



SCIENTIFIC PAPER

***Neuroterus fusifex* Pujade-Villar and Ferrer-Suay n. sp.: FIRST RECORD OF GALLS ON CATKINS IN MEXICO (HYMENOPTERA: CYNIPIDAE)**

Juli Pujade-Villar ¹✉

Rosa D. García-Martíñón ²

Armando Equihua-Martínez ²

Edith G. Estrada-Venegas ³

Mar Ferrer-Suay ⁴

¹Universitat de Barcelona, Facultat de Biologia, Departament de Biologia Animal

² Instituto de Fitosanidad, Colegio de Postgraduados, Campus Montecillo.

delisgama@live.com.mx
equihuaua@colpos.mx

³Campus Montecillo, Colegio de Postgraduados.
estradae@colpos.mx

⁴ American Museum of Natural History
mar.ferrer.duay@gmail.com

✉ jpujade@ub.edu

¹Avda. Diagonal 645, 08028-Barcelona, Cataluña.

^{2,3} Km. 36.5 Carretera México-Texcoco, Colonia Montecillo, estado de México, C. P. 56230.

⁴ Central Park West at 79 th Street, New York, NY 10024, USA.

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***Neuroterus fusifex* Pujade-Villar and Ferrer-Suay n. sp. (HYMENOPTERA:
CYNIPIDAE): FIRST RECORD OF GALLS ON CATKINS IN MEXICO**

***Neuroterus fusifex* Pujade-Villar y Ferrer-Suay n. sp. (Hymenoptera: Cynipidae): primer
registro de agallas en amentos de encinos en México**

Juli Pujade-Villar^{1*}, Rosa D. García-Martíñon², Armando Equihua-Martínez², Edith. G. Estrada-Venegas³
y Mar Ferrer-Suay³.

¹ Universitat de Barcelona, Facultat de Biologia, Departament de Biología Animal.

² Fitosenidad, Entomología y Acarología, Colegio de Postgraduados, Campus Montecillo.

³ Colegio de Postgraduados, Campus Montecillo.

⁴ American Museum of Natural History.

*Autor de correspondencia: jpujade@ub.edu

ABSTRACT. A new species of oak gallwasps, *Neuroterus fusifex* Pujade-Villar & Ferrer-Suay n. sp., known from the sexual generation, is described from Mexico. This is the first record of *Neuroterus* species which are inducing galls in catkins. It is an inducing gall on *Quercus laeta* Liebm. (Section *Quercus*) on endemic Mexican oak. Diagnosis, distribution and biology of the new species are given.

Key words: Cynipidae, oak gallwasp, *Neuroterus*, taxonomy, morphology, distribution, biology.

RESUMEN. Una nueva especie de avispa agalladora de encino, *Neuroterus fusifex* Pujade-Villar y Ferrer-Suay n. sp., de la cual se conoce la generación sexual, se describe en México. Este es el primer registro de especies del género *Neuroterus* que están induciendo agallas en los amentos de *Quercus laeta* Liebm. (Sección *Quercus*) un encino endémico mexicano. La diagnosis, distribución y biología de la nueva especie es presentada.

Palabras clave: Cynipidae, avispa agalladora, *Neuroterus*, Taxonomía, morfología, distribución, biología.

INTRODUCTION

The oak gallwasps (Cynipidae: Cynipini) are by far the most species-rich group of cynipids with more than 1000 described species (Melika and Abrahamson, 2002; Pujade-Villar, 2003; Melika, 2006) in more than 30 genera, some of which were only described recently (Medianero and Nieves-Aldrey, 2013; Melika *et al.*, 2010, 2013; Pujade-Villar *et al.*, 2010, 2012a, 2012b, 2013; Tang *et al.*, 2011). The species diversity of the Mexican oak gallwasps is extraordinarily high, around 184 species are known (Pujade-Villar and Ferrer-Suay, 2015) which are associated with more than 30 oak species (Pujade-Villar *et al.*, 2009).

The genus *Neuroterus* was erected by Hartig (1840) to include several European species, adults of which lack the transscutal articulation. Since then many other species were included into this genus, increasing the morphological variability and the taxonomical chaos. Kinsey (1923) subdivided *Neuroterus* into six subgenera on the

basis of adult morphology, geographic distribution, gall structure, and life cycles, underlining the fact that this group is biologically diverse and quite possibly not monophyletic. Melika *et al.* (2010) revised the group considering five valid genera, *Neuroterus*, *Trichagalma* Mayr, *Pseudoneuroterus* Kinsey, *Latuspina* Monzen and *Cerroneuroterus* Melika and Pujade-Villar; latter another genus was described without transscutal articulation: *Cycloneuroterus* Melika and Tang. Nevertheless, *Neuroterus* is still a problematic genus particularly by its generic limits, the Nearctic *Neuroterus* is a polyphyletic group, moreover phylogenetic reconstructions strongly challenge the monophyly of *Neuroterus* (Liljeblad *et al.*, 2008; Stone *et al.*, 2009; Melika *et al.*, 2010).

The diagnostic features of *Neuroterus* are (i) malar sulcus at least traceable, (ii) tarsal claws with basal lobe (except simple in *N. tricolor* Hartig), (iii) notaular absent, incomplete or present in the posterior 1/2 or 1/3 of the mesoscutum,

always superficial (exceptions: *N. anthracinus* with deep and complete notauli, and *N. tricolor* with shallow and complete notauli in sexual form and deeper notauli in agamic form), (iv) lateral propodeal carinae absent (except in *N. anthracinus* and *N. tricolor*), (v) mesoscutum smooth or with weak alutaceous or coriaceous sculpture, (vi) scutellar foveae absent (except in *N. anthracinus*) only with an anterior scutellar depression, (vi) transscutellar carinae absent (except in *N. anthracinus*) and (vii) having a very compressed metasoma (except in *N. anthracinus*). Of these diagnostic features, only the first one, the presence of traceable malar sulcus, appears to be synapomorphic for the genus (in some North-American species it is absent, probably they have been erroneously placed in *Neuroterus*), a feature not found in any other genera belonging to the “*Neuroterus* complex” (*Trichagalma*, *Pseudoneuroterus*, *Latuspina*, *Cerroneuroterus* and *Cycloneuroterus*) and supported by the putative synapomorphy of the lack of the medial transscutal articulation.

Also, *Neuroterus* presents head and mesosoma with sparse setae; F1 in male antenna slightly or not modified, never expanded and flattened, sometimes only curved or of a similar shape as F2; notaulus absent or incomplete, extending to half-length of mesoscutum or in some rare cases complete (e.g. *N. anthracinus* and in some Chinese species recently described in Pujade-Villar *et al.*, (2016)); the mesoscutum and/or mesoscutellum are smooth or entirely or partially alutaceous or delicately coriaceous (except also in some Chinese species recently described in Pujade-Villar *et al.*, (2016)); mesoscutum emarginated and elevated posterolaterally above the dorsoaxillar area, fused with the mesoscutellum; the propodeum without or with weak fragmented, indistinct lateral propodeal carinae (complete in *N. anthracinus* and *N. politus* Hartig); the hind tarsal claw with a basal lobe (except in *N. tricolor* also in some Chinese species recently described in Pujade-Villar *et al.*, (2016)); the prominent part of the ventral spine of the hypopygium is always short, pointed to the apex, never more than 4.0 times as long as broad, with some long subapical setae, which never form a tuft.

Kinsey (1938) was the first who described six new species of *Neuroterus* from Mexico all of which are known to induce leaf galls (Pujade *et al.*, 2009) and recently Pujade-Villar *et al.* (2014) described two species inducing galls in twigs of an endemic Mexican oak. The species here described is the first Mexican species of *Neuroterus* producing catkin galls.

MATERIALS AND METHODS

Sexual adults gallwasps were reared from galls collected on *Quercus laeta* Liebm. (section *Quercus*) and *Q. crassifolia* Bonpl. (section *Lobatae*) (Govaerts and Frodin, 1998). We follow the current terminology of morphological structures (Liljeblad and Ronquist, 1998; Melika, 2006). Abbreviations for the forewing venation follow Ronquist and Nordlander (1989); cuticular surface terminology follows that of Harris (1979). Measurements and abbreviations used here include: F1–F11, 1st 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, 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.

The SEM pictures were made by first author using field-emission gun environmental scanning electron microscope (FEI Quanta 200 ESEM), with for hard-resolution imaging with gold-coating the specimens. Galls images were taken by the second author; galls images with a Canon digital camera PowerShot SX510 HS followed by processing with Adobe Photoshop CS3 program. Adults images were taken by Jorge M. Valdez Carrasco at Colegio de Postgraduados (Texcoco, Mexico) with a digital camera associated to Carl Zeiss microscopy III followed by processing with GIMP 2.8 program.

The type material, collected by Rosa D. García Martíñón, is deposited in the next institutions: **UB**, University of Barcelona, Spain (J. Pujade-Villar); **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, USA (curator M. Buffington).

DESCRIPTION

Neuroterus fusifex Pujade-Villar and Ferrer-

Suay n. sp.

(Figs 1–3)

Diagnosis. According to Kinsey's descriptions and keys (Kinsey, 1923), *Neuroterus fusifex* Pujade-Villar and Ferrer-Suay n. sp. belongs to the *Diplobius* Kinsey subgenus, known from the Nearctic only, with six species, *N. tumba* Kinsey, *N. visibilis* Kinsey, *N. reconditus* Kinsey, *N. volutans* Kinsey, *N. vulpinus* Kinsey, described from Mexico (Kinsey, 1938) and *N. verrucum* Pujade-Villar, 2014. All Kinsey Mexican *Neuroterus* (*Diplobius*) species have the mesoscutum smooth, glabrous, without surface sculpture and all induce leaf galls, while in *Neuroterus fusifex* Pujade-Villar and Ferrer-Suay n. sp. the mesoscutum is alutaceous to delicately coriaceous and galls occurs in catkins. The new species is morphologically similar to *N. verrucum*, nevertheless, the new species is a sexual form, F1 is 1.5 times as long as F2, ocelli raised, mesoscutum smooth in the centre, scutellum slightly pointed distally, tarsal claws with a short tooth and galls occur in catkins while in *N. verrucum* is an asexual form, females have F1 shorter, ocelli non raised, mesoscutum completely sculptured, scutellum rounded, tarsal claws almost simple and galls occur in twigs (cryptic galls).

SEXUAL FEMALE (length 1.7–1.9 mm; n = 20)

Colour. Body dark. Head chestnut to black, yellowish in malar area; mesosoma chestnut to black, metasoma lighter. Mandibles yellow with black tooth. Antennae brown, except yellow scape, pedicel and basal part of F1. Tegulae yellowish. Legs yellow except last tarsomere and some femurs area light brown. Wing veins brown.

Head (Figs. 1a, b, e) around 2.8 times as wide as long from above, 1.1 times as wide as high in front view and as wide as mesosoma. Lower face alutaceous to smooth, with sparse setae, without

striae radiating from clypeus. Gena only very slightly broadened behind eye, around 1/10 as wide as transverse diameter of eye; malar space very short 0.2 times as long as eye height, malar sulcus present. Ocellar area slightly elevated; POL:OOL:LOL equal 5:2:3, lateral ocellus 1.5. Transfacial distance equal than height of eye; diameter of torulus (including rims) slightly shorter to distance between toruli (1.8:2.0), distance between torulus and inner margin slightly longer than diameter of torulus (2.0:1.8); inner margins of eyes slightly converge ventrally. Clypeus small, trapezoid, alutaceous in the centre, smooth lateral, ventrally straight, medially not incised; anterior tentorial pits, epistomal sulcus and clypeo-pleurostomal line distinct. Frons, vertex and interocellar area alutaceous, shiny and glabrous.

Antenna (Fig. 2a). Antenna longer than head+mesosoma, with 13 antenomeres; pedicel 1.5 times as long than wide; F1 slightly curved 1.8 times as long as pedicel; F2 straight; F3–F11 slightly subequal; F1 shorter than scape+pedicel (42:52) and 1.5 times as long than F2; antennal formula: 3: 2.5: 4: 3: 3: 3: 3: 2.5: 2.5: 2.5: 3.5; placodeal sensilla in all flagellomere segments.

Mesosoma (Figs. 3a–c). Around 1.1 times as long as high in lateral view, glabrous. Pronotum alutaceous and shiny. Mesoscutum 1.2 times as long as wide in dorsal view, weakly alutaceous, smooth in the centre, with very few sparse setae laterally. Notauli absent, anterior parallel and parapsidal lines absent, or only indicated by an absence of weak sculpture. Parascutal carina absent, mesoscutum emarginate and elevated postero-laterally, fused with mesoscutellum. Mesoscutellum weak alutaceous, around 0.5 times as long as mesoscutum, broader than long (10:8), not overhanging metanotum, surface with some sparse short setae, slightly pointed distally; scutellar foveae absent; superficial, shiny anterior scutellar depression present. Mesopleuron and mesopleural triangle alutaceous, almost without setae; axillula alutaceous, with few sparse setae; subaxillular bar very short, smooth, shiny; postalar process absent; metapleural sulcus reaching mesopleuron in 1/2 of its height, dorsal part of sulcus inconspicuous. Metascutellum

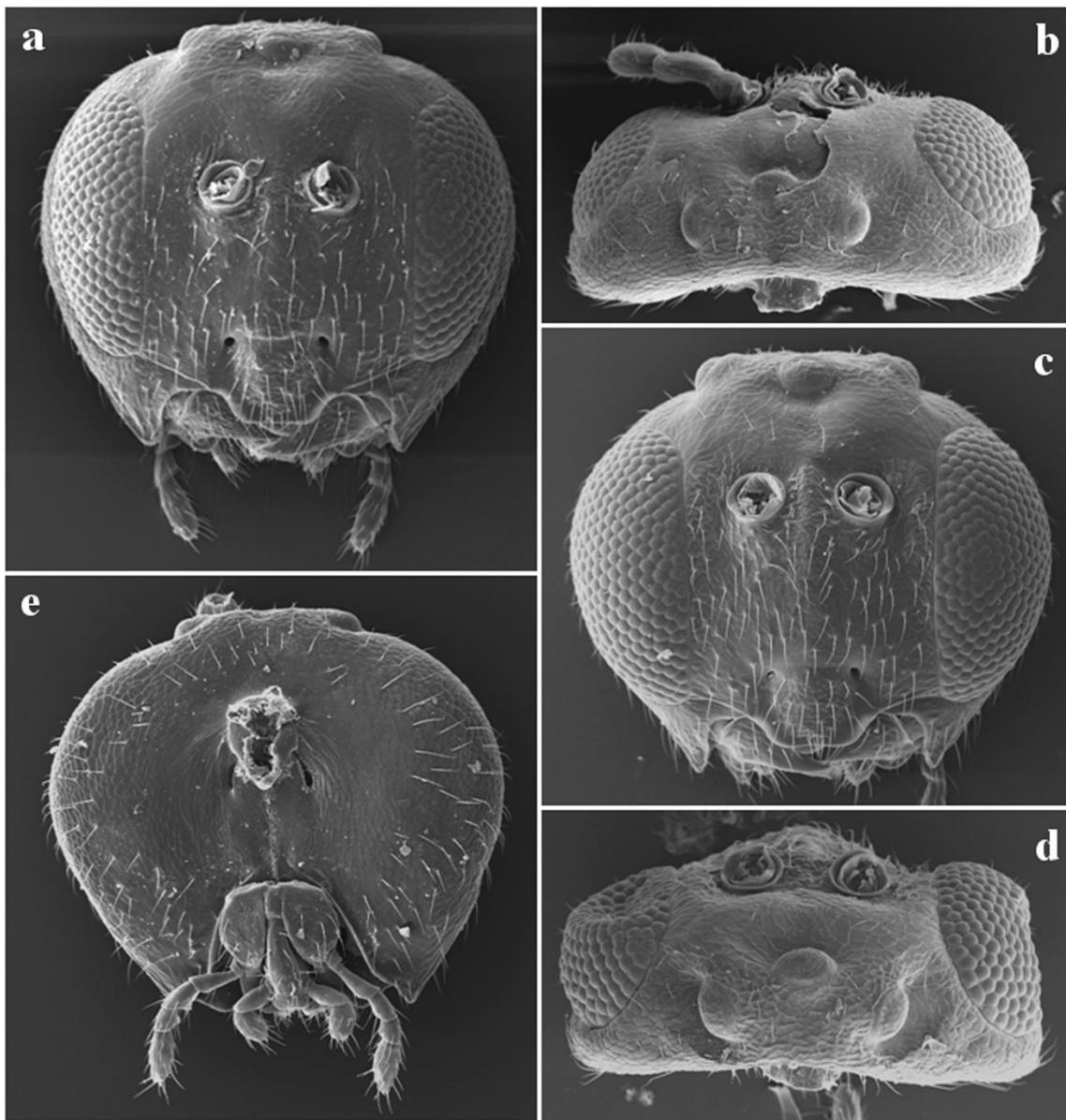


Figure 1. *Neuroterus fusifex* Pujade-Villar and Ferrer-Suay n. sp.: (a) female head, frontal view; (b) female head, dorsal view; (c) male head, frontal view; (d) male head, dorsal view; (e) female head, posterior view.

alutaceous, subrectangular. Metanotal trough alutaceous and glabrous; ventral impressed area 1/3 metascutellum height, slightly carinate. Propodeum alutaceous, glabrous; posterolateral process absent; propodeal spiracle big; propodeal carinae absent, but with some central weak rugae. Nucha short alutaceous to smooth.

Legs. Tarsal claws with a short tooth (Fig. 3d).

Forewing (Figs. 4c-d). Longer than body length (32:27), transparent with brown veins, with cilia on margins, without dark spots; radial cell around 4.5 times as long as wide; 2r curved; R1 not reaching wing margin; Rs conspicuous, straight,

not reaching to forewing margin and slightly project parallel to margin; areolet present, triangular; Rs + M reaching basal vein in posterior 1/3 of its height.

Metasoma. Shiny, shorter than head + mesosoma, slightly longer than high in lateral view, second metasomal tergite smooth, with very few sparse setae laterally; subsequent tergites without setae, smooth and shiny. Prominent part of ventral spine of hypopygium short, tapering to apex, around 2.0 times as long as wide, with very few long sparse setae laterally which not extend beyond apex of spine (Fig. 3e).



Figure 2. *Neuroterus fusifex* Pujade-Villar and Ferrer-Suay n. sp.: (a) female antenna and detail of pedicellum and first flagellomeres, (b) male antenna and detail of pedicellum and first flagellomeres.

MALE (length 1.7-1.8 mm; N = 11)

Similar to female except in: body lighter (Fig. 4e); antennae lighter, all flagellomeres yellowish to light brown; metasoma yellowish, with some light brown spots dorsally, rarely also in lateral; malar space shorter (0.1 times as long as eye height), transfacial distance shorter, 0.9 as long as height of eye (Fig. 1c); POL:OOL:LOL equal 5:1:2, lateral ocellus 2.5 (Fig. 4d); antenna with 14 segments (Fig. 2b), F1 slightly curved and slightly broadened distally, 2.4 times as long as pedicellum and 1.7 times as long as F2; antenal formula 3: 2.5: 6.5: 4: 3: 3: 3: 3: 3: 3: 3: 3;

mesoscutum sculpture alutaceous, more conspicuous; scutellum relatively more pubescent.

Type material. Holotype ♀ with the following labels: “MEX Cerro de las Campanas - Arenales, San Felipe del Progreso (Estado de México), 19° 68' 52.35" W, 99° 93' 78.16" N, 2,600 m., Ex. Q. laeta, (19.iv.2014) 23-30.iv.2014, Delia col.” (white label), Holotype of *Neuroterus fusifex* Pujade-Villar n. sp. design. JP-V 2013” (red label). Paratypes (18♂ & 30♀): the same data as the holotype. The holotype ♀ and 10♂ & 20♀ paratypes are deposited in the UB (JP-V col.), 4♂ & 5 ♀ paratypes in AMNH, 4♂ & 5 ♀ paratypes in USNM.

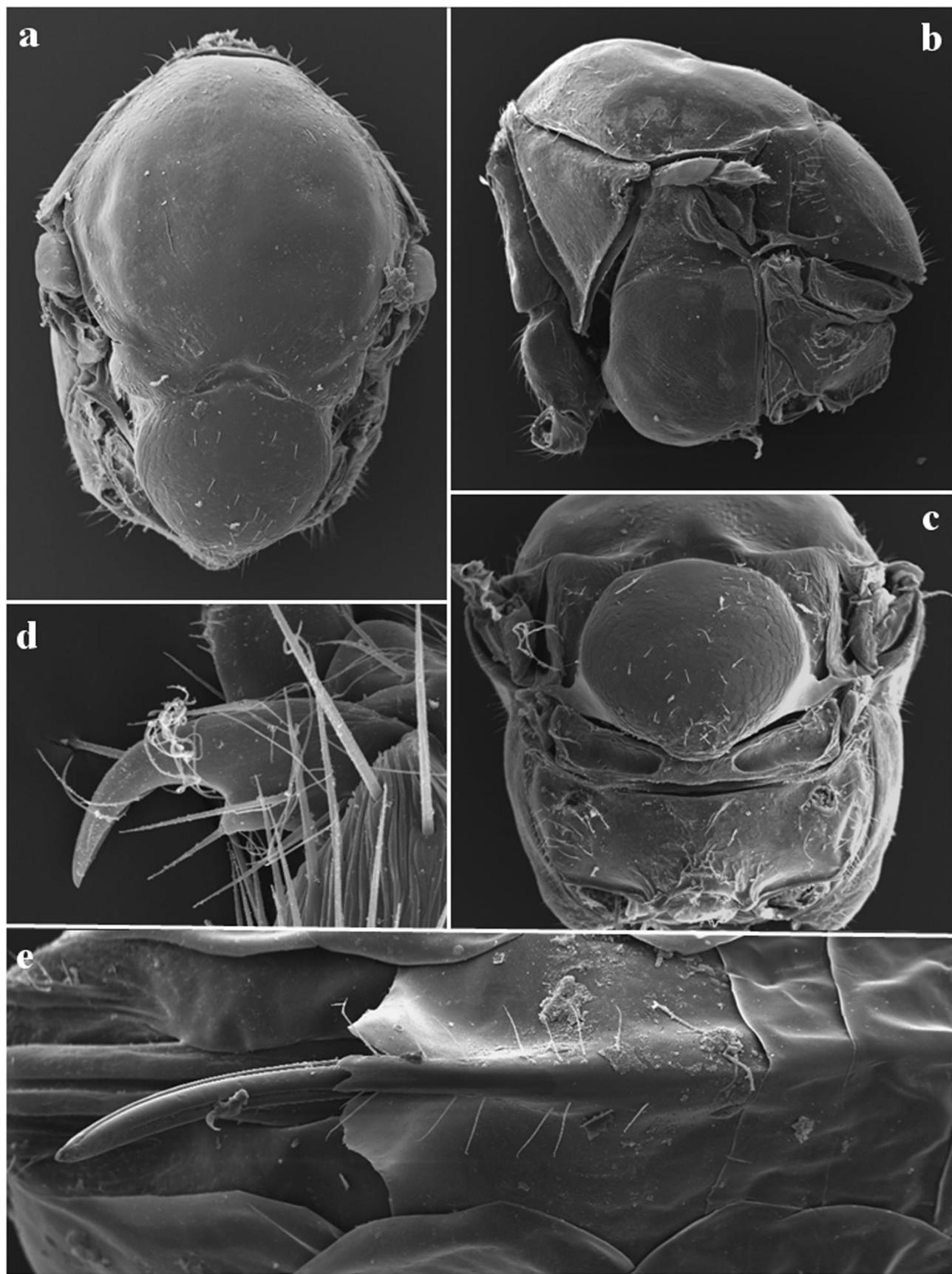


Figure 3. *Neuroterus fusifex* Pujade-Villar and Ferrer-Suay n. sp.: (a) metasoma, dorsal view; (b) metasoma, lateral view; (c) mesosoma, posterior view, tarsal claw; (d) hypopygium and ventral spine in ventral view.

Additional material. 5♂ & 37♀ (1♂ & 3♀ dissected) with the same data as the holotype.

Gall (Fig. 4a-b). Multilocular gall, located in catkins, ovoid (7-12 mm long and 5-7 mm wide). It is caused by the hypertrophy of the axis with anthers of the some flowers are protruding. When young it is green and turgescent, which hardens and becomes violet-red at maturity. The surface is provided with a thin, dense whitish pubescence. Inside numerous rounds larval chambers (0.5 mm in diameter) are closely disposed ones together with each other, jointed with a hard consistency. The medullar space between larval chambers hardly exists.

Host plant. *Quercus laeta* Liebm. (section *Quercus*) endemic from Mexico.

Distribution. Mexico (Cerro de las Campanas - Arenales, San Felipe del Progreso, Estado de México).

Biology. Only the sexual generation is known. The galls appear in April on catkins. Adults emerge in the last April or early May. The galls fall to the ground shortly after although some can remain in the tree some more months.

Etymology. The species name “*fusifex*” is related with a very similar gall present in the Palaearctic area: *Plagiotrochus fusifex* (currently a synonym of *P. quercusilicis*).

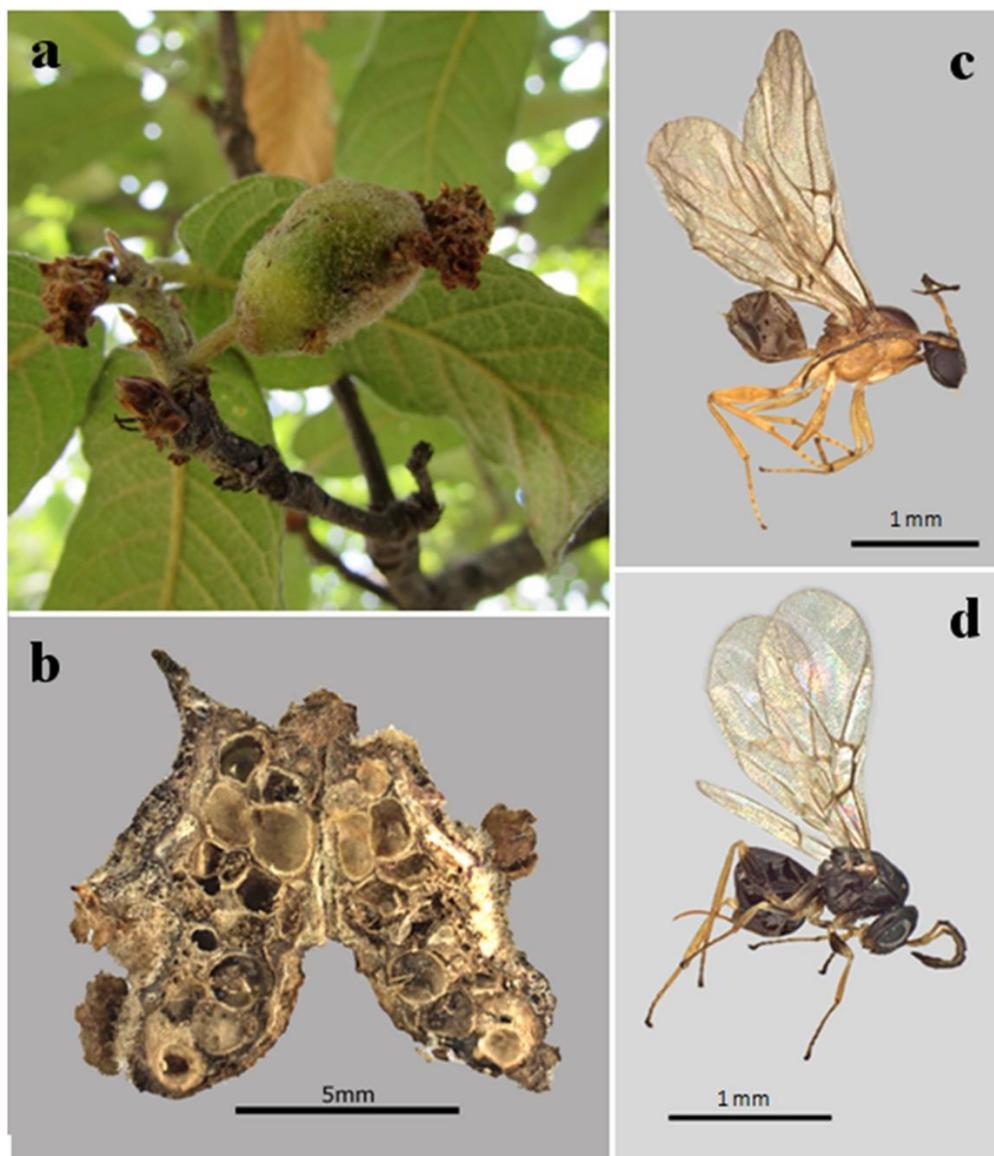


Figure 4. *Neuroterus fusifex* Pujade-Villar & Ferrer-Suay n. sp.: (a) gall in catkins, (b) cut gall with larval chambers, (c) male, (d) female.

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