

GEA, FLORA ET FAUNA

***Neuroterus titou* n. sp. from Costa Rica (Cynipidae: Cynipini)**

Juli Pujade-Villar* & Paul Hanson**

* Universitat de Barcelona. Facultat de Biologia. Departament de Biologia Evolutiva, Ecologia i Ciències Ambientals. Avda. Diagonal, 645. 08028 Barcelona. Catalonia. A/e: jpujade@ub.edu

** Universidad de Costa Rica. Escuela de Biología. Universidad de Costa Rica. San Pedro, Costa Rica. A/e: phanson91@gmail.com

Corresponding author: Juli Pujade-Villar, A/e: jpujade@ub.edu

Rebut: 14.09.2021; Acceptat: 20.09.2021; Publicat: 30.09.2021

Abstract

A new species of *Neuroterus* Hartig, 1840 (Hymenoptera: Cynipidae: Cynipini) is described from Costa Rica: *Neuroterus titou* n. sp. This new species is the second species of the genus *Neuroterus* recorded from Costa Rica. *Neuroterus titou* n. sp. induces leaf galls on *Quercus copeyensis* CH Mull. (Fagaceae, subgen. *Quercus*, sect. *Quercus*, White Oaks, Series *Leucomexicanae*). The diagnostic morphological features, the description of the adult and the gall, and other biological data of this new species are given and discussed.

Key words: Cynipidae, Cynipini, *Neuroterus*, *Quercus*, Costa Rica; new species.

Resum***Neuroterus titou* n. sp. de Costa Rica (Cynipidae: Cynipini)**

Es descriu de Costa Rica una nova espècie de *Neuroterus* Hartig, 1840 (Hymenoptera: Cynipidae: Cynipini): *Neuroterus titou* n. sp. Aquesta nova espècie és la segona espècie del gènere *Neuroterus* registrada a Costa Rica. *Neuroterus titou* n. sp. induïx gales foliars a *Quercus copeyensis* CH Mull. (Fagaceae, subgènere. *Quercus*, sect. *Quercus*, Alzines blanques, Sèrie *Leucomexicanae*). Es donen i es discuteixen els caràcters morfològics diagnòstics, la descripció de l'adult i de la gala, i altres dades biològiques d'aquesta nova espècie.

Paraules clau: Cynipidae, Cynipini, *Neuroterus*, *Quercus*, Costa Rica, nova espècie.

[urn:lsid:zoobank.org:pub:3DB26C70-29BB-46EB-AEF9-4C0B12C1A846](https://zoobank.org/pub:3DB26C70-29BB-46EB-AEF9-4C0B12C1A846)

Introduction

Neuroterus Hartig (Hymenoptera, Cynipidae) is one of the more species-rich genera of Cynipini, along with *Andricus* Hartig (Stone *et al.*, 2002). Since Hartig (1840) first described the genus, based only on European species, *Neuroterus* has become one of the more problematic genera of Cynipini with respect to its generic limits, and the identification and classifications of the included species (Medianero & Nieves-Aldrey, 2017). It is widely distributed around the world where *Quercus* is present, although it is not yet known from eastern Panama or Colombia (in America) and the Oriental region (in Eurasia). The character that allows recognition of the genus (in its traditional sense) is the absence of a transcutellar suture separating the mesoscutum and the scutellum. For many years all Cynipini without this suture were included in *Neuroterus*, thereby becoming a chaotic and non monophyletic genus (Liljeblad *et al.*; 2008; Melika *et al.*, 2010). In the Eurasian area Pujade-Villar *et al.* (2004) considered the subgenus *Pseudoneuroterus* Kinsey as a valid genus, and Melika *et al.* (2010) described *Cerroneuroterus* Melika & Pujade-Villar for some *Neuroterus* inducing galls on oaks in the Cerris section and considered the subgenus *Latuspina* Monzen as a valid genus. Mayr (1907) described from the eastern Palearctic the genus *Trichagalma*, which does not have a transscutellar

lar suture but is very pubescent (unlike *Neuroterus* which is glabrous). Thus, in the Palearctic region there are five genera without a transcutellar suture that induce galls on *Quercus*. More recently, a new genus closely related to *Neuroterus*, *Cycloneuroterus* Melika & Tang, was described for a group of Oriental species (Taiwan and mainland China) associated with *Cyclobalanopsis*, *Lithocarpus* and *Castanopsis* (Tang *et al.*, 2011; Péntzes *et al.*, 2018).

In America all species without a transcutellar suture are included in *Neuroterus*, but these species need to be revised and should probably be divided into several genera as was done for the Eurasian species. In fact, Pujade-Villar *et al.* (2015) argued that Nearctic *Neuroterus* is a polyphyletic group as currently defined and suggested that new genera will need to be established. An attempt in this direction was made by Kinsey (1923), who recognized 6 subgenera, 3 of them for the American species.

Neuroterus includes around eighty species (Melika *et al.*, 2010; Medianero & Nieves-Aldrey, 2017; Péntzes *et al.*, 2018; Pujade-Villar *et al.*, 2018), sixty-five of them from America: 51 have been listed from the United States and Canada (Burks, 1979; Melika & Abrahamson, 1997); 11 from Mexico (Pujade-Villar *et al.*, 2018), 2 from Panama (Medianero & Nieves-Aldrey, 2017) and a single species from Costa Rica (Medianero & Nieves-Aldrey, 2017).

