yellow. Flagellomeres: dark brown. Mesosoma: black. Tegula: brown. Metasoma (dorsally): black to dark brown. Metacoxa: mostly black to dark brown (posterior 0.1–0.2 yellow). Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: absent. T1 sculpture: mostly sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.08–0.10 mm. Interocellar distance: 0.08 mm. Posterior ocellus diameter: 0.05 mm. Body length: 1.98–2.14 mm. Fore wing length: 2.23–2.25 mm. Ovipositor length: 1.40–1.57 mm. Metacoxa length: 0.45–0.47 mm. Metafemur length: 0.52–0.56 mm. Metatibia length: 0.65–0.69 mm. T1 length/width at posterior margin: 0.24–0.27 mm/ 0.11 mm. T2 length/width at posterior margin: 0.06–0.07 mm/ 0.27–0.29 mm.

Distribution. Known only from the holotype locality in ACG, cloud forest, Costa Rica.

Etymology. *Promicrogaster fabiancastroi* is named in honor of 8-year-old Fabián Castro Gutiérrez from Educarte school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

***Promicrogaster fabriciocambroneroi* Fernandez-Triana & Boudreault, sp. n.**

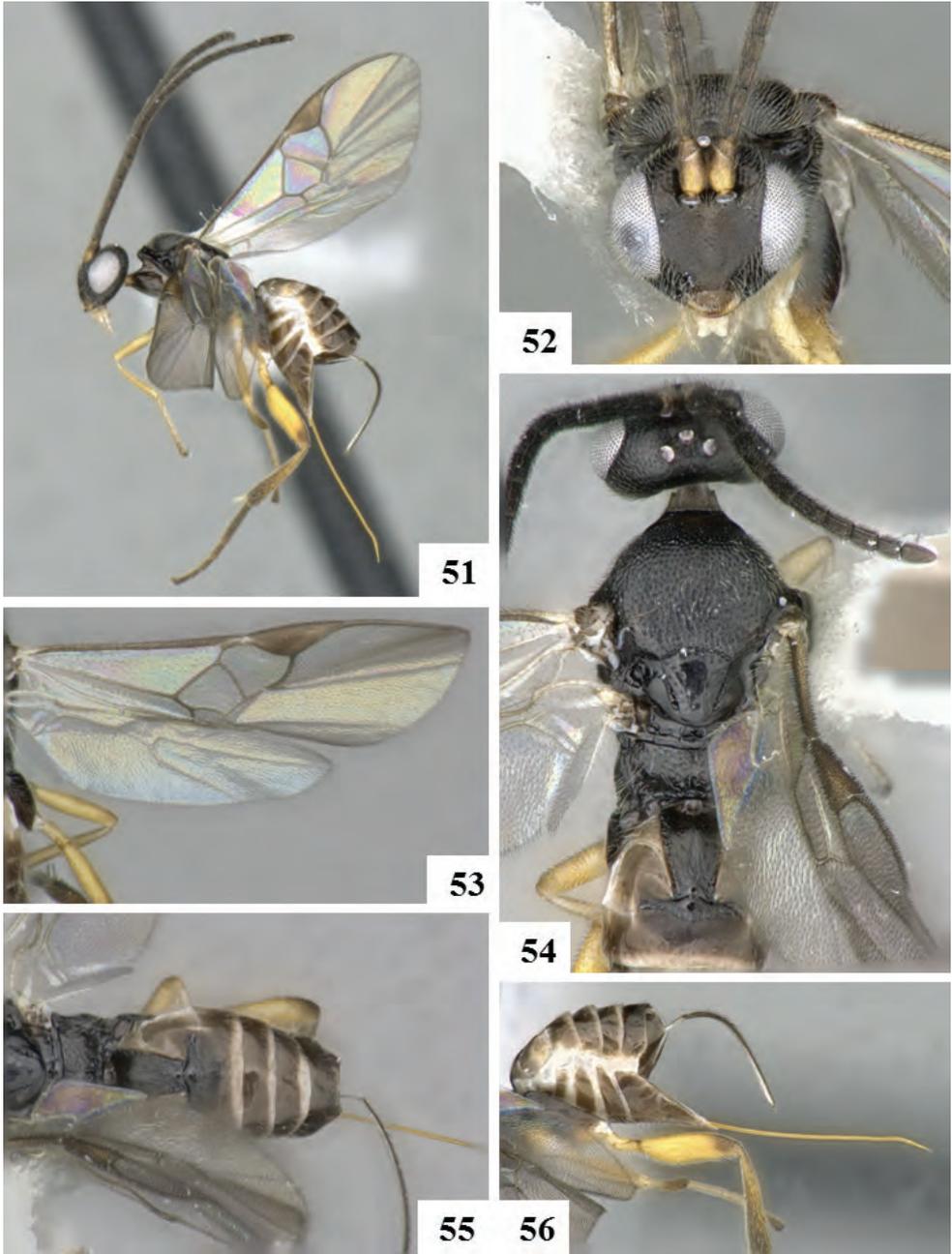
<http://zoobank.org/812785CB-AAC1-4E96-A138-99C25043D5A4>

Figs 57–62

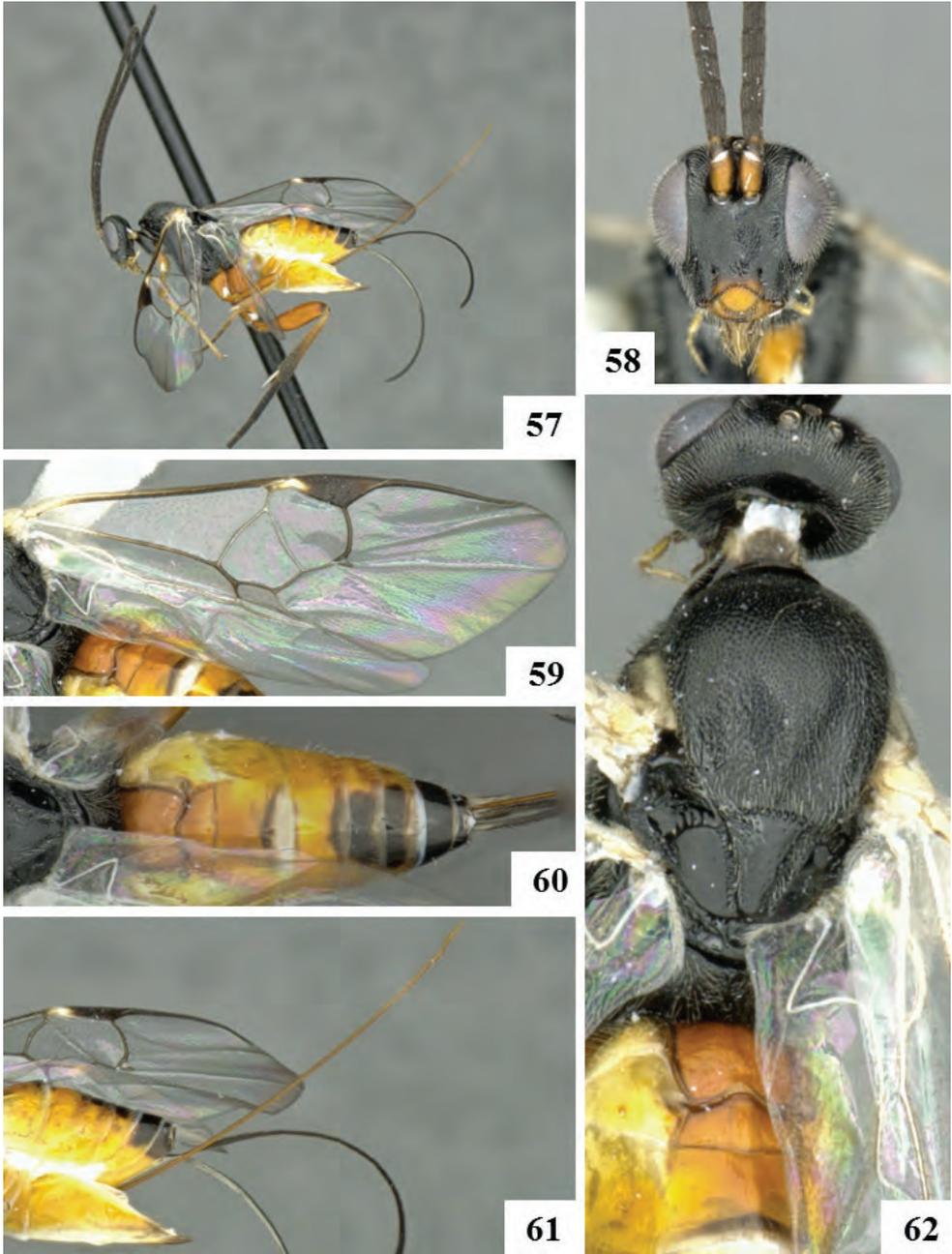
Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector El Hacha, Sendero Bejuquilla, 280m, 11.03004, -85.52699. DNA Voucher code: DHJPAR0012588.

Description. Head: mostly black, clypeus, labrum and mandibles yellow. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: white. Metasoma (dorsally): T1–T4 entirely orange-yellow, T5+ mostly dark brown to black. Metacoxa: orange. Malar distance: more than $0.3 \times$ eye length. Fore wing areolet: present. T1 sculpture: smooth. T2 sculpture: smooth. Ocular–ocellar line: 0.19 mm. Interocellar distance: 0.13 mm. Posterior ocellus diameter: 0.10 mm. Body length: 5.28 mm. Fore wing length: 4.96 mm. Ovipositor length: 4.26 mm. Metacoxa length: 1.18 mm. Metafemur length: 1.29 mm. Metatibia length: 1.71 mm. T1 length/width at posterior margin: 0.48 mm/ 0.56 mm. T2 length/width at posterior margin: 0.26 mm/ 0.58 mm.

Distribution. Known only from the holotype locality in ACG, dry forest, Costa Rica.



Figures 51–56. *Promicrogaster fabiancastroi* sp. n. holotype.



Figures 57–62. *Promicrogaster fabriciocambroneroi* sp. n. holotype.

Etymology. *Promicrogaster fabriciocambroneroi* is named in honor of 11-year-old Félix Fabricio Cambronero Mendoza from the Colonia Bolaños school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

***Promicrogaster hillaryvillafuertee* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/F736CEEE-A2C6-4457-82E3-DAC19BCC6752>

Figs 63–68

Holotype. Female, CNC. COSTA RICA, Alajuela, Area de Conservación Guanacaste, Sector San Cristobal, Rio Blanco Abajo, 500m, 10.90037, -85.37254. DNA Voucher code: DHJPAR0026620.

Description. Head: mostly black, labrum and mandibles yellow. Flagellomeres: flagellomeres 1–4 yellow-brown, flagellomeres 5–16 dark brown. Mesosoma: black. Tegula: black. Metasoma (dorsally): mostly dark brown, with orange-yellow areas on anterior 0.6 of T1 and anterior 0.5 of T3. Metacoxa: orange-yellow. Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: present. T1 sculpture: mostly smooth, with posterior 0.3 sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.11 mm. Interocellar distance: 0.08 mm. Posterior ocellus diameter: 0.06 mm. Body length: 2.47 mm. Fore wing length: 2.52 mm. Ovipositor length: 2.02 mm. Metacoxa length: 0.60 mm. Metafemur length: 0.65 mm. Metatibia length: 0.84 mm. T1 length/width at posterior margin: 0.34 mm/ 0.15 mm. T2 length/width at posterior margin: 0.08 mm/ 0.31 mm.

