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CALLIRHYTIS CAMERONI: A NEW SPECIES OF OAK GALL WASP (HYMENOPTERA: CYNIPIDAE: CYNIPINI) IN PANAMA

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ABSTRACT

A new species of *Callirhytis* Förster 1869 (Hymenoptera: Cynipidae: Cynipini) is described from Panama: *Callirhytis cameroni* **sp. nov.** *Callirhytis cameroni* is the first species of genus *Callirhytis* 'sensu lato' recorded from the Neotropical region. The new species induces galls on *Quercus salicifolia* Neé (Fagaceae, sect. Lobatae). The diagnostic characteristics, gall description, distribution and biological data of the new species are given.

Key Words: Cynipidae, oak gall wasps, *Quercus*, Chiriqui, Panama

RESUMEN

Una nueva especie del género *Callirhytis* Förster 1869 (Hymenoptera: Cynipidae: Cynipini) se describe de Panamá: *Callirhytis cameroni* **sp. nov.** *Callirhytis cameroni* representa la primera especie del género *Callirhytis* 'sensu lato' descrita para la región Neotropical. La nueva especie induce agallas en *Quercus salicifolia* Neé (Fagaceae, sect. Lobatae). Se aportan los caracteres diagnósticos del adulto, la descripción de sus agallas, así como datos de la biología de la nueva especie.

Palabras Claves: Cynipidae, avispas de los robles, *Quercus*, Chiriquí, Panamá

The tribe Cynipini (Hymenoptera: Cynipidae) represents the more species-rich lineage of gall wasps, comprising the "oak gall wasps", so named because they induce galls on plants of the Fagaceae family, mainly on oaks. More than 1,000 species of cynipini are known, distributed mainly in the Holarctic region (Liljeblad et al. 2008; Stone et al. 2009; Melika et al. 2010). However, in recent years, important faunas of oak gall wasps from the Neotropical and Oriental regions have been discovered and are being studied, mainly those from Japan (Ide et al. 2010, 2012, 2013) and Taiwan (Melika et al. 2011, 2013; Tang et al. 2011a, b) and those from Panama and Costa Rica (see Medianero & Nieves-Aldrey 2011 for an updated list of the Cynipidae of the Neotropical region). In the above-mentioned list, 17 species of cynipini in 9 genera were recorded, but the list has been enlarged since then with the addition of 2 new genera and species (Pujade-Villar et al. 2012; Medianero & Nieves-Aldrey 2013).

Callirhytis Förster (Hymenoptera: Cynipidae: Cynipini) is one of the more species-rich genera of oak gall wasps. The genus was described from the Palaeartic region where only 7 species are known (Nieves-Aldrey 1992; Melika 2006), while more than 100 species from the Nearctic region have been described, mainly in the USA and Canada (Weld 1952; Burks 1979; Melika & Abrahamson 2002). Six species from Mexico have been recorded (Dailey & Sprenger 1977; Pujade-Villar et at. 2009), but to date, the genus has not yet been recorded from the Neotropical region.

Taxonomically, *Callirhytis* is a genus close to *Andricus,* and for a time, the former was included as a subgenus of *Andricus* (Nieves-Aldrey 2001; Melika 2006). The Palaeartic *Callirhytis* species are characterized by the following combination of characters: a transversely sculptured scutum, a face with carinae radiating from the clypeus, with malar sulcus present, a longitudinally striated mesopleuron (in part) and with the projecting part of the hypopygial spine relatively short (Nieves-Aldrey 1992, 2001). The Palaeartic species are polymorphic with regard to the shape of the metatarsal claws, having ei-

ther simple or toothed tarsal claws, a feature which has been used to differentiate *Callirhytis* from *Andricus* but which can no longer used as a diagnostic character of *Callirhytis* (Nieves-Aldrey 2001; Melika & Abrahamson 2002). As far as is known, the genus is not defined by derived morphological character states; most diagnostic characters are generalized or plesiomorphic. For this reason, according to current knowledge, the genus is a true "catch-all" genus for the numerous Nearctic species, as is the case for the related and rich genus *Andricus*, and the classification of the American species requires revision.

In the framework of a continued study of the oak gall wasps (Cynipidae) of Panama, this paper includes the description of a new species ascribed to *Callirhytis* 'sensu lato', which represents the first accurate report of this genus in the Neotropical region.