The aim of this study is to describe a new species of *Neuroterus* from Costa Rica belonging to the subgenus *Diplobius* Kinsey and producing a leaf gall very similar to that of *N. pulchrigalla*, which was described and illustrated by Medianero & Nieves Aldrey (2017).

Material and methods

Adult gall wasps were reared from galls collected in Cerro de la Muerte by the second author on *Quercus copeyensis* belonging to section *Quercus*, in 1997 and 2000. The galls were stored in rearing containers. The adults emerged under laboratory conditions and were preserved in ethanol, with selected specimens subsequently dried and point mounted.

We follow Liljeblad & Ronquist (1998) and Melika (2006) with respect to morphological terminology, except abbreviations for forewing venation follow Ronquist & Nordlander (1989); cuticular surface terminology follows that of Harris (1979). Measurements and abbreviations used here include: F1–F12, 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 type specimens of the newly described species are deposited in the following institutions: UB, Universitat de Barcelona, Catalonia (Juli Pujade-Villar col.); MZUCR, Museo de Zoología, Universidad de Costa Rica (Paul Hanson curator).

The SEM pictures were acquired using a field-emission gun environmental scanning electron microscope (FEI Quanta 200 ESEM), for high-resolution imaging without gold-coating the specimens. Gall images were taken with a Canon A1 camera with a 50 mm macro lens followed by Adobe Photoshop CS3 software processing. Adult images were taken with an Olympus SC30 camera, coupled to an Olympus U-CMAD3, adapted to an Olympus SZX10 stereomicroscope. Multiple photograph combinations were achieved with a Helicon Focus 6.2.2 for stacking and image processing. Forewing with a Canon camera (Power Shot SX 210 IS) directly from the microscope eyepiece.

Results

Neuroterus titou Pujade-Villar & Hanson n. sp. (Figs. 1-4)

[urn:lsid:zoobank.org:act:9D8091E3-B083-4B46-95F4-90CB6B5-DF612](https://zoobank.org/act:9D8091E3-B083-4B46-95F4-90CB6B5-DF612)

Diagnosis

The galls are similar to those of *Neuroterus pulchrigalla* Medianero & Nieves-Aldrey, 2017 but the adults have 12

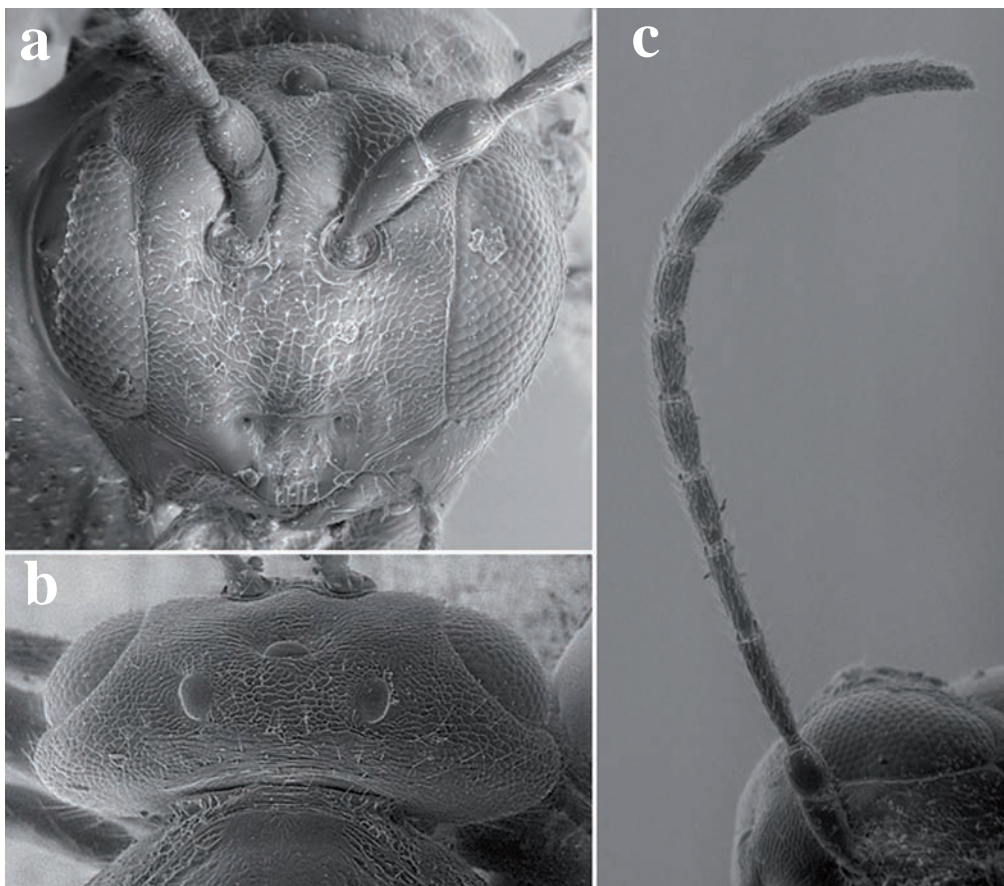


Figure 1. *Neuroterus titou* n. sp. