

A new species of woody tuberous oak galls from Mexico (Hymenoptera: Cynipidae) and notes with related species

Una nueva especie de agalla leñosa tuberosa en encinos de México (Hymenoptera: Cynipidae) y anotaciones sobre las especies relacionadas

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ABSTRACT

A new species of cynipid gallwasp, *Andricus tumefaciens* n. sp. (Hymenoptera: Cynipidae: Cynipini), is described from Mexico. This species induces galls on twigs of *Quercus chihuahuensis* Trelease, white oaks (*Quercus*, section *Quercus* s.s.). Diagnosis, full description, biology and distribution data of *Andricus tumefaciens* n. sp. are given. Some morphological characters are discussed and illustrated, and compared to related species (*A. durangensis* Beutenmüller from Mexico and *A. wheeleri* Beutenmüller from USA). *Andricus cameroni* Ashmead is considered as ‘*nomen nudum*’.

Key words: Cynipidae, tuberous gall, *Andricus*, taxonomy, morphology, distribution, biology.

RESUMEN

Se describe de México una nueva especie de cinípido gallicola de encinos: *Andricus tumefaciens* n. sp. (Hymenoptera: Cynipidae: Cynipini). Esta especie induce agallas en ramas de una especie de roble blanco: *Quercus chihuahuensis* Trelease (*Quercus*, sección *Quercus* s.s.). Se aporta una diagnosis, la descripción completa, biología y distribución de dicha nueva especie. Se ilustran y discuten los caracteres morfológicos, y se comparan con las especies relacionadas (*A. durangensis* Beutenmüller de México y *A. wheeleri* Beutenmüller de EE.UU.). *Andricus cameroni* Ashmead es considerada como “*nomen nudum*”.

Palabras clave: Cynipidae, agalla tuberosa, *Andricus*, taxonomía, morfología, distribución, biología.



INTRODUCTION

Woody tuberous galls on oak twigs and branches are induced by species of several oak gallwasps of the tribe Cynipini (Cynipidae). These galls are usually irregularly shaped, polythalamous, with delicate or dull rugose surface, and a color that can be light grayish with light green tones -similar to the color of the bark when fresh-, or light woody brown when mature. The inducing wasps can remain inside the gall for several years, during which the gall tissues turn hard and lignified; due to this it is difficult to obtain living adults because many times they cannot chew out their way from the gall, and die before emerging from the gall.

The following oak cynipids are known to induce woody tuberous galls in Mexico: *Andricus bonanseai* Mayr, 1905; *A. durangensis* Beutenmüller, 1911; *A. dugesi* Beutenmüller, 1917; *A. furnaceus* Kinsey, 1920; *Andricus montezumus* (Beutenmüller, 1913); *A. peredurus* Kinsey, 1920; and *A. tumeralis* Pujade-Villar, 2009 (= *A. ashmeadi* Dalla Torre & Kieffer, 1910 non *A. ashmeadi* Bassett, 1900 = *A. championi* Ashmead, 1899 non *A. championi* Cameron, 1833). Two *Odontocynips* Kieffer species inducing woody tuberous galls have been reported from the Neotropical area: *Odontocynips hansonii* Pujade-Villar, 2008 from Costa Rica and Panama, and *O. championi* (Cameron, 1883) from Panama (Medianero *et al.*, 2011).

In America north of Mexico some species are known to induce tumor-like stem galls, and similar galls on roots and/or on tree stems near the ground (so-called subterranean galls) (Weld, 1921);

many species of *Andricus* Hartig, *Bassetia* Ashmead, *Callirhytis* Förster, and *Loxaulus* Mayr are known to induce small stem swelling-like galls (Weld, 1957, 1959, 1960; Burks, 1979).

After a revision of the type material of all *Andricus* species producing tuberous galls in Mexico, we conclude that two adult morphological groups are present (Fig. 1): adults with the metasoma scarcely pubescent in metasomal tergite II (only *A. durangensis*, Fig. 1a), and adults with the metasoma completely pubescent (the rest of species mentioned above, Fig. 1b). In this work we describe a new cynipid species from Mexico, *Andricus tumefaciens* n. sp., which induces woody tuberous galls on *Q. chihuahuensis* Trelease. *Andricus tumefaciens* n. sp. has the metasoma almost glabrous, with scarce setae in TII, thus is similar to *A. durangensis* among the Mexican species.

MATERIAL AND METHODS

Material studied here to describe the new species was collected in Monte Escobedo (Zacatecas, Mexico) by the first author and Olivia Cabral-Gamboa, Rosa Treto-Pereyra, Luis Gerardo Landa-Orozco and Carlos Carrillo-Sánchez.

The studied type material of Mexican species includes: *Andricus bonanseai* (deposited in NHM), *A. durangensis* (USHM), *A. dugesi* (USHM), *A. peredurus* (AMNH), *A. furnaceus* (AMNH), *A. tumeralis* (USHM) and *A. montezumus* (USHM); we have also examined the type material of two species from USA but collected very close to Mexico, both deposited in AMNH: *A.*

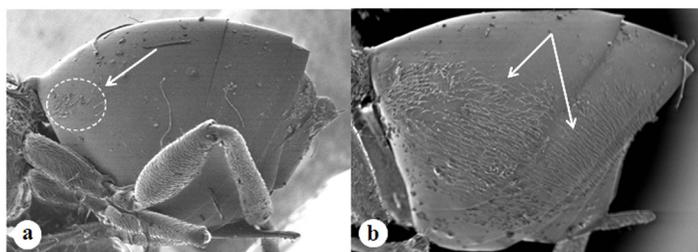


Figura 1. Metasomal segments in lateral view: (a) *A. durangensis*, (b) *A. bonansea*.

wheeleri Beutenmüller, 1907 (Arizona), and *A. ruginosus* Bassett, 1890 (New Mexico).

We follow the current terminology of morphological structures on Cynipidae (Liljeblad and Ronquist, 1998; Melika, 2006). Abbreviations for forewing venation follow Ronquist and Nordlander (1989); cuticular surface terminology follows Harris (1979). Measurements and abbreviations used include: F1–F12, first and subsequent flagellomeres; POL (post-ocellar distance) is the distance between the inner margins of the posterior ocelli; OOL (ocellar-ocular distance) is the distance from the outer edge of a posterior ocellus to the inner margin of the compound eye; LOL is the distance between lateral and frontal ocelli. The width of the forewing radial cell is measured from the margin of the wing to the Rs vein.

SEM pictures were taken with a Stereoscan Leica-360 by Palmira Ros-Farré (Barcelona University, Spain) at low voltage (1.0 KV) and without gold coating. The habitus and forewing pictures were taken by Mar Ferrer-Suay (Barcelona University, Spain) with a digital camera 21C INFINITYX attached to a compound microscope Zeiss Discovery V8; the program DeltaPix View AZ-Pro was used to combine the series of images obtained in one image.

Type material of the new species is deposited in the following institutions:

UB, University of Barcelona, Spain (J. Pujade-Villar).

PDD, Pest Diagnostic Department, Plant Protection & Soil Conservation Directorate of County Vas, Tanakajd, Hungary (G. Melika).

AMNH, American Museum of Natural History, New York, USA (curator J.M. Carpenter).

USNM, U.S. National Museum of Natural History, Smithsonian Institution, Washington, DC, U.S.A. (curator M. Buffington).

RESULTS

Andricus tumefaciens n. sp.

Type material. HOLOTYPE female (deposited in UB): “MEX (084): Zacatecas, Monte Escobedo, Mesa de San Gabriel, 22° 18' 53.71”N 103° 28' 54.57W” (white label), “Ex. *Q. chihuahuensis*, (15.x.2010) 16–31.x.2010, leg. O. Cabral, R. Treto, L.G. Landa & C. Carrillo-2012” (white label), “Holotype of *Andricus tumefaciens* ♀ Pujade-Villar & Melika n. sp. design. J.P-V” (red label). PARATYPES (5 females): with the same data as the holotype; deposited paratypes: 2 females in UB; 2 females in PDD, 1 female in USNM.

Diagnosis. *Andricus tumefaciens* n. sp. has metasomal segment III with sparse pubescence, similar to *A. durangensis*, also

described from Mexico. We can distinguish both species by the following characters: head, mesosoma and legs coloration (black in *A. tumefaciens* n. sp., reddish brown in *A. durangensis*); presence of irradiating facial carinae in *A. tumefaciens* n. sp. (absent in *A. durangensis*, face rugose); notauli thin and lacking sculpture in *A. tumefaciens* n. sp. (broad in posterior half and with carinae inside in *A. durangensis*); and propodeal area with straight carinae and pubescent anteriorly in *A. tumefaciens* n. sp. (curved carinae and glabrous in *A. durangensis*).

Description. Female (Figs. 2a–g, 3d).

Length. 4.5–4.7 mm (n = 5).

Coloration. Body, antennae and legs black. Metasoma chestnut brown, darker posteriorly; hypopygium with ventral spine yellowish. Forewing veins brown. Pubescence silvery, mandibles with long testaceous pubescence.

Head (Figs. 2a, b). Lower face granulose-reticulate, with delicate striae radiating from clypeus extending near to eye margin, with weak longitudinal carinae from ocelli to toruli and some weak rugae from ocelli to eyes; densely pubescent, 2.7–2.8 times as broad as long from above, 1.3–1.4 times as broad as high in frontal view and slightly narrower than mesosoma. Gena broadened behind eye, 0.4 as broad as transverse diameter of eye; malar space 0.35–0.4 times as long as eye height, malar sulcus absent. Ocellar area elevate, interocellar area smooth, shiny; POL:OOL:LOL is 11:5:4, lateral ocellus is 4. Transfacial distance equal to eye height; diameter of torulus (including rims) around 3.7 times as large as distance between toruli, distance between torulus and inner margin of eye equal or slightly longer than diameter of torulus; inner margins of eyes parallel. Clypeus small, trapezoid, smooth, impressed basally, curved ventrally, not incised; anterior tentorial pits, epistomal sulcus and clypeo-pleurostomal line distinct. Frons, vertex, interocellar area and occiput from granulate to strongly coriaceous with some weak rugae; median frontal carina more or less impressed. Postocciput strongly coriaceous.

Antenna (Fig. 2g). With 12 flagellomeres. Antennal formula 8: 5: 13: 11: 10: 10: 9: 7: 6: 5: 3.5: 3.5: 3.5: 5; shorter than head+mesosoma (63:72); pedicel nearly 2.0 times as long as broad; F1–F5 broader distally; F1 very slightly curved laterally, as long as scape+pedicel; F1 1.2 times as long as F2; F2 longer than F3, F3=F4; F4–F8 shorter and progressively shortening in length; F9–F11 subequal and shorter; F12 longer than F10; placodeal sensilla on F7–F12 but only slightly impressed.

Mesosoma (Figs. 2c–d). 1.2–1.3 times as long as high in lateral view, with white setae. Mesoscutum as long as broad, or only slightly longer than broad in dorsal view; with setae and transverse, delicate, interrupted striae that connect with longitudinally orientated weak striae, forming an irregular network of striae, and an irregularly reticulate surface sculpture; interspaces coriaceous, strongly coriaceous in anterior part. Notauli complete but only superficially impressed in anterior 1/4, converging posteriorly; sculptured, basally with some striae on bottom and anteriorly strongly coriaceous. Anterior parallel lines extending to 1/2 length of mesoscutum, divergent, alutaceous, basally with a dilated smooth and shiny area. Parapsidal lines distinct and broad, alutaceous and shiny, starting from posterior margin and extending to 1/2 length of mesoscutum. Parascutal carina anteriorly ending just at tegula level, not projecting to notaulus. Median mesoscutal line long, starting

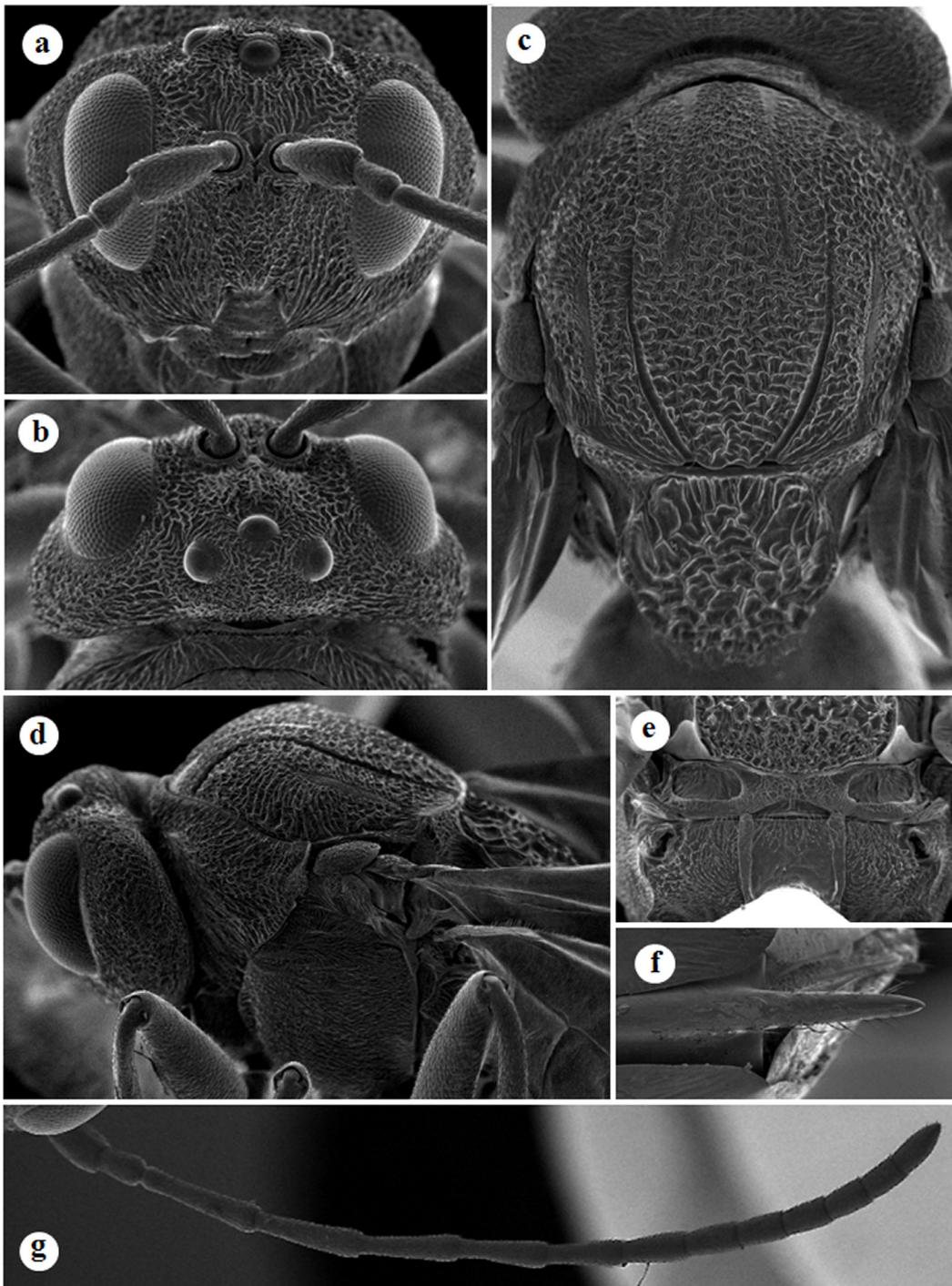


Figura 2. *Andricus tumefaciens* n. sp.: (a) head in frontal view, (b) head in dorsal view, (c) mesosoma in dorsal view, (d) head and mesosoma in lateral view, (e) propodeum, (f) ventral spine, and (g) antenna.

from posterior margin and extending to 1/2 length of mesoscutum, with parallel striae at bottom. Mesoscutellum 0.5 times as long as mesoscutum, as long as broad, overhanging metanotum, uniformly rugous; scutellar foveae present, big, superficial, not delimited posteriorly, bottom shiny, with some longitudinal rugae; median carina absent. Mesopleuron conspicuously setose, carinated, punctuated anteriorly, microscutule coriaceous; mesopleural triangle conspicuously setose; axillula dull, weak smooth, with

white setae; subaxillary bar smooth, shiny, as height as height metanotal trough; postalar process short, as a carina; metapleural sulcus reaching mesopleuron in 2/3 of its height. Metascutellum strongly microreticulate, rectangular incised basally. Metanotal trough smooth with short white setae; ventral impressed area at least twice as narrow as metascutellum height, strongly coriaceous. Propodeum smooth, dull, setose laterally, glabrous centrally with some setae in anterior 1/3; posterolateral process conspicuous;

central propodeal area smooth, shiny, with many irregular rugae slightly impressed, propodeal carinae impressed and parallel, with a coriaceus-reticulate sculpture. Nucha with irregular wrinkles and rugae.

Legs. Tarsal claws with basal tooth; hind coxae with dense white setae on dorsoposterior surface.

Forewing (Fig. 3d). As long or slightly longer than body length, hyaline and smoked brown between venae, lacking cilia on anterior margin, microciliated on apex and basal margin; radial cell 3.0 times as long as broad; 2r curved; R1 short, not reaching wing margin; Rs very conspicuous, curved; areolet present; Rs+M visible, reaching basalis at half length.

Metasoma. Slightly shorter than head+mesosoma, longer than high in lateral view; base of TII with sparse white setae in lateral part; following segments shiny, smooth glabrous or without setae. Prominent part of ventral spine of hypopygium needle-like (Fig. 2f), tapering to apex, around 5-6 times as long as broad, with two parallel rows of short white scattered setae that do not extend beyond the spine apex.

Gall (Figs 3a-c). Large red-chestnut gall, irregular, woody mass completely surrounding small twigs. Polythalamous, 6x4 cm, too hard to cut. The entire gall is formed of very many distinct but thoroughly fused masses, resulting in a rather irregular gall. The surface is very rough, completely cracked similar to burnt leather, and with raised polygonal portions that are 1-2 mm in diameter, dark or blackish brown, lines separating them much lighter. Galls remain several years in the oak branch, but after months or years become fragile.

Biology. Only the asexual generation is known which induces galls on *Quercus chihuahuensis*. Galls were collected in October and adults emerged immediately after the galls were collected. The gall tissue is easy to cut during the growth phase but later it turns very hard and lignified, and thus some adults are unable to chew out their way to the surface and die inside the gall. Similar galls were collected on *Q. intricata* Trel., *Q. resinosa* Liebm., *Q. striatula* Trel. and *Q. pringlei* Trel. also in Zacatecas, but no adults were obtained from them.

Distribution. Currently known only from Mexico (Zacatecas).

Etymology. The shape and form of the gall resembles stem tubers caused by *Agrobacterium tumefaciens* Smith & Townsend (Proteobacteria: Rhizobiales), thus we have given the same specific name to this new species of gallwasp.

Andricus durangensis Beutenmüller, 1911

Type material. Lectotype deposited in USNM with the following labels: “7336, on *Q. sp.*, Durango, Mex. iss April 3/97” (handwritten, white label), “type” (red label), “Type n° 13721 U.S.N.M.” (red label), *Andricus durangensis* Beut.” (handwritten, white label), “Lectotype of *Andricus durangensis* Beutenmüller, 1911 desig. JP-V 2012” (red label), “*Andricus durangensis* Beut., 1911” (white label). This species was collected by E. Palmer and described by Beutenmüller (1911). Only a specimen (lectotype) is preserved (M. Buffington and T. Nuhn *pers. com.*). *Andricus durangensis* (Figs. 3e, 4) is morphologically closely related to *A. tumefaciens* but differs having: reddish brown colour in head,

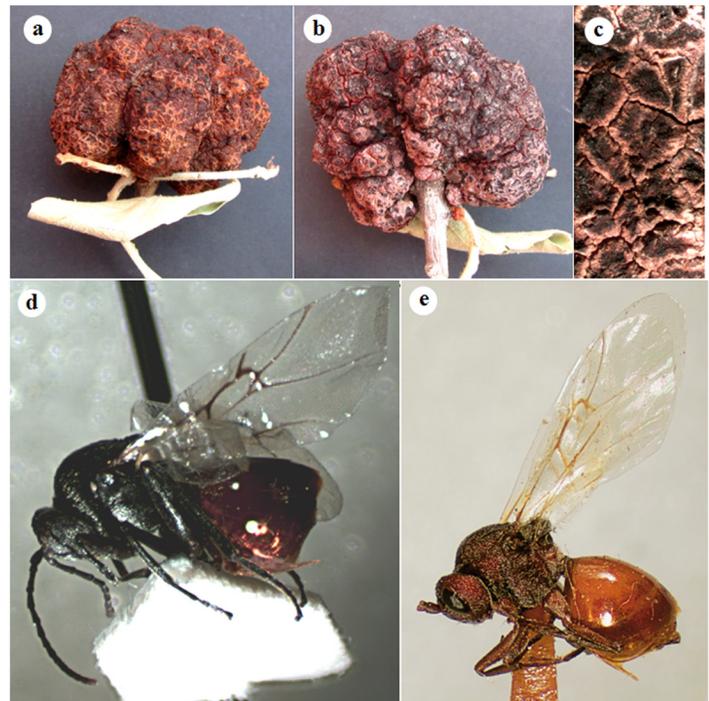


Figura 3. *Andricus tumefaciens* n. sp. (a-d) and holotype of *A. durangensis* (e). Gall (a-b), surface of the gall (c) and adult habitus (d-e).

antennae, mesoscutum and legs; metasoma red; veins light brown; notauli broader posteriorly and with carinae inside; propodeum with carinae slightly curved lacking setae inside; face lacking defined irradiating carinae; and sculpture more strongly impressed. According to the original description the antenna has 14 segments, but all flagellomeres are missing in the lectotype (no further details of antennal segments are mentioned in the original description). The host and gall of this species is unknown (Beutenmüller, 1911).

Andricus wheeleri (Beutenmüller, 1907)

Type material. LECTOTYPE (designated here) deposited in AMNH with the following labels: “Caconino Forest, Grand Canyon, Ariz., May 1905, N.W. Wheeler coll.” (handwritten, white label), “type” (red label), “*Andricus wheeleri* Type Beuten.” (handwritten, white label), “Beut. Coll., rec’ dl 935” (handwritten, white label), “*Andricus wheeleri* Beut.” (handwritten, white label), “Lectotype of *Andricus wheeleri* Beutenmüller, 1907, design. JP-V.2012” (red label), “*Andricus wheeleri* Beut., 1907” (white label). PARALECTOTYPES (4 agam females): 1♂ “Coconino Forest, Grand Canyon, Ariz., May 1905, N.W. Wheeler coll.” (handwritten, white label), “type” (red label), “*Andricus wheeleri*” (handwritten, white label), “*Andricus wheeleri* Beutenmüller” (handwritten, white label), “Paralectotype of *Andricus wheeleri* Beutenmüller, 1907” (red label), “*Andricus wheeleri* Beut., 1907” (white label); 2♂ “Coconino Forest, Grand Canyon, Ariz., May 1905, N.W. Wheeler coll.” (handwritten, white label), “type n° AMNH” (red label), “Paralectotype of *Andricus wheeleri* Beutenmüller, 1907” (red label), “*Andricus wheeleri* Beut., 1907” (white label); 1♂ “Coconino Forest, Grand Canyon, Ariz., May 1905, N.W. Wheeler coll.” (handwritten, white label), “type n°



Figura 4. *Andricus durangensis*: (a) head in frontal view, (b) head in dorsal view, (c) mesosoma in dorsal view, (d) head and mesosoma in lateral view, (e) propodeum.

AMNH" (red label), "*Andricus wheeleri* Beut." (handwritten, white label), "Paralectotype of *Andricus wheeleri* Beutenmüller, 1907" (red label), "*Andricus wheeleri* Beut., 1907" (white label).

Andricus wheeleri was collected in Arizona (USA) and belongs to the same morphological group of species having metasomal segments almost glabrous, only with some scarce setae in lateral areas of second metasomal tergite.

The gall is polythalamous, hard, irregularly rounded or elongate, 14-20 mm x 15-30mm, located in smaller twigs of an

unknown species of scrub oak (Beutenmüller, 1907).

Adults (Fig. 5) are characterized by: small size (2.5-3.5 mm); ambarinus to rufous colour (in one paratype the posterior part of the metasoma is darker); antenna with 13 flagellomeres (12 mentioned in the original description, but this is a mistake); pronotum with some conspicuous parallel carinae laterally; mesoscutum with deep and separated wrinkles or rugae; notauli wide throughout its length, deep; median mesoscutal line absent; parascutal carina anteriorly continuing to anterior end of notauli; propodeal carinae

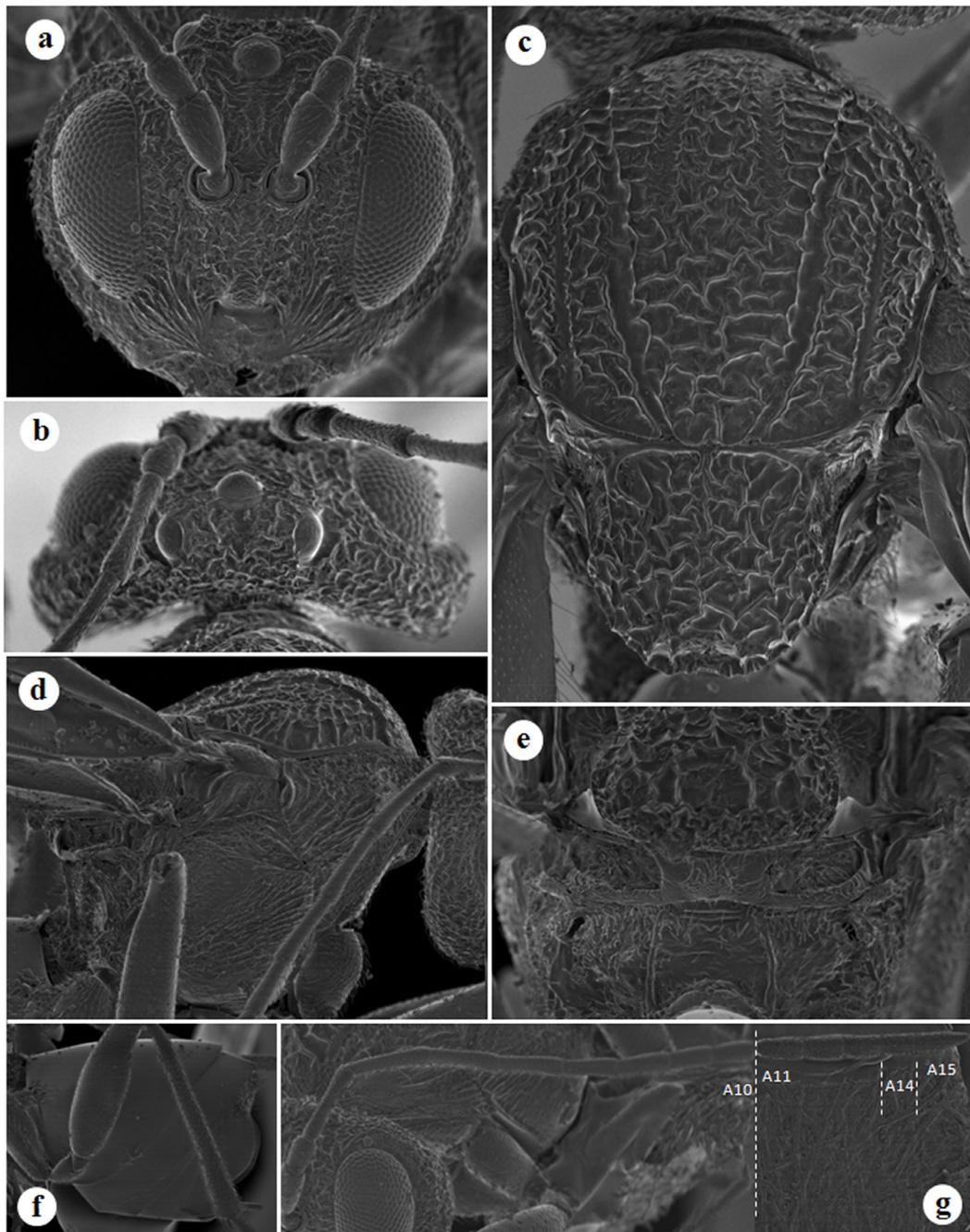


Figura 5. *Andricus wheeleri*: (a) head in frontal view, (b) head in dorsal view, (c) mesosoma in dorsal view, (d) mesosoma in lateral view, (e) propodeum, (f) metasoma, (g) antenna.

thin, slightly curved with very few setae inside on anterior area; metascutellum straight inferiorly or very slightly curved; and forewings not ciliated in margin, with a radial cell 2.9-3.2 times as long as wide and Rs+M vein reaching basal vein.

DISCUSSION

Gallwasps from different genera that induce woody stem swelling-like galls on oaks -*Andricus*, *Bassettia*, *Callirhytis*, *Holocynips* *Loxaulus* and *Odontocynips*- are common in North and Central America. However, galls of different species and genera in stems, branches and twigs are quite different in size and shape. For example, *Bassettia* and *Loxaulus* induce galls in twigs without

visible twig enlargements. Many *Callirhytis* species induce small spindle-shaped or club-shaped galls in twigs. Gall shape depends on the position on the twig: if terminal, the gall is club-shaped; if the gall is in the middle of the twig, then it is usually spindle-shaped. There is a smaller group of species belonging to *Andricus*, *Callirhytis*, *Dryocosmus*, *Eumayria*, *Holocynips* and *Odontocynips*, which induce large, tuberous galls on stems and twigs, commonly located in the tree crown or at the base of young sprouts (near or slightly under ground surface), so-called "subterranean galls" (Weld, 1921). Tuberous galls are a phenotype extended among gallwasps, which has evolved independently several times in different phylogenetically unrelated groups. In the Nearctic area one

species is mentioned by Beutenmüller (1917) when he described *A. dugesi*. This species, named *Andricus cameroni* Ashmead, has been never described; therefore, we consider *Andricus cameroni* Ashmead a **nomen nudum**.

Andricus montezumus Beutenmüller, 1913, is known to induce tuberous galls on white oaks distributed in USA (Arizona) and Mexico. The new species we described herein, *A. tumefaciens*, is also associated with white oaks. Six other species are known only from Mexico with unknown host associations: *Andricus bonansea* Mayr, *A. durangensis* Beutenmüller, *A. dugesi* Beutenmüller, *A. peredurus* Kinsey, *A. furnaceus* Kinsey, and *A. tumeralis* Pujade-Villar. The hosts of these species are probably white oaks.

The morphological differences between *A. tumefaciens* and *A. durangensis* could be argued to be only intraspecific variations. However, both species emerge in different periods (*A. durangensis* in April-May, *A. tumefaciens* in November). In addition, after studying all type material of the species described from Mexico, we observe that the morphology of all Mexican species is very similar. Thus, we conclude that there are sufficient differences to consider *A. tumefaciens* and *A. durangensis* as distinct species until the gall and host of *A. durangensis* are known. Also galls of *A. tumefaciens* and *A. peredurus* are similar, nevertheless, adults are morphologically different (metasoma glabrous in *A. tumefaciens* but pubescent in *A. peredurus*).

Finally, adults of *A. wheeleri*, collected in USA (Arizona) are morphologically similar to *A. durangensis* and *A. tumefaciens* (see above). Galls similar to those of *A. wheeleri* have been collected on several oaks in Mexico, but we only obtained parasitoids and inquiline in Mexican samples. Most probably, *A. wheeleri* is also present in Mexico.

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