Material and Methods

Study Material

The adults studied were reared from galls collected on *Quercus salicifolia* Neé. Samples were taken, and the material was collected from Dec 2007 to May 2009 at Volcan Barú and Boquete, Chiriqui Province, Panama. The adult insects emerged from the galls in rearing cages under laboratory conditions. Voucher adult specimens and their galls were deposited in the entomology collections of the Museo Nacional de Ciencias Naturales, Madrid (Spain) and Maestría en Entomología, Universidad de Panamá (MEUP). The identification of the *Quercus* species was based on several key references (Burger 1977; Breedlove 2001), as well as on a comparison with materials from the collections of the University of Panama and the Smithsonian Tropical Research Institute.

Specimen Preparation

For observation under a scanning electron microscope (SEM), adult cynipids were dissected in 70% ethanol, air dried, mounted on a stub and coated with gold. Micrographs were taken by a FEI QUANTA 200 microscope (high vacuum technique) for several standardized views. The forewings were mounted on slides in Euparal and were later examined under a Wild MZ8 stereo microscope. Images of the adult habitus and gall dissections were taken with a NIKON Coolpix 4500 digital camera attached to a Wild MZ8 stereo microscope. Measurements were performed with a calibrated micrometer scale attached to an ocular of the light microscope. The terminology of morphological structures and abbreviations follows Ronquist & Nordlander (1989), Ronquist (1995), Nieves-Aldrey (2001) and Liljeblad et al. (2008). For the cuticular sculpture we follow Harris (1979). Measurements and abbreviations used include the following: the post-ocellar distance (POL) is the distance between the inner margins of the posterior ocelli; the ocellar-ocular distance (OOL) is the distance from the outer edge of a posterior ocellus to the inner margin of the compound eye.

Callirhytis cameroni Medianero and Nieves-Aldrey **sp. nov.**
(Figs. 1, 2 and 3)

Type Material

HOLOTYPE ♀ (Fig. 3A) [in Museo Nacional de Ciencias Naturales, Madrid, Spain (MNCN), card mounted. Cat. no. 2518]: PANAMA, Chiriquí, Volcán Barú, N 8° 47´ 50.8" W 82° 29´ 35.9", 1,800-2,200 m; ex gall on leaf of *Quercus salicifolia* Neé (Fagaceae); gall collected 28-II-2009; insect emerged III.2009, E. Medianero leg. PARATYPES: 7♂, 19♀, same data as holotype; 1♀ same data as holotype, but collected 27-I-2009; insect emerged II-2009, E. Medianero leg. 1♂, 3♀ Panama, Chiriquí, Carretera de Volcancito, Boquete, 8°46´23.7" N, 82°27´19.7" W, 1,400 m; gall collected 25-I-2009. 4♂ 7♀, in MNCN; 3♂, 12♀, paratypes in Maestría en Entomología, Universidad de Panamá (MEUP).

Additionally, 2♀ paratypes of the type series were dissected for SEM observation (in MNCN).

Etymology. Named in honor of Peter Cameron, who wrote part of Insecta Hymenoptera section in the classical book "Biologia Centrali-americana".

Diagnosis and Comments

The new species is closely allied to *Callirhytis flora* (Weld) (sexual generation) and *C. corrugis* (Bassett) from the USA, being similar both in color and regarding a majority of morphological characteristics, including a rugose mesoscutum. The new species differs from the above-mentioned species in the number of antennal segments and in the form of the lateral carinae of propodeum. *C. cameroni* has antennae with 13 antennomeres, whereas *C. corrugis* and *C. flora* have antennae with 14 antennomeres. *C. corrugis* and *C. flora* have the lateral carinae of propodeum bent slightly outward, whereas in *C. cameroni,* the lateral carinae of propodeum are parallel. In *C. corrugis,* F1 is nearly two times as long as pedicel, while in *C. cameroni,* F1 is three times as long as pedicel.

General Description

Body length, 2.12 mm (range 1.82-2.59 mm; *N* = 29) for females, 1.63 mm (range 1.38-1.82; *N* = 6) for males. Female body predominantly dark

brown with head (except occiput and vertex), mesoscutum and lateral surface of pronotum orange-brown. Scape, pedicel, F1-F3 and legs light brown. Forewings hyaline with basal veins light brown. Wings not ciliate on the apical margin. Males black with antennae and legs yellowish-brown.

Female

Head, reticulate, carinate to slightly rugose, barely pubescent; in dorsal view approximately 2.24 times wider than long. POL 1.25 times longer than OOL; posterior ocellus separated from inner orbit of eye by 2.1 times its longest diameter (Fig. 1A). Head in anterior view more or less oval (Fig. 1B), 1.28 times wider than high. Genae slightly expanded behind eyes. Vertex, frons and face with strong carinae; vertex, frons and occiput barely pubescent with sparse and shorter setae. Clypeus trapezoidal, 1.5 times wider than high, shining, moderately pubescent, ventral margin slightly sinuate and projecting over mandibles. Anterior tentorial pits conspicuous; epistomal sulcus and clypeopleurostomal lines distinct. Malar space 0.4 times height of compound eye, with a distinctive malar sulcus. Distance between antennal rim and compound eye 1.31 times width of antennal socket including rim. Ocellar plate not raised. Head, posterior view (Fig. 1C). Gula relatively short; distance between occipital and oral foramina as high as the occipital foramen. Without an occipital carina.

Mouthparts (Fig. 1C). Mandibles strong and exposed with five long setae at apex; right mandible with three teeth, left with two teeth. Cardo of maxilla visible, maxillary stipes approximately 1.3 times longer than wide. Maxillary palp five-segmented. Labial palp three-segmented.

Antennae (Fig. 2E) of moderate length, as long as 1/2 body length, with 13 segments; last flagellomere formed by incompletely fused segments, flagellum not broadening toward apex, with short, erect setae and elongate placodeal sensilla visible only on flagellar segments 4-11. Relative lengths of antennal segments: 16:11:31:26:23:20 :17:15:15:14:12:11:26. Pedicel, globose, small, 0.7 times as long as scape; F1 1.2 times as long as F2 (Fig. 2H); F11 2.36 times longer than wide and 2.3 times as long as F10 (Fig. 2G).

Mesosoma. Irregularly rugose in lateral view, weakly sculptured in frontal view; 1.2 times wide as high. Pronotum, rugose sculpture in lateral view, with a lateral pronotal carina visible and barely pubescent laterally, with some strong longitudinal carinae. Ratio of length of pronotum medially/laterally = 0.29.

Mesonotum. Mesoscutum (Fig. 1F), barely pubescent, with very strong irregular rugose sculpture. Notauli complete and convergent posteriorly, crossed by irregular, transversal, rugose sculpture; median mesoscutal impression indistinct and lost in coarse sculpture. Anteroadmedian signa visible. Transscutal fissure narrow. Scutellum (Fig. 1F), rounded, approximately 0.7 times as long as mesoscutum, coarsely rugose, posterior margin not emarginate. Scutellar foveae not well differentiated, shallow, confluent medially, with some longitudinal striae and indistinctly margined posteriorly. Scutellum, overlapping the dorsellum posteriorly in lateral view. Mesopleuron (Fig. 1E) with coriaceous reticulate sculpture, barely pubescent with sparse and shorter setae in mesopleural triangle.

Metanotum (Fig. 2A). Metapectal-propodeal complex. Metapleural sulcus reaching posterior margin of mesopectus at approximately two-thirds height (Fig. 1E). Lateral propodeal carinae distinct, strong and parallel (Fig. 2A), with a median longitudinal carina distinct and complete, bifurcated posteriorly. Median propodeal area narrow and bare (Fig. 2A). Lateral propodeal area barely pubescent. Nucha rugose.

Legs (Fig. 2C). Metatarsal claws without a basal lobe or tooth (Fig. 2D).

Forewing (Fig. 3C). As long as body, veins pigmented. Radial cell 3.4 times longer than wide, open along anterior margin, areolet small. Rs slightly bowed reaching wing margin. M slightly bowed, not reaching wing margin. Rs+M reaching basalis at its mid-height. First abscissa of radius (2r) slightly curved, 2r-m straight. Basal cell bare. Hair fringe on apical margin virtually absent.

Metasoma (Fig. 2B). Large, as long as head and mesosoma combined, 1.1 times as long as high in lateral view. T3 covering approximately 2/3 of metasoma, smooth and shining, with a group of sparse short setae anteromedially; following tergites with weak and delicate reticulate sculpture. Projecting part of hypopygial spine, beyond attachment of lateral flap, relatively short (Fig. 2I); approximately 2.2 times as long as basal height of the spine; lateral margins of hypopygial spine with long setae not projecting over apical end of the spine.

Male (Fig. 3B)

Similar to female except as follows: body uniformly black; antennae 15-segmented (Fig. 2F); F1 slightly curved and broadened apically. Placodeal sensillae present on all flagellomeres. Relative length of antennomeres: 11:8:26:24:22:19:16: 14:14:14:14:14:14:14:13.

Gall (Fig. 3 D-E)

Large, irregular swellings of the leaves, with smooth and bare surface. Polythalamous, developing in petiole and midrib and engulfing leaf lamina. When fresh, the galls are light green,

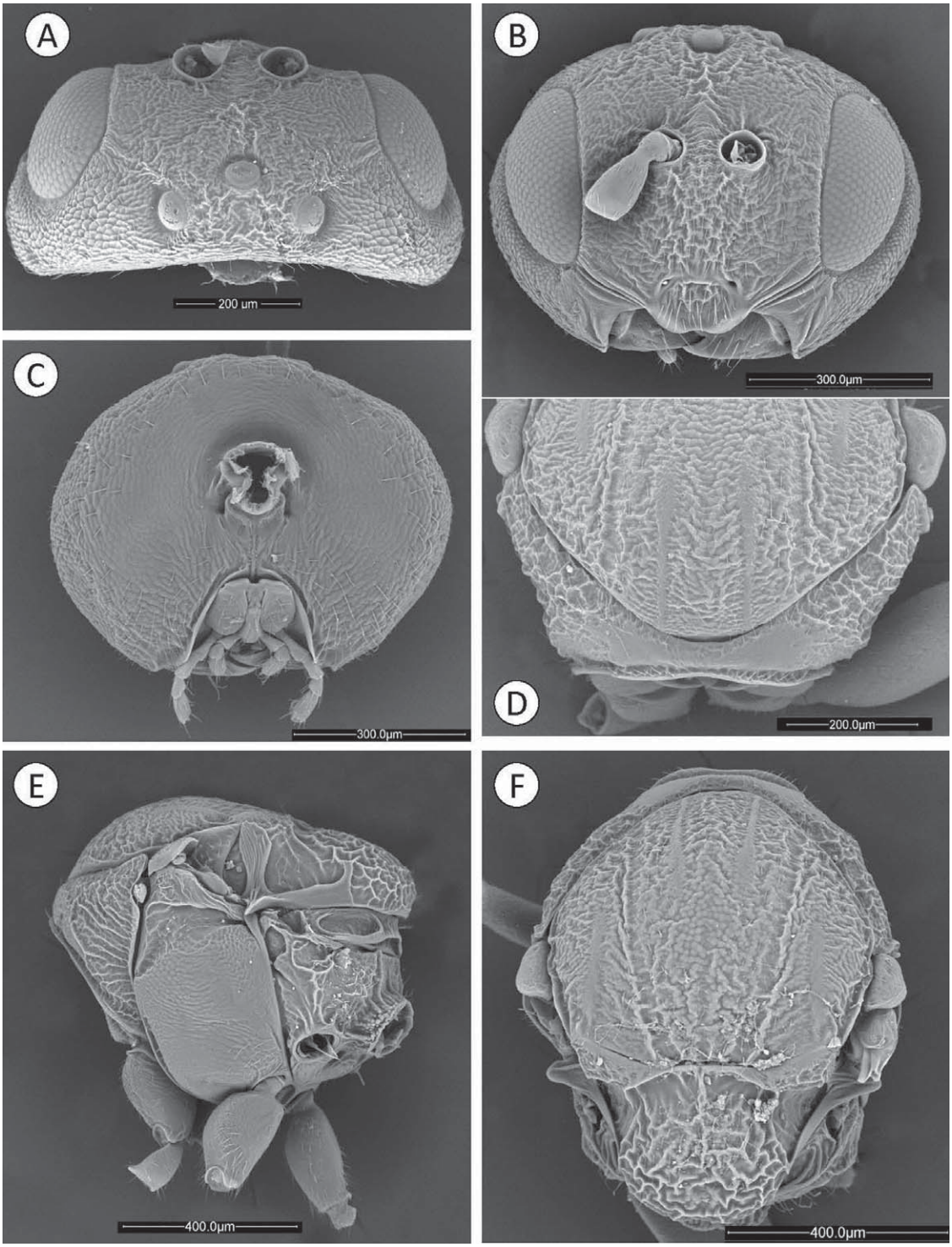

Fig. 1. *Callirhytis cameroni:* (A) Head, dorsal view. (B) Head, anterior view. (C) Head, posterior view. (D) Pronotum, antero-dorsal view. (E) Mesosoma, lateral view. (F) Mesosoma, dorsal view.