Distribution. Known only from the holotype locality in ACG, mid-elevation rain forest, Costa Rica.

Etymology. *Promicrogaster hillaryvillafuertee* is named in honor of 11-year-old Hillary Massiel Villafuerte Villegas from the Santa Rosa school for her growing enthusiasm for understanding and protecting the wild nature that occurs in her homeland.

***Promicrogaster kevinmartinezi* Fernandez-Triana & Boudreault, sp. n.**

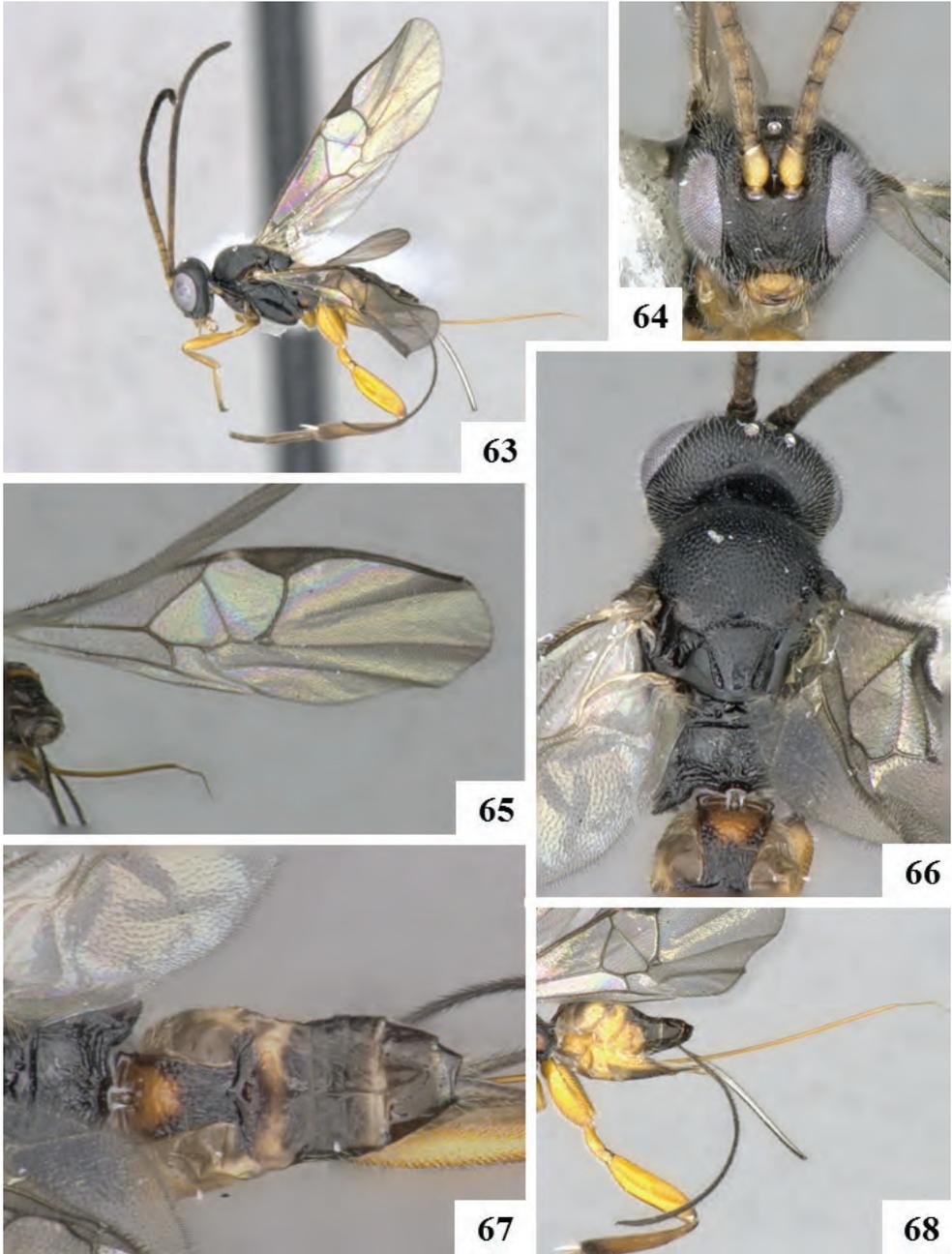
<http://zoobank.org/BA30242A-0A37-40D9-891A-3C4F09FADD9C>

Figs 69–80

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Sendero Arenales, 1080m, 10.92471, -85.46738. DNA Voucher code: DHJPAR0031319.

Paratypes. 1♀, 1♂ (CNC), same locality as holotype. DNA voucher codes: DHJPAR0031274, DHJPAR0031318.

Description. Head: mostly black, clypeus, labrum and mandibles yellow. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: yellow. Metasoma (dorsally): T1–T2 dark brown to black, T3 mostly yellow, with anterior 0.2 light brown, T4–7 brown anteriorly, white on posterior 0.3–0.5. Metacoxa: orange-yellow. Malar distance:



Figures 63–68. *Promicrogaster hillaryvillafuerteae* sp. n. holotype.



Figures 69–74. *Promicrogaster kevinmartinezi* sp. n. holotype.



Figures 75–80. *Promicrogaster kevinmartinezi* sp. n. male paratype.

0.2–0.3 × eye length. Fore wing areolet: present. T1 sculpture: anterior 0.5 smooth, posterior 0.5 sculptured. T2 sculpture: mostly sculptured. Ocular–ocellar line: 0.14–0.15 mm. Interocellar distance: 0.10 mm. Posterior ocellus diameter: 0.07–0.08 mm. Body length: 2.85–3.37 mm. Fore wing length: 3.47–3.67 mm. Ovipositor length: 2.49–3.38 mm. Metacoxa length: 0.81–0.85 mm. Metafemur length: 0.89 mm. Metatibia length: 1.13–1.18 mm. T1 length/width at posterior margin: 0.40–0.56 mm/ 0.21–0.24 mm. T2 length/width at posterior margin: 0.11 mm/ 0.40–0.47 mm.

Distribution. Known only from the holotype locality in ACG, cloud forest, Costa Rica.

Etymology. *Promicrogaster kevinmartinezi* is named in honor of 12-year-old Kevin Olivier Martínez Pérez from the Colonia Bolaños school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

***Promicrogaster kiralycastilloae* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/55057CB5-20C4-4AF8-B401-8306916B4773>

Figs 81–86

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Sendero Arenales, 1080m, 10.92471, -85.46738. DNA Voucher code: DHJPAR0031288.

Description. Head: mostly black, clypeus, labrum and mandibles yellow. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: dark brown. Metasoma (dorsally): mostly dark brown, with T3+ white on posterior 0.2–0.5. Metacoxa: dark brown on anterior 0.7, yellow-white on posterior 0.3. Malar distance: 0.2–0.3 × eye length. Fore wing areolet: present. T1 sculpture: anterior 0.5 smooth, posterior 0.5 sculptured. T2 sculpture: mostly sculptured. Ocular–ocellar line: 0.13 mm. Interocellar distance: 0.13 mm. Posterior ocellus diameter: 0.08 mm. Body length: 3.51 mm. Fore wing length: 3.80 mm. Ovipositor length: 2.95 mm. Metacoxa length: 0.82 mm. Metafemur length: 0.89 mm. Metatibia length: 1.10 mm. T1 length/width at posterior margin: 0.37 mm/ 0.22 mm. T2 length/width at posterior margin: 0.10 mm/ 0.47 mm.

Distribution. Known only from the holotype locality in ACG, cloud forest, Costa Rica.

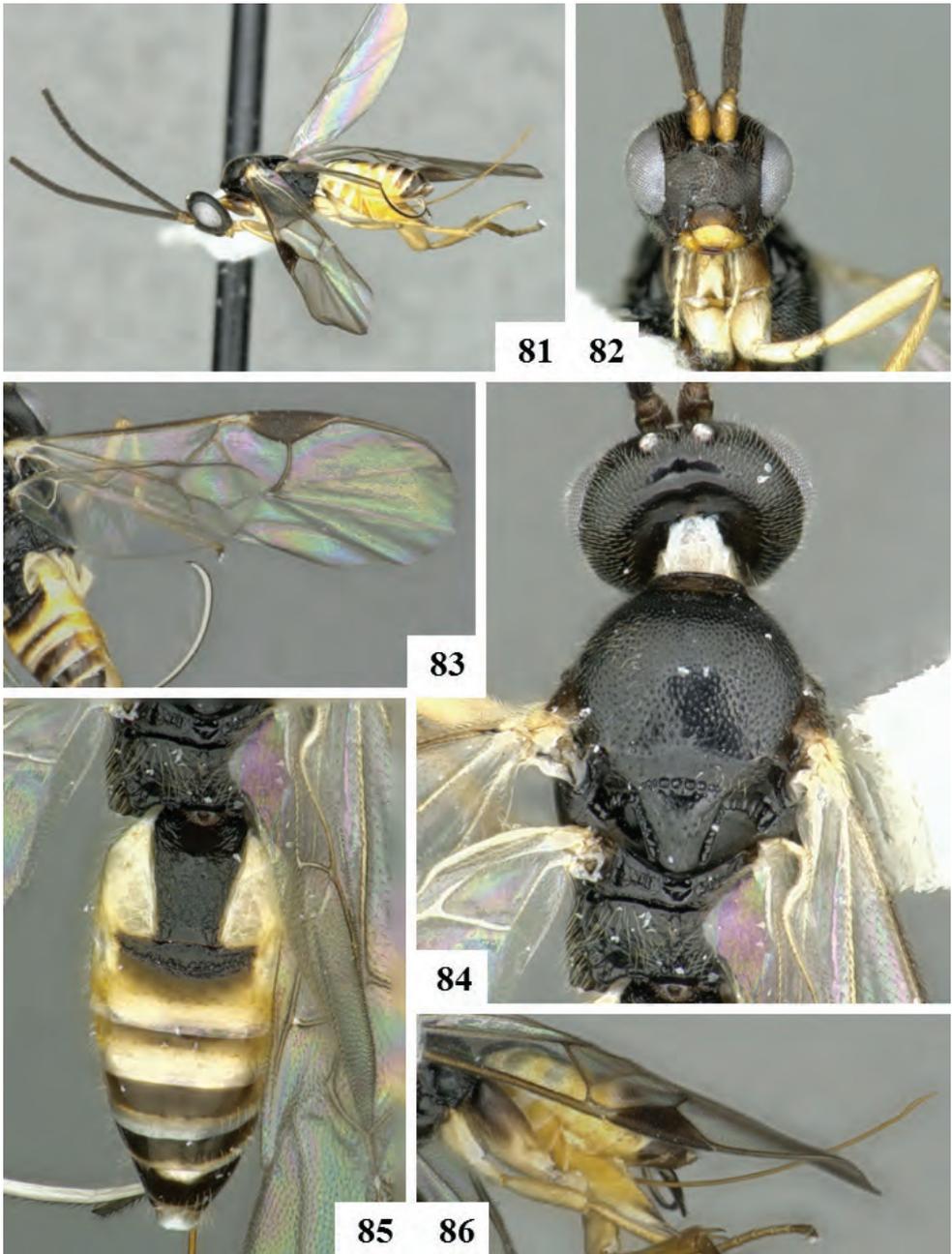
Etymology. *Promicrogaster kiralycastilloae* is named in honor of 12-year-old Kiraly Castillo García from the Colonia Bolaños school for her growing enthusiasm for understanding and protecting the wild nature that occurs in her homeland.

***Promicrogaster leilycastilloae* Fernandez-Triana & Boudreault, sp. n.**

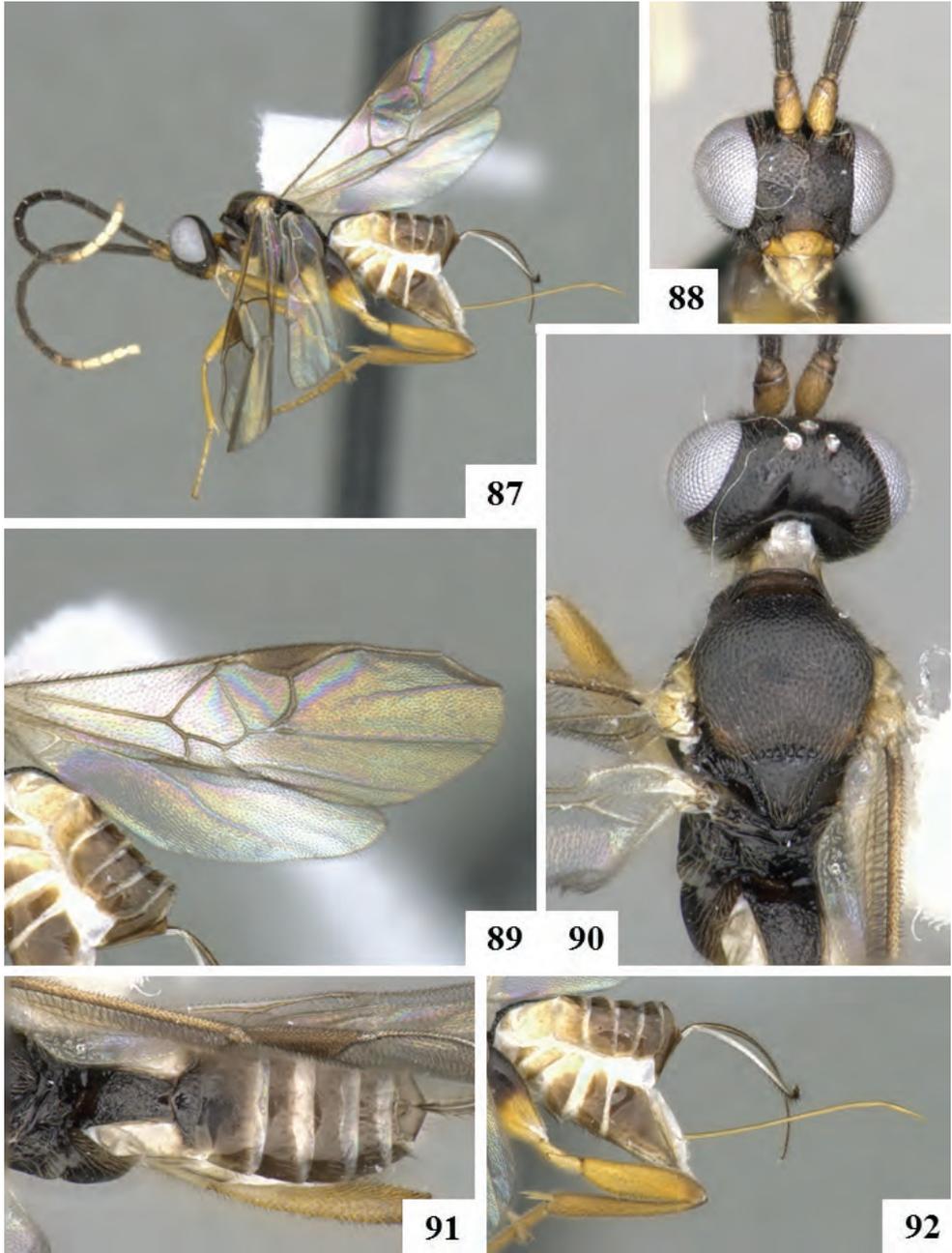
<http://zoobank.org/20043702-F698-4670-BB16-69EDC7DE4CEE>

Figs 87–92

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Cerro Pedregal, 1080m, 10.92767, -85.47449. DNA Voucher code: DHJPAR0031431.



Figures 81–86. *Promicrogaster kiralycastilloae* sp. n. holotype.



Figures 87–92. *Promicrogaster leilycastilloae* sp. n. holotype.

Description. Head: mostly black, labrum and mandibles yellow. Flagellomeres: first 10 flagellomeres dark brown to black, flagellomeres 11–16 yellow-white. Mesosoma: black. Tegula: white. Metasoma (dorsally): dark brown to black. Metacoxa: dark brown on anterior 0.5, yellow on posterior 0.5. Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: present. T1 sculpture: mostly sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.10 mm. Interocellar distance: 0.06 mm. Posterior ocellus diameter: 0.06 mm. Body length: 2.16 mm. Fore wing length: 2.02 mm. Ovipositor length: 1.30 mm. Metacoxa length: 0.65 mm. Metafemur length: 0.77 mm. Metatibia length: 0.97 mm. T1 length/width at posterior margin: 0.32 mm/ 0.15 mm. T2 length/width at posterior margin: 0.10 mm/ 0.26 mm.

Distribution. Known only from the holotype locality in ACG, cloud forest, Costa Rica.

Etymology. *Promicrogaster leilycastilloae* is named in honor of 12-year-old Leily María Castillo Mora from the Colonia Bolaños school for her growing enthusiasm for understanding and protecting the wild nature that occurs in her homeland.

***Promicrogaster liagranta* Fernandez-Triana & Boudreault, sp. n.**
<http://zoobank.org/3CD68CCD-A608-4B7F-9F04-0EE3D44FEBA8>
 Figs 93–99

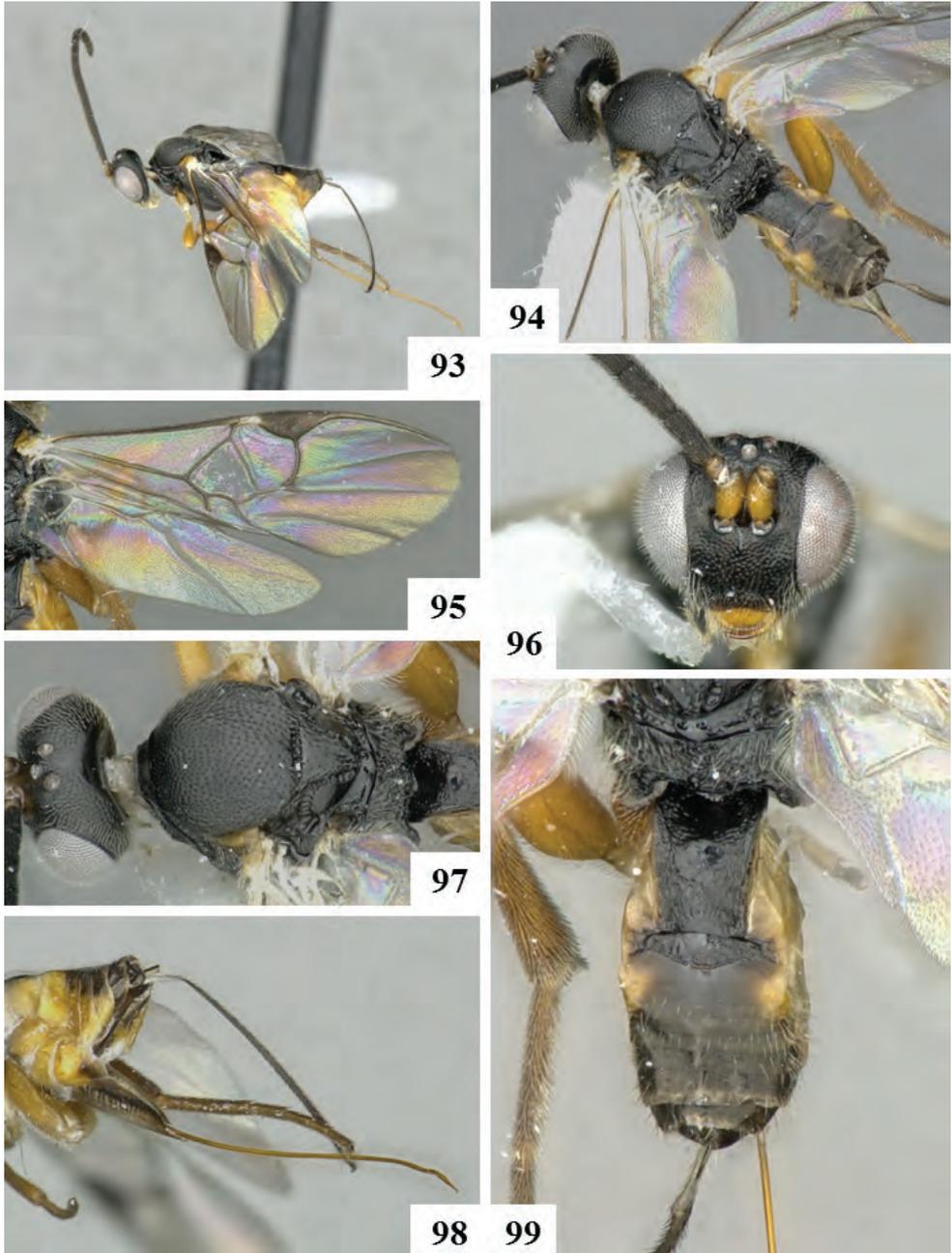
Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Santa Rosa, Bosque San Emilio, 300m, 10.84389, -85.61384. DNA Voucher code: DHJPAR0013138.

Paratypes. 2♀ (CNC), Costa Rica, ACG, Sector El Hacha, Sendero Bejuquilla, 280m, 11.0.004, -85.52699. DNA Voucher codes: DHJPAR0012586, DHJPAR0012587.

Description. Head: mostly black, labrum and mandibles yellow. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: yellow. Metasoma (dorsally): mostly dark brown to black, T3 with yellow spots laterally. Metacoxa: yellow. Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: present. T1 sculpture: anterior 0.5 smooth, posterior 0.5 sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.11–0.14 mm. Interocellar distance: 0.08–0.10 mm. Posterior ocellus diameter: 0.06–0.07 mm. Body length: 2.95–3.28 mm. Fore wing length: 3.11–3.15 mm. Ovipositor length: 2.66–2.70 mm. Metacoxa length: 0.73–0.76 mm. Metafemur length: 0.77–0.82 mm. Metatibia length: 0.97–1.03 mm. T1 length/width at posterior margin: 0.48–0.52 mm/ 0.24–0.27 mm. T2 length/width at posterior margin: 0.10–0.11 mm/ 0.40–0.45 mm.

Distribution. Costa Rica (ACG, dry forest).

Etymology. *Promicrogaster liagranta* is named in honor of 12-year-old Lia Thamará Grant Chacón from the Huacas school for her growing enthusiasm for understanding and protecting the wild nature that occurs in her homeland.



Figures 93–99. *Promicrogaster liagranta* sp. n. holotype.

***Promicrogaster luismendezi* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/FA0AFC58-103C-433B-95A8-388A9667B0D6>

Figs 100–105

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Sendero Circular, 1185m, 10.92714, -85.46683. DNA Voucher code: DHJPAR0031207.

Description. Head: mostly black, labrum and mandibles light brown. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: brown. Metasoma (dorsally): black to dark brown. Metacoxa: mostly black to dark brown (posterior 0.1–0.2 yellow). Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: absent. T1 sculpture: mostly sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.08 mm. Interocellar distance: 0.09 mm. Posterior ocellus diameter: 0.05 mm. Body length: 2.33 mm. Fore wing length: 2.37 mm. Ovipositor length: 1.67 mm. Metacoxa length: 0.50 mm. Metafemur length: 0.58 mm. Metatibia length: 0.76 mm. T1 length/width at posterior margin: 0.23 mm/ 0.13 mm. T2 length/width at posterior margin: 0.10 mm/ 0.32 mm.

Distribution. Known only from the holotype locality in ACG, cloud forest, Costa Rica.

Etymology. *Promicrogaster luismendezi* is named in honor of 12-year-old Luis Eduardo Méndez from the Santa Rosa school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

***Promicrogaster miranda* Muesebeck, 1958**

Figs 106–110

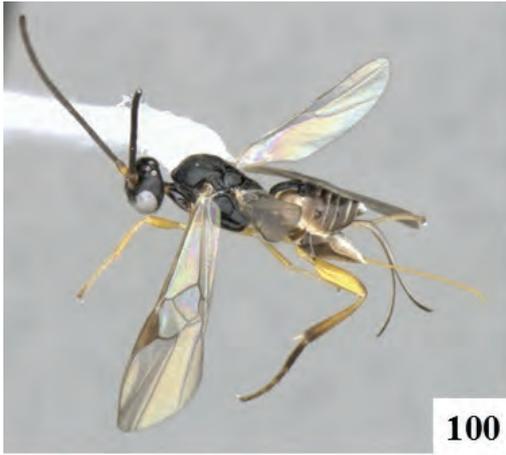
Promicrogaster miranda Muesebeck, 1958: 421. Original description.

Holotype. Female, NMNH (not examined). PANAMA, Barro Colorado Island, Canal Zone. Voucher code: USNM 63052.

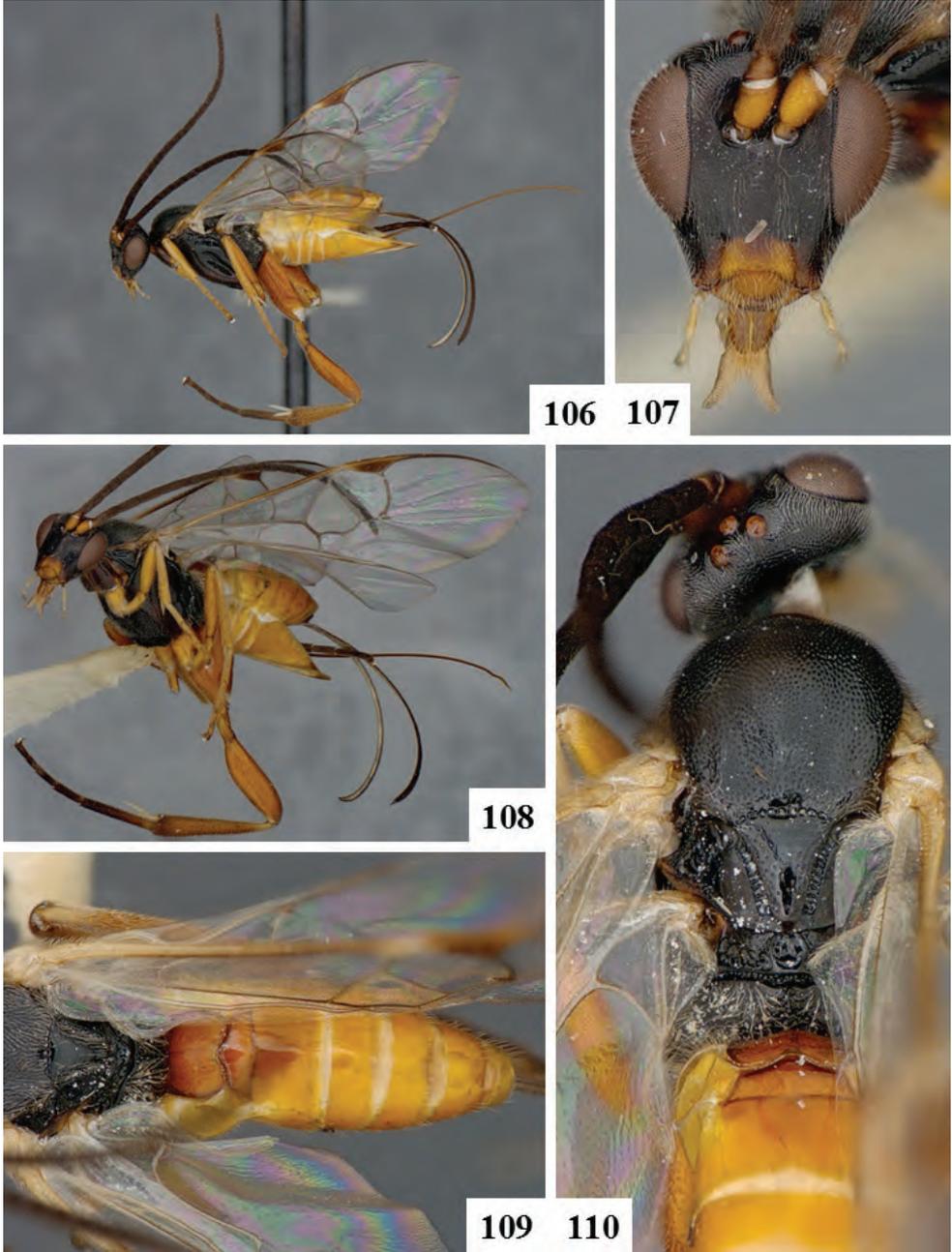
Material examined. 1♀ (CNC), TRINIDAD, Curepe, viii.1978, Malaise Trap; 1♀ (CNC), TRINIDAD, St. Augustine, x.1946, collected on *Cordia* (Boraginaceae).

Distribution. Panama, Trinidad.

Comments. Previously known only from the holotype, we consider here two specimens from Trinidad (in the CNC collection) to be conspecific based on morphological similarities with the original description -thus expanding the known distribution of the species. However, future study of the holotype will be needed to corroborate our present decision. The photos provided in this paper were taken from one of the Trinidad specimens.



Figures 100–105. *Promicrogaster luismendezi* sp. n. holotype.



Figures 106–110. *Promicrogaster miranda*.

***Promicrogaster monteverdensis* Fernández-Triana & Boudreault, sp. n.**

<http://zoobank.org/8FDEF466-0376-424A-8D82-C295D7C43D77>

Figs 111–116

Holotype. Female, CNC. COSTA RICA, Puntarenas, Monteverde. Holotype labels: COSTA RICA, Puntarenas, Monteverde, v.1990, D. Goulet, FIT [Flight Interception Trap], cloud forest. Voucher code: CNC 483494

Paratype. 1♀ (CNC), Costa Rica, Alajuela, ACG, Sector San Cristobal, Bosque Trampa Malaise, 815m, 10.86280, -85.38460. DNA voucher code: DHJPAR0025917.

Description. Head: mostly black, labrum and mandibles yellow to light brown. Flagellomeres: dark brown. Mesosoma: black. Tegula: dark brown to black. Metasoma (dorsally): black to dark brown. Metacoxa: orange-yellow. Malar distance: less than 0.2 × eye length. Fore wing areolet: present. T1 sculpture: mostly sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.10–0.11 mm. Interocellar distance: 0.08–0.10 mm. Posterior ocellus diameter: 0.06 mm. Body length: 3.18–3.19 mm. Fore wing length: 2.95–3.34 mm. Ovipositor length: 2.60–2.96 mm. Metacoxa length: 0.60–0.70 mm. Metafemur length: 0.73–0.82 mm. Metatibia length: 0.92–1.05 mm. T1 length/width at posterior margin: 0.27–0.35 mm/ 0.18–0.24 mm. T2 length/width at posterior margin: 0.09–1.00 mm/ 0.39–0.45 mm.

Distribution. Costa Rica, mid-elevation rain forest in Monteverde and ACG.

Etymology. Named after the type locality, Monteverde.

***Promicrogaster munda* Muesebeck, 1958**

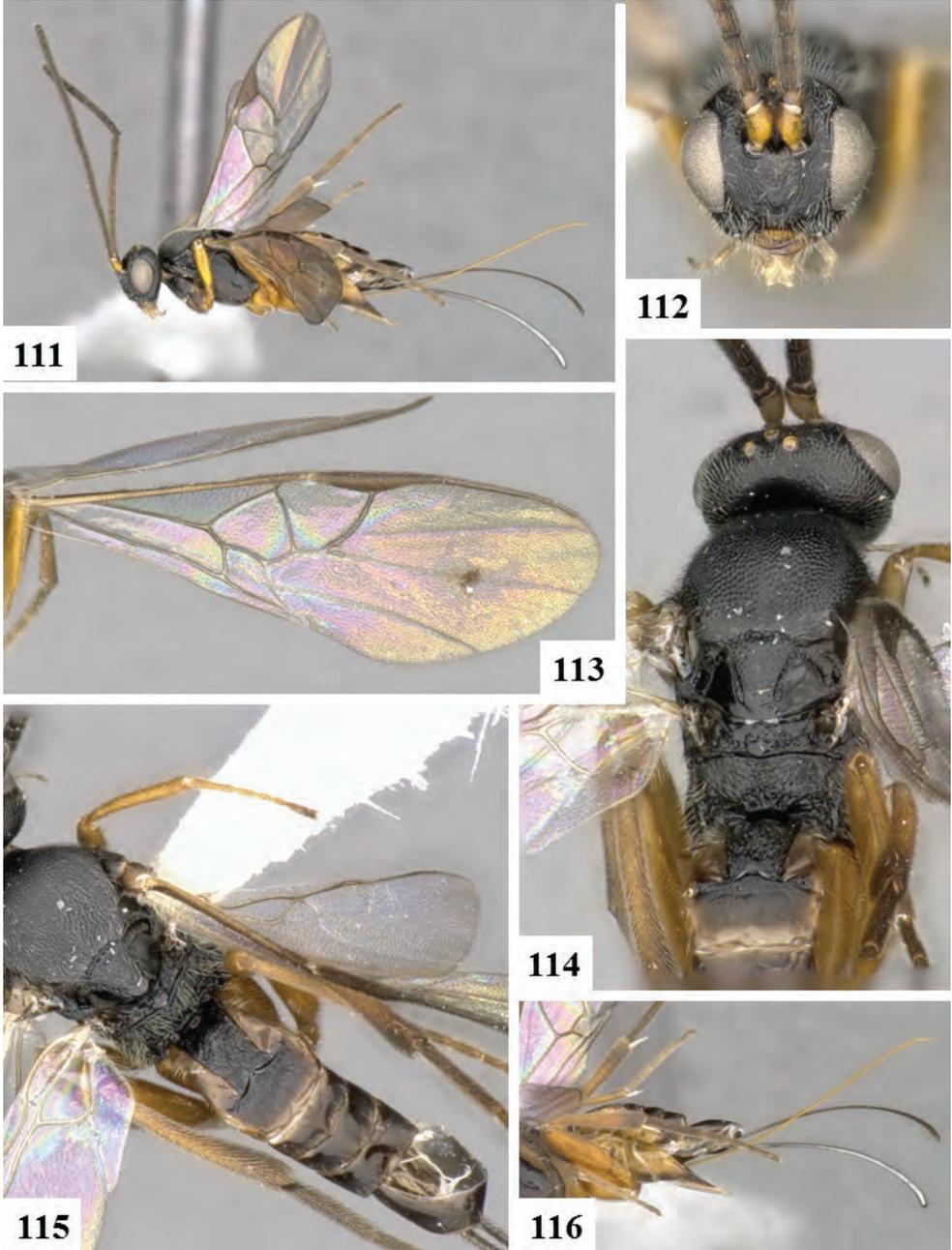
Figs 117–122

Promicrogaster munda Muesebeck, 1958: 422. Original description.

Holotype. Female, NMNH (not examined). HONDURAS, Tegucigalpa. Voucher code: USNM 63052.

Material Examined. 2♀ (CNC), COSTA RICA, Puntarenas, San Vito, Las Cruces Biological Station, ~1,200m, 8.7853, -82.9589, voucher code: CNCH3316; 5.vii.1983, B. Gill (coll.); 2♀ (CNC), PANAMA, Chiriquí Province, 15km NW of Hato del Volcán, 1200m, 24–31.v.1977, Peck & Howden (colls.).

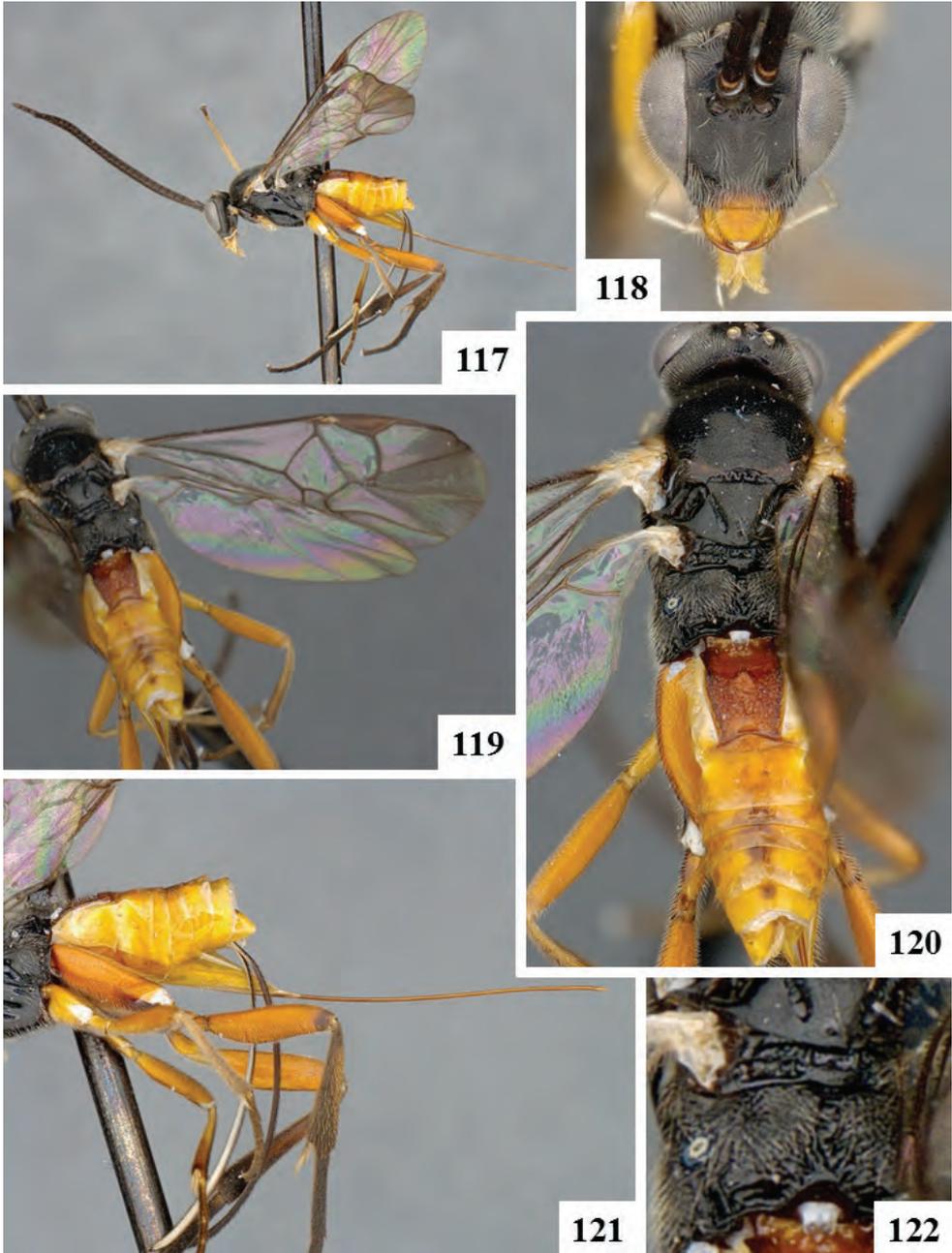
Description. Head: mostly black, clypeus, labrum and mandibles yellow. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: yellow. Metasoma (dorsally): T1 orange-yellow, T2+ yellow (some specimens with small brown spot centrally on T4+). Metacoxa: orange-yellow. Malar distance: 0.2–0.3 × eye length. Fore wing areolet: present. T1 sculpture: mostly smooth, with posterior 0.3 sculptured. T2 sculpture: smooth. Ocular–ocellar line: 0.15–0.18 mm. Interocellar distance: 0.11–0.14 mm. Posterior ocellus diameter: 0.10–0.11 mm. Body length: 4.33–5.12 mm. Fore wing length: 4.00–4.95 mm. Ovipositor length: 3.44–4.58 mm. Metacoxa length: 1.08–1.41 mm. Metafemur length: 1.14–1.51 mm. Metatibia length: 1.43–



Figures 111–116. *Promicrogaster monteverdensis* sp. n. holotype.

1.89 mm. T1 length/width at posterior margin: 0.45–0.74 mm/ 0.29–0.40 mm. T2 length/width at posterior margin: 0.10–0.15 mm/ 0.39–0.60 mm.

Distribution. Costa Rica, Honduras, Mexico, Panama.



Figures 117–122. *Promicrogaster munda*.

Comments. The description and photos provided above are based on the CNC specimens studied, not the holotype—which was not examined. However, we suspect that *P. munda* is actually a complex of at least 2 morphologically similar species. We found variable coloration of the metatibia (entirely black vs mostly orange-yellow) and

fore wing (hyaline vs infumated) among the specimens seen, as well as significant differences in size (with specimens from Panama being smaller than those of Costa Rica, with body and fore wing lengths 0.6–0.8 mm shorter) and relative length of T1. Until more material becomes available for study we prefer to keep all specimens as *P. munda*.

***Promicrogaster naomiduarteae* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/6C89EDBD-6AAC-4798-AF9E-745D9DA66EC1>

Figs 123–128

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Cerro Pedregal, 1080m, 10.92767, -85.47449. DNA Voucher code: DHJPAR0031409.

Paratype. 1♀ (CNC), same locality as holotype. DNA voucher code: DHJPAR0031404.

Description. Head: mostly black, labrum and mandibles light brown. Flagellomeres: dark brown. Mesosoma: black. Tegula: brown. Metasoma (dorsally): black to dark brown. Metacoxa: mostly black to dark brown (posterior 0.1–0.2 yellow). Malar distance: less than 0.2 × eye length. Fore wing areolet: absent. T1 sculpture: anterior 0.5 sculptured, posterior 0.5 sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.11–0.14 mm. Interocellar distance: 0.07–0.09 mm. Posterior ocellus diameter: 0.06 mm. Body length: 2.33–2.39 mm. Fore wing length: 2.31–2.47 mm. Ovipositor length: 1.41–1.92 mm. Metacoxa length: 0.47–0.53 mm. Metafemur length: 0.52–0.61 mm. Metatibia length: 0.66–0.79 mm. T1 length/width at posterior margin: 0.24–0.30 mm/ 0.16–0.18 mm. T2 length/width at posterior margin: 0.08–0.10 mm/ 0.32–0.34 mm.

Distribution. Known only from the holotype locality in ACG, cloud forest, Costa Rica.

Etymology. *Promicrogaster naomiduarteae* is named in honor of 11-year-old Naomi Duarte Cerdas from the Huacas school for her growing enthusiasm for understanding and protecting the wild nature that occurs in her homeland.

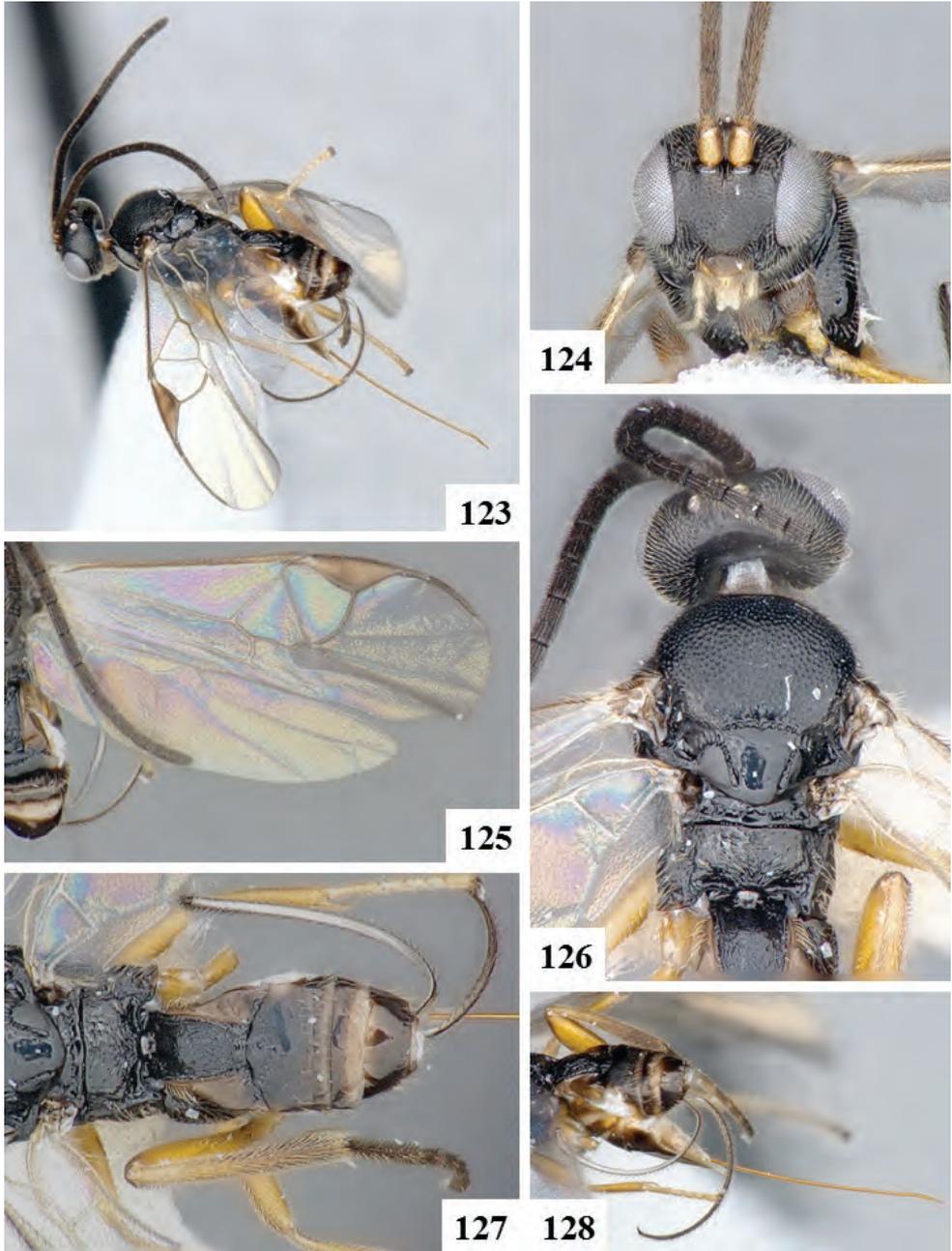
***Promicrogaster pablouzagai* Fernandez-Triana & Boudreault, sp. n.**

<http://zoobank.org/1B87199D-93D4-448B-B0EB-E2AC9490B64A>

Figs 129–134

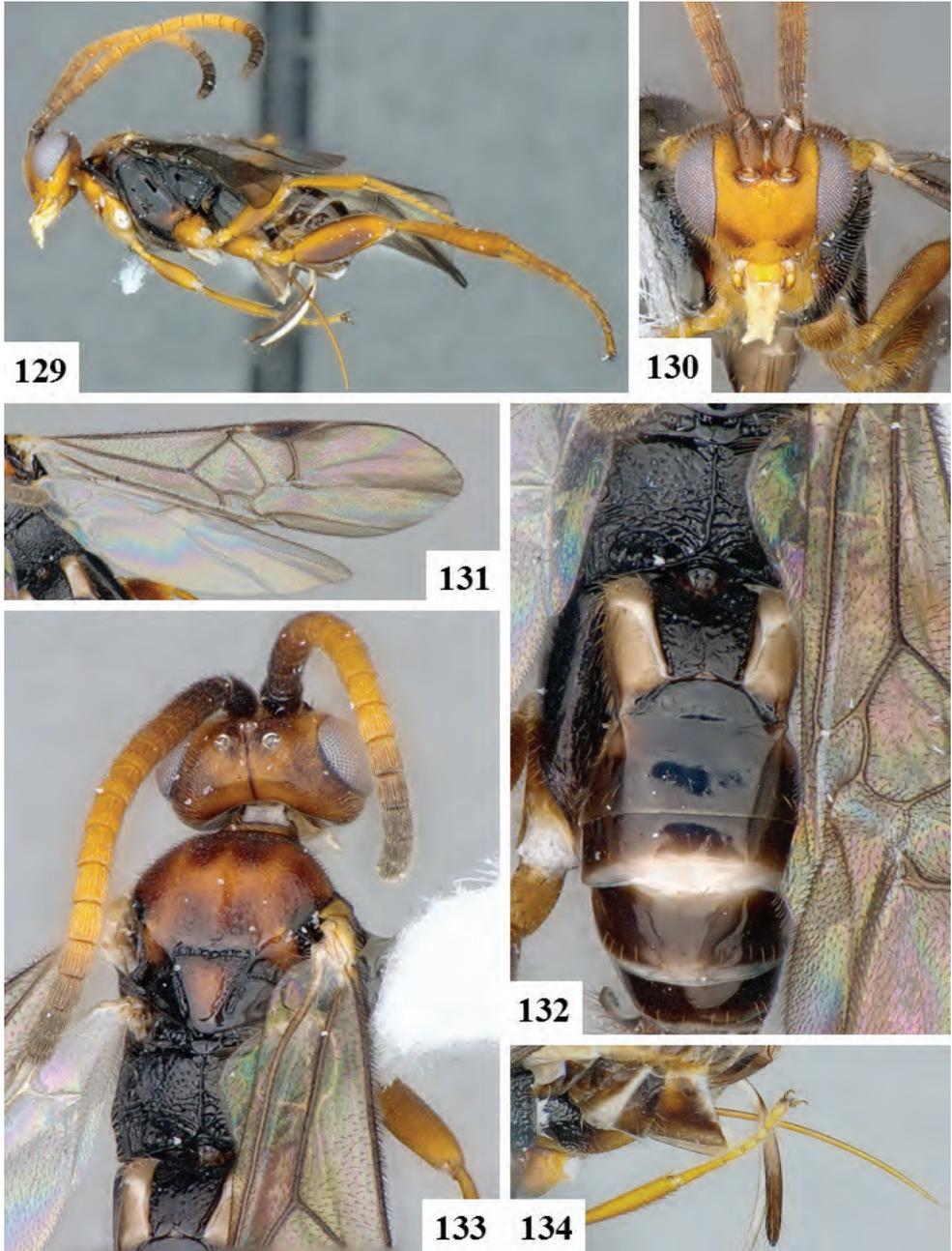
Holotype. Female, CNC. COSTA RICA, Alajuela, Area de Conservación Guanacaste, Sector San Cristobal, Bosque Trampa Malaise, 815m, 10.86280, -85.38460. DNA Voucher code: DHJPAR0025926.

Paratypes. 6♂ (CNC, NMNH), same locality as holotype; 1♂ (CNC), from Costa Rica, Guanacaste, ACG, Sector Cacao, Cerro Pedregal, 1080m, 10.92767, -85.47449. DNA Voucher codes: DHJPAR0025962, DHJPAR0025964, DHJPAR0025993, DHJPAR0026085, DHJPAR0026089, DHJPAR0027659, DHJPAR0031406.



Figures 123–128. *Promicrogaster naomiduarteae* sp. n. holotype.

Description. Head: orange-yellow. Flagellomeres: flagellomeres 1–2 light brown, flagellomeres 3–11 orange-yellow, flagellomeres 12–16 dark brown. Mesosoma: mostly black, with anteromesoscutum, scutellar disc and part of the axillar complex orange-brown.



Figures 129–134. *Promicrogaster pablouzagai* sp. n. holotype.

Tegula: yellow. Metasoma (dorsally): dark brown to black. Metacoxa: orange dorsally, brown ventrally. Malar distance: $0.2\text{--}0.3 \times$ eye length. Fore wing areolet: present. T1 sculpture: smooth. T2 sculpture: smooth. Ocular–ocellar line: 0.11 mm. Intercellar dis-

tance: 0.10–0.11 mm. Posterior ocellus diameter: 0.06–0.07 mm. Body length: 2.65 mm. Fore wing length: 2.99 mm. Ovipositor length: 1.28 mm. Metacoxa length: 0.77 mm. Metafemur length: 0.90 mm. Metatibia length: 1.06 mm. T1 length/width at posterior margin: 0.48 mm/ 0.21 mm. T2 length/width at posterior margin: 0.11 mm/ 0.40 mm.

Distribution. Costa Rica (ACG, mid-elevation rain forest and cloud forest).

Etymology. *Promicrogaster pablouzagai* is named in honor of 14-year-old Juan Pablo Uzaga López from the Colonia Bolaños school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

Comments. Based in body color, propodeum sculpture, and shape of areolet in fore wing, this is the most distinctive *Promicrogaster* among all species studied.

Promicrogaster polyporicola Muesebeck, 1958

Figs 135–140

Promicrogaster polyporicola Muesebeck, 1958: 423. Original description.

Holotype. Female, NMNH (not examined). PANAMA, Barro Colorado Island, Canal Zone. Voucher code: USNM 63053.

Material examined. 1♀, paratype (CNC), same locality than holotype; 1♂ (CNC), PANAMA, Panama, Cerro Campana, 850m, 8°40'N, 19°50'W; 1♂ (CNC), PANAMA, Panama, no further locality information.

Distribution. Panama.

Promicrogaster ronycastilloi Fernandez-Triana & Boudreault, sp. n.

<http://zoobank.org/D7B8BB92-E509-405E-B6FF-F0401634F6E9>

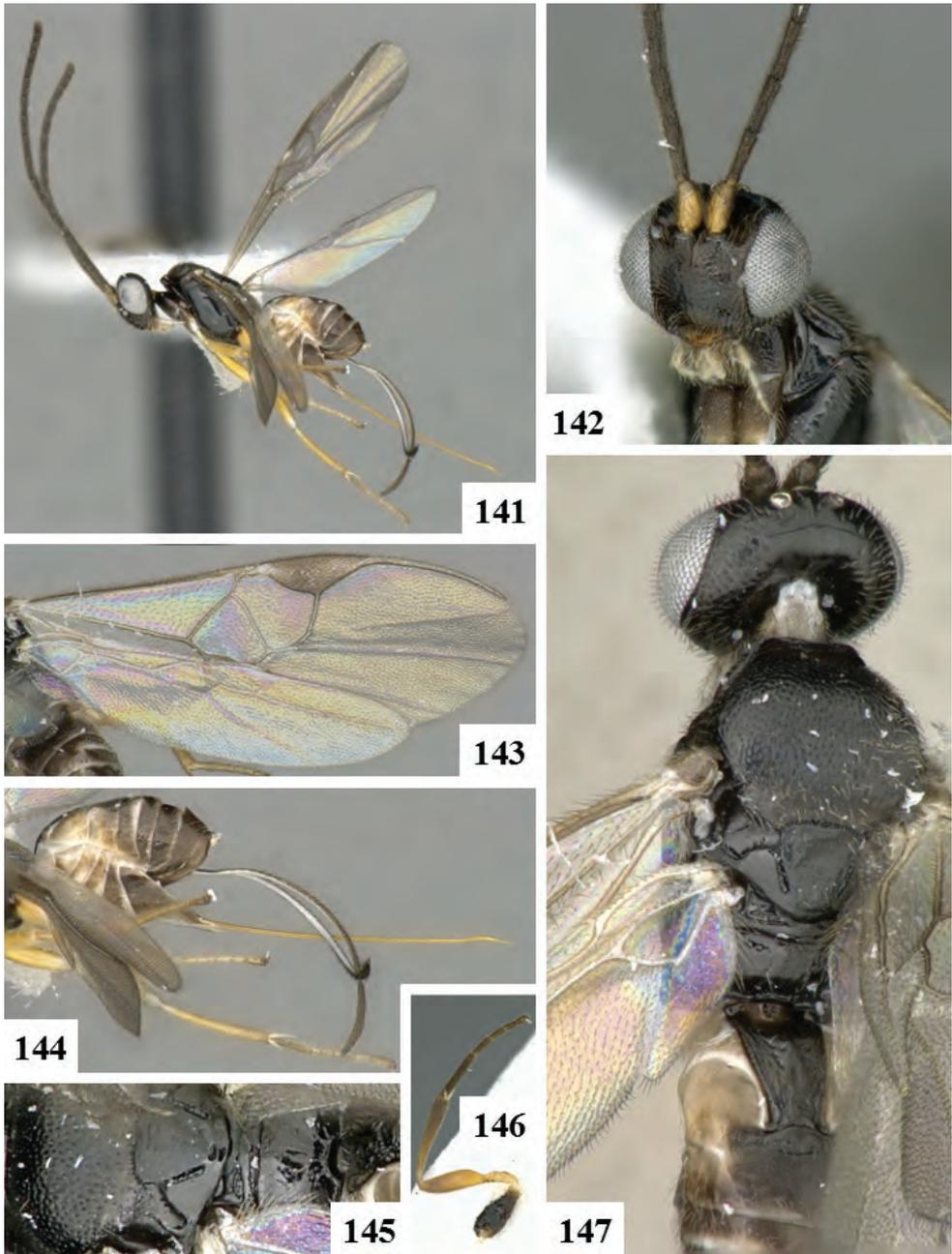
Figs 141–147

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Sendero Arenales, 1080m, 10.92471, -85.46738. DNA Voucher code: DHJPAR0031345.

Description. Head: mostly black, labrum and mandibles light brown. Flagellomeres: dark brown to black. Mesosoma: black. Tegula: dark brown. Metasoma (dorsally): black to dark brown. Metacoxa: mostly black to dark brown (posterior 0.1–0.2 yellow). Malar distance: less than $0.2 \times$ eye length. Fore wing areolet: absent. T1 sculpture: mostly smooth, with some sculpture laterally. T2 sculpture: mostly smooth with some sculptured near posterior margin. Ocular–ocellar line: 0.07 mm. Interocellar distance: 0.08 mm. Posterior ocellus diameter: 0.06 mm. Body length: 1.94 mm. Fore wing length: 2.21 mm. Ovipositor length: 1.56 mm. Metacoxa length: 0.47 mm. Metafemur length: 0.48 mm. Metatibia length: 0.68 mm. T1 length/width at posterior margin: 0.23mm/ 0.15 mm. T2 length/width at posterior margin: 0.06 mm/ 0.21 mm.



Figures 135–140. *Promicrogaster polyporicola*.



Figures 141–147. *Promicrogaster ronycastilloi* sp. n. holotype.

Distribution. Known only from the holotype locality in ACG, cloud forest, Costa Rica.

Etymology. *Promicrogaster ronycastilloi* is named in honor of 10-year-old Rony Castillo Martínez from the Colonia Bolaños school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

***Promicrogaster sebastiancambroneroi* Fernandez-Triana & Boudreault, sp. n.**<http://zoobank.org/1EEA621A-D68F-495B-98B9-809993983FEE>

Figs 148–153

Holotype. Female, CNC. COSTA RICA, Guanacaste, Area de Conservación Guanacaste, Sector Cacao, Cerro Pedregal, 1080m, 10.92767, -85.47449. DNA Voucher code: DHJPAR0033736.

Description. Head: mostly black, labrum and mandibles orange-brown. Flagellomeres: dark brown. Mesosoma: black. Tegula: dark brown. Metasoma (dorsally): black to dark brown. Metacoxa: mostly black to dark brown (posterior 0.1–0.2 yellow). Malar distance: 0.2–0.3 × eye length. Fore wing areolet: absent. T1 sculpture: anterior 0.5 smooth, posterior 0.5 sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.10 mm. Interocellar distance: 0.08 mm. Posterior ocellus diameter: 0.05 mm. Body length: 2.43 mm. Fore wing length: 2.37 mm. Ovipositor length: 1.73 mm. Metacoxa length: 0.50 mm. Metafemur length: 0.56 mm. Metatibia length: 0.69 mm. T1 length/width at posterior margin: 0.22 mm/ 0.16 mm. T2 length/width at posterior margin: 0.08 mm/ 0.27 mm.

Distribution. Known only from the holotype locality in ACG, cloud forest, Costa Rica.

Etymology. *Promicrogaster sebastiancambroneroi* is named in honor of 12-year-old Erick Sebastián Cambronero Narváez from the Colonia Bolaños school for his growing enthusiasm for understanding and protecting the wild nature that occurs in his homeland.

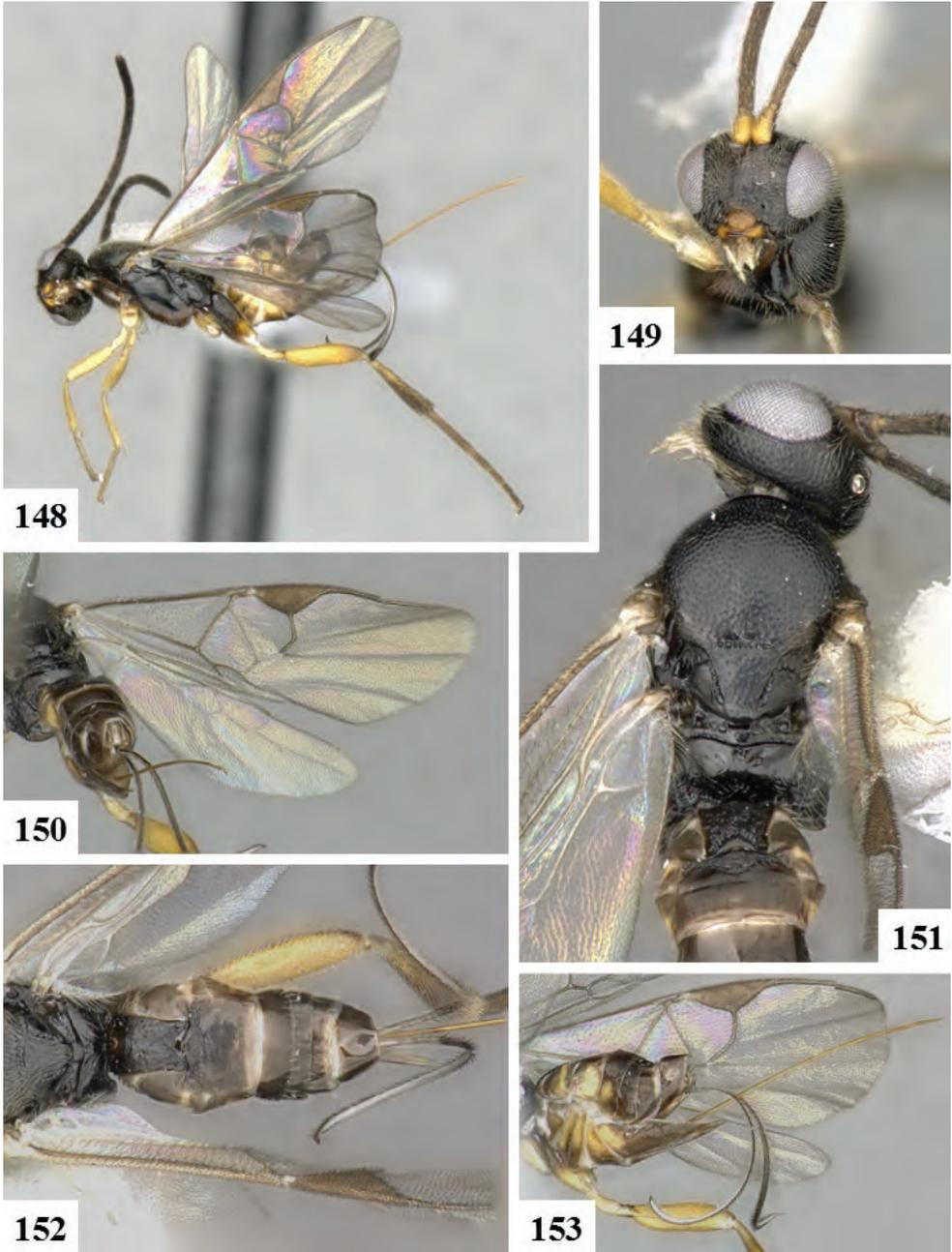
***Promicrogaster tracyvindasae* Fernandez-Triana & Boudreault, sp. n.**<http://zoobank.org/60402B64-D1CF-4E15-9718-16B4466D5930>

Figs 154–159

Holotype. Female, CNC. COSTA RICA, Alajuela, Area de Conservación Guanacaste, Sector Rincón Rain Forest, Vado Rio Francia, 400m, 10.90093, -85.28915. DNA Voucher code: DHJPAR0025529.

Paratypes. 1♀, 1♂ (CNC), Costa Rica, Alajuela, ACG, Sector San Cristobal, Potrero Argentina, 520m, 10.89021, -85.38803; 1♀ (CNC), Costa Rica, Braulio Carrillo National Park, 500m, 10.10, -84.07; 1♀ (CNC), Costa Rica, San Vito, Las Cruces. DNA voucher codes: CNCHYM 01515, DHJPAR0025572, DHJPAR0025660.

Description. Head: mostly black, labrum and mandibles yellow to orange-brown. Flagellomeres: dark brown to black. Mesosoma color: black. Tegula: yellow. Metasoma (dorsally): black to dark brown. Metacoxa: orange-yellow. Malar distance: less than 0.2 × eye length. Fore wing areolet: present. T1 sculpture: anterior 0.5. Smooth, posterior 0.5 sculptured. T2 sculpture: mostly sculptured, except for smooth central area. Ocular–ocellar line: 0.13–0.14 mm. Interocellar distance: 0.08–0.10 mm. Posterior ocellus diameter: 0.08 mm. Body length: 3.61–3.93 mm. Fore wing length: 3.57–4.08 mm. Ovipositor length: 2.50–2.96 mm. Metacoxa length: 0.82–0.90 mm. Metafemur length: 0.89–1.03 mm.



Figures 148–153. *Promicrogaster sebastiancambroneroi* sp. n. holotype.

Metatibia length: 1.04–1.29 mm. T1 length/width at posterior margin: 0.50–0.55 mm/ 0.30–0.32 mm. T2 length/width at posterior margin: 0.10–0.14 mm/ 0.45–0.58 mm.

Distribution. Costa Rica, mid-elevation rain forest.



Figures 154–159. *Promicrogaster tracyvindasae* sp. n. holotype.

Etymology. *Promicrogaster tracyvindasae* is named in honor of 11-year-old Tracy Johana Vindas Espinoza from the Huacas school for her growing enthusiasm for understanding and protecting the wild nature that occurs in her homeland.