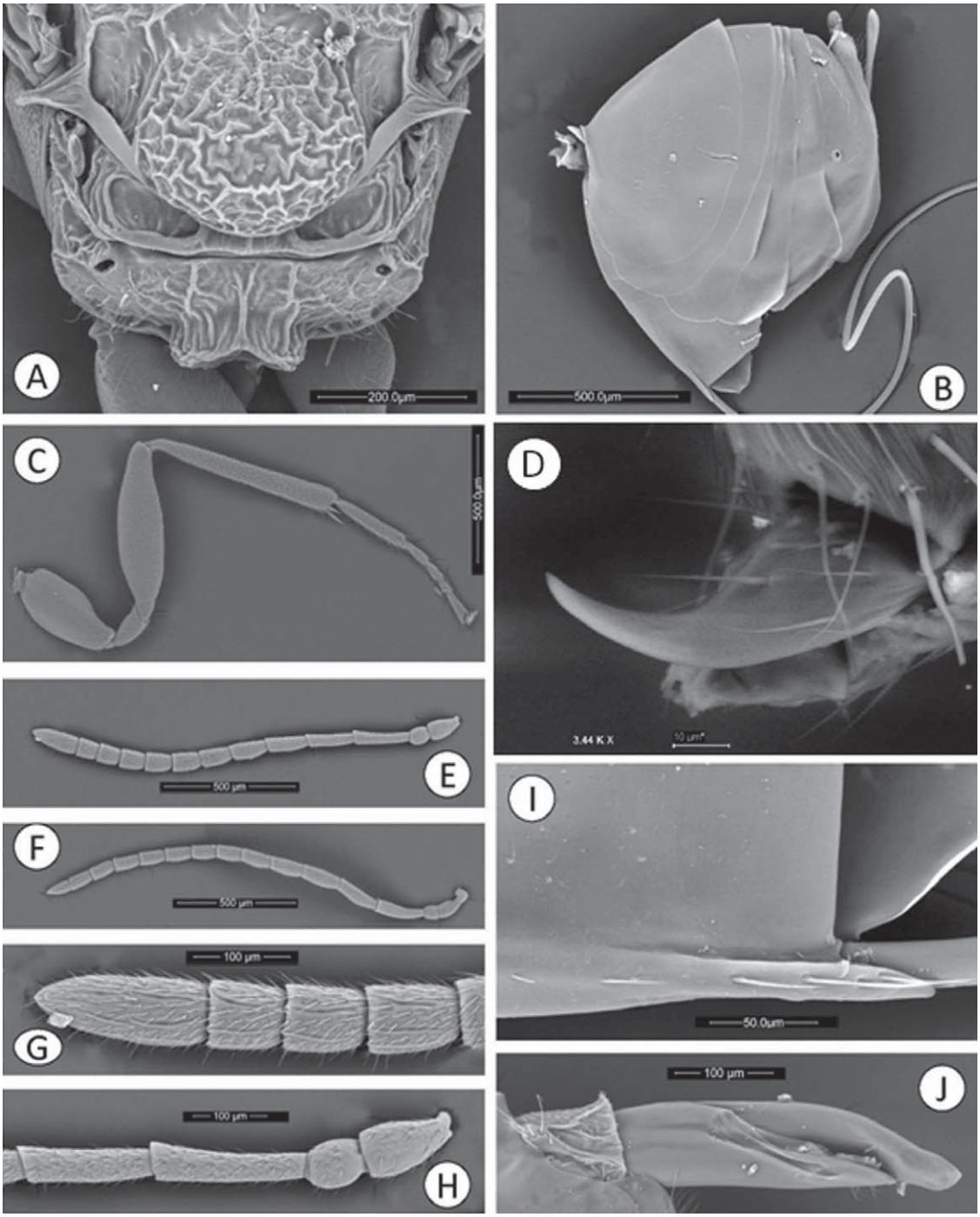

Fig. 2. *Callirhytis cameroni:* (A) Propodeum. (B) Metasoma, lateral view. (C) Legs. (D) Metatarsal claw. (E) Female antenna. (F) Male antennae. (G) Detail of last flagellomeres.
(H) Detail of basal flagellomeres. (I) Detail of ventral spine of hypopygium, lateral view. (J) Aedeagus.

but galls are dark green with violet tones when mature (Fig. 3D) and are brown when old (Fig. 3E). Diameter 14 to 25 mm. Galls are relatively common on *Quercus salicifolia* at the Volcán Barú site. The gall most closely resembles that of *C. flora* Weld, which is known from California, USA.

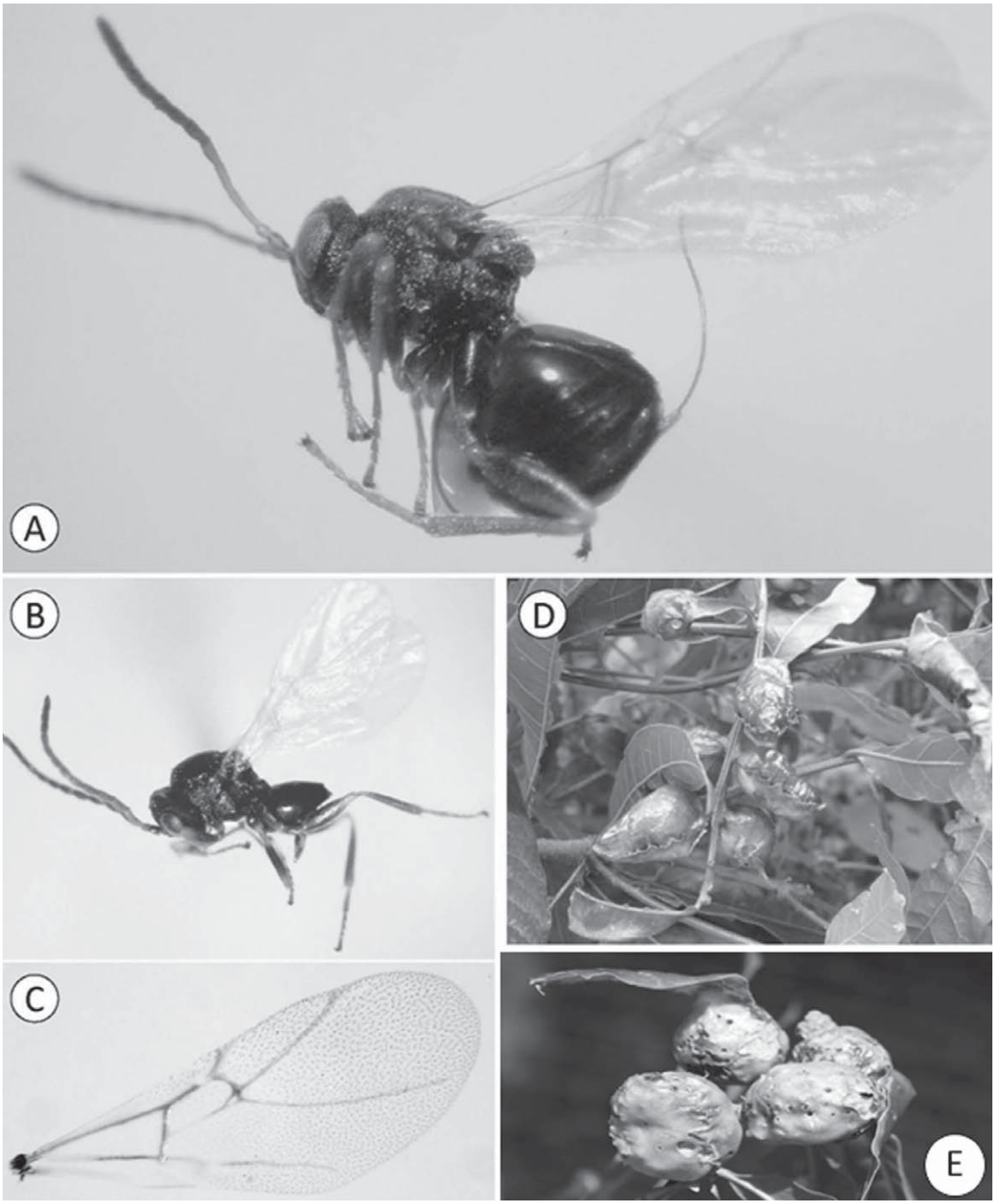

Fig. 3. *Callirhytis cameroni:* (A) Habitus, female. (B) Habitus, male. (C) Forewings, female. (D) Mature gall. (E) Old gall.

Distribution

Callirhytis cameroni was found between 1,000-2,220 m asl. at Volcán Barú, Carretera de Volcancito, Palmira and Hornitos, Chiriquí Province, Panama.

Biology

Only the sexual generation of *Callirhytis cameroni* is known, inducing integral galls on leaves of *Q. salicifolia*. The galls are found between Dec-Apr, during the dry season, when new leaves of

Q. salicifolia begin to bloom. The adult insects emerge from mature galls in Feb. or Mar.

Discussion

Weld (1952) divided the described species of *Callirhytis* into 4 groups, although it was argued that these groups could not be considered as distinct genera. The characters that he used (whether the wing was ciliated on the margin, if the venation was "normal" or pale, the coloration of the female in each generation, the sculpture of the scutum, and especially the presence of simple or toothed metatarsal claws) are unstable within *Callirhytis,* as was demonstrated by Nieves-Aldrey (1992) for the European species in the case of the metatarsal claws. Consequently, the concept of the genus *Callirhytis* according to Weld (1952), and widely used by many researchers over many decades, is problematic (Pujade-Villar et al. 2012).

According to the recent phylogenetic evidence, only the Palaeartic species seem to be monophyletic and relatively basal in the Cynipini tree (Nylander 2004; Liljeblad et al. 2008; Stone et al. 2009). However, the monophyly of the entire genus, including the wide majority of Nearctic species, has not been investigated. Recent studies, based on traditional taxonomy and morphological evidence, have questioned the validity of the genus as currently understood. However, it has become evident that the entire genus requires a profound systematic revision.

The new combinations established by Melika & Abrahamson (2002) and the newly established genus *Zapatella* (Pujade-Villar & Melika 2012) are the first attempts to reorganize the Nearctic *Callirhytis* 'sensu lato'. However, a thorough review of all the species within this genus is required, and the new genera that may result must be defined by clear and distinct diagnostic characters. The new species described here exhibits the morphological characteristics of the genus *Callirhytis* 'sensu lato', although some distinctive features are present that could suggest erecting a new genus for this species. However, we prefer to describe the new species within *Callirhytis* until ongoing new revisions of this genus more accurately reveal the taxonomic identity (Pujade-Villar et al. 2012; personal communication).

The discovery of the genus *Callirhytis* in Panama represents a new contribution to the knowledge regarding the distribution of the Cynipidae in the Americas. The new species described in this report, together with the recently discovered genus *Diastrophus* Hartig in Colombia (Nieves-Aldrey et al. 2013), confirms the notion that the global distribution of the family Cynipidae should be reviewed because the scarcity of cynipid records for this family in the Neotropics are primarily due to minimal sampling in the region and not to the absence of the family (Medianero & Nieves-Aldrey 2011).

Recently Pujade-Villar et al. (2014) erected a new genus, *Melikaiella* Pujade-Villar, which comprises some old and new species from the Nearctic region formerly included in *Callirhytis*. Our new species seems to be closely related to some species included in *Melikaiella* by Pujade-Villar et al. (2014). Despite a general resemblance with the adults and galls of some species of *Melikaiella*, *C. cameroni* lacks some of the distinctive features that define *Melikaiella*, such as the presence of a circumscutellar carina and a clear presence of reticulate sculpture on metasomal terguites. Both characters are inconspicuous to virtually invisible in our new species from Panama. Also the presence of a well-defined median propodeal carina in both sexes differentiates *C. cameroni* from the new species described within *Melikaiella* or transferred to this genus from *Callirhytis* (Pujade et al. 2014). Finally we believe that further revisions of these 2 genera should be deferred until more comprehensive and integrative morphological and biological studies, including a phylogenetic analysis, become available. For these reasons we prefer to maintain the new species within the large sensu lato old concept of C*allirhytis* rather than include it in the new genus *Melikaiella*.

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