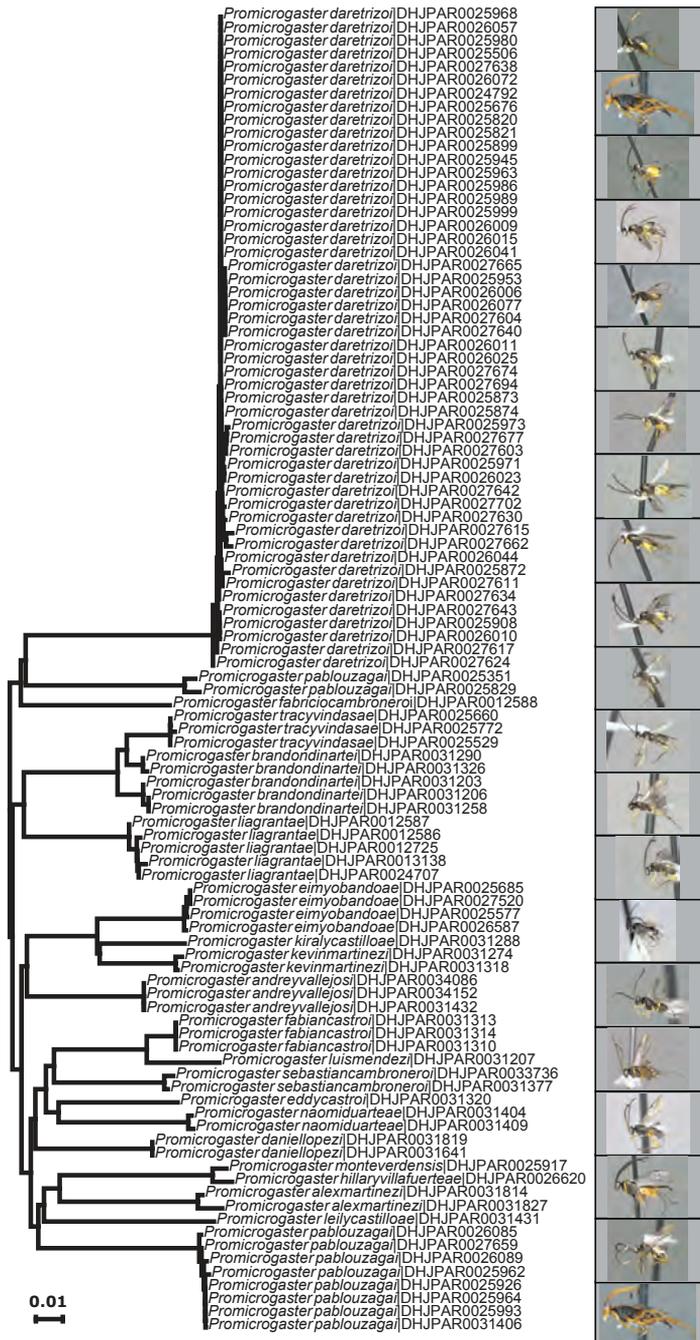


Figure 160. Neighbor-Joining (NJ – Saitou and Nei 1987) tree based on Kimura 2-parameter distances (K2P – Kimura 1980) made using MEGA6 (Tamura et al. 2013) for all currently barcode specimens of *Promicrogaster* in ACG. Tip labels include species name and specimen accession number. Panel on the right contains a single lateral image of each species. The order of the photographs within this panel from top to bottom corresponds to the order of the species within the tree from top to bottom.

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References

- Brues CT, Richardson CH (1913) Descriptions of new parasitic Hymenoptera from British Guiana. *Bulletin of the American Museum of Natural History* 32: 485–503.
- Cohen M (1936) The biology of the *Chrysanthemum* leaf-miner, *Phytomyza atricornis* MG. (Diptera: Agromyzidae). *Annals of Applied Biology* 23: 612–632. doi: 10.1111/j.1744-7348.1936.tb06114.x
- Davis DR (1996) Neotropical Tineidae, VI: *Prosetomorpha falcata*, a new genus and species of Setomorphinae (Lepidoptera: Tineoidea) from Colombia associated with curculionid galleries in stems of *Solanum*. *Proceedings of the Entomological Society of Washington* 98(2): 173–187.
- Fernandez-Triana J, Cardinal S, Whitfield J, Smith M, Janzen D (2013) A review of the New World species of the parasitoid wasp *Iconella* (Hymenoptera, Braconidae, Microgastrinae). *ZooKeys* 321: 65–87. doi: 10.3897/zookeys.321.5160
- Fernández-Triana J, Whitfield JB, Rodríguez JJ, Smith MA, Janzen DH, Hallwachs W, Hajibabaei M, Burns JM, Solis MA, Brown J, Cardinal S, Goulet H, Hebert PDN (2014a) Review of *Apanteles* (Hymenoptera: Braconidae, Microgastrinae) from Area de Conservación Guanacaste, northwestern Costa Rica, with keys to all described species from Mesoamerica. *ZooKeys* 383: 1–565. doi: 10.3897/zookeys.383.6418
- Fernandez-Triana J, Janzen D, Hallwachs W, Whitfield J, Smith M, Kula R (2014b) Revision of the genus *Pseudapanteles* (Hymenoptera, Braconidae, Microgastrinae), with emphasis on the species in Area de Conservación Guanacaste, northwestern Costa Rica. *ZooKeys* 446: 1–82. doi: 10.3897/zookeys.446.8195
- Fernandez-Triana J, Whitfield J, Smith M, Hallwachs W, Janzen D (2014c) First record of the genus *Venanus* (Hymenoptera: Braconidae: Microgastrinae) in Mesoamerica, with the description of two new species from Costa Rica. *Biodiversity Data Journal* 2: e4167. doi: 10.3897/BDJ.2.e4167

- Fernandez-Triana JL, Whitfield JB, Smith MA, Hallwachs W, Janzen DH (2014d) Revision of the neotropical genus *Sendaphne* Nixon (Hymenoptera, Braconidae, Microgastrinae). *Journal of Hymenoptera Research* 41: 1–29. doi: 10.3897/JHR.41.8586
- García JL, Montilla R (2010) Hymenopteros parasitoides de insectos asociados a las plantaciones de cacao, en la región costera del estado Aragua, Venezuela. *Agronomía Tropical* (Maracay) 60(1): 91–97.
- Hebert PDN, Cywinska A, Ball SL, deWaard JR (2003) Biological identifications through DNA barcodes. *Proceedings of the Royal Society B* 270: 313–321. doi: 10.1098/rspb.2002.2218
- Huber JT, Sharkey MJ (1993) Structure. In: Goulet H, Huber JT (Eds) *Hymenoptera of the world: an identification guide to families*. Agriculture Canada Research Branch, Monograph No. 1894E, Ottawa, Canada, 13–59.
- Ivanova NV, deWaard JR, Hebert PDN (2006) An inexpensive, automation-friendly protocol for recovering high-quality DNA. *Molecular Ecology Notes* 6: 998–1002. doi: 10.1111/j.1471-8286.2006.01428.x
- Janzen DH, Hallwachs W (2011) Joining inventory by parataxonomists with DNA barcoding of a large complex tropical conserved wildland in northwestern Costa Rica. *PLoS ONE* 6(8): e18123. doi: 10.1371/journal.pone.0018123
- Janzen DH, Hallwachs W, Blandin P, Burns JM, Cadiou J, Chacon I, Dapkey T, Deans AR, Epstein ME, Espinoza B, Franclemont JG, Haber WA, Hajibabaei M, Hall JPW, Hebert PDN, Gauld ID, Harvey DJ, Hausmann A, Kitching I, Lafontaine D, Landry J, Lemaire C, Miller JY, Miller JS, Miller L, Miller SE, Montero J, Munroe E, Rab Green S, Ratnasingham S, Rawlins JE, Robbins RK, Rodriguez JJ, Rougerie R, Sharkey MJ, Smith MA, Solis MA, Sullivan JB, Thiaucourt P, Wahl DB, Weller SJ, Whitfield JB, Willmott KR, Wood DM, Woodley NE, Wilson JJ (2009) Integration of DNA barcoding into an ongoing inventory of complex tropical biodiversity. *Molecular Ecology Resources* 9 (Supplement 1): 1–26. doi: 10.1111/j.1755-0998.2009.02628.x
- Karlsson D, Ronquist F (2012) Skeletal morphology of *Opius dissitus* and *Biosteres carbonarius* (Hymenoptera: Braconidae), with a discussion of terminology. *PLoS ONE* 7(4): e32573. doi: 10.1371/journal.pone.0032573
- Kazmier R (2015) 20 new wasp species named after Costa Rican school children. *The Tico Times*. <http://www.ticotimes.net/2015/12/14/20-new-wasp-species-named-costa-rican-schoolchildren> [December 14, 2015]
- Mason WRM (1981) The polyphyletic nature of *Apanteles* Foerster (Hymenoptera: Braconidae): A phylogeny and reclassification of Microgastrinae. *Memoirs of the Entomological Society of Canada*, Ottawa, 147 pp.
- Morrillo F, Sanchez P, Herrera B, Liendo-Baradiaran C, Muñoz W (2009) Pupal development, longevity and behavior of *Carmentia theobromae* (Lepidoptera: Sesiidae). *Florida Entomologist* 92(2): 355–361. doi: 10.1653/024.092.0222
- Muesebeck CFW (1958) New Neotropical wasps of the family Braconidae (Hymenoptera) in the U.S. National Museum. *Proceedings of the United States National Museum* 107: 405–461. doi: 10.5479/si.00963801.108-3389.405
- Nixon G (1965) A reclassification of the tribe Microgasterini (Hymenoptera: Braconidae). *Bulletin of the British Museum (Natural History), Entomology series, Supplement* 2: 1–284.

- Quicke DLJ (2015) *The Braconid and Ichneumonid Parasitoid Wasps: Biology, Systematics, Evolution and Ecology*. Willey-Blackwell, 704 pp.
- Ratnasingham S, Hebert PDN (2007) BOLD: The Barcode of Life Data System (www.barcodinglife.org). *Molecular Ecology Notes* 7: 355–364. doi: 10.1111/j.1471-8286.2007.01678.x
- Sathe TV, Bhoje PM (1998) On a new species of the genus *Promicrogaster* Brues & Richardson (Hymenoptera: Braconidae). *Journal of Advanced Zoology* 19(2): 105–106.
- Shaw MR, Huddleston T (1991) Classification and biology of Braconid wasps (Hymenoptera: Braconidae). *Handbooks for the Identification of British Insects* 7(11): 1–126.
- Smith MA, Woodley NE, Janzen DH, Hallwachs W, Hebert PDN (2006) DNA barcodes reveal cryptic host-specificity within the presumed polyphagous members of a genus of parasitoid flies (Diptera: Tachinidae). *Proceedings of the National Academy of Sciences* 103: 3657–3662. doi: 10.1073/pnas.0511318103
- Smith MA, Wood DM, Janzen DH, Hallwachs W, Hebert PDN (2007) DNA barcodes affirm that 16 species of apparently generalist tropical parasitoid flies (Diptera, Tachinidae) are not all generalists. *Proceedings of the National Academy of Sciences* 104: 4967–4972. doi: 10.1073/pnas.0700050104
- Smith MA, Rodriguez JJ, Whitfield JB, Deans AR, Janzen DH, Hallwachs W, Hebert PDN (2008) Extreme diversity of tropical parasitoid wasps exposed by iterative integration of natural history, DNA barcoding, morphology, and collections. *Proceedings of the National Academy of Sciences* 105: 12359–12364. doi: 10.1073/pnas.0805319105
- Whitfield JB (1997) Subfamily Microgastrinae. In: Wharton RA, Marsh PM, Sharkey MJ (Eds) *Manual of the New World genera of the family Braconidae* (Hymenoptera). Special Publication No. 1, International Society of Hymenopterists, Washington, DC, 333–364.
- Zhang D-X, Hewitt G (1996) Nuclear integrations: challenges for mitochondrial DNA markers. *Trends in Ecology and Evolution* 11: 247–251. doi: 10.1016/0169-5347(96)10031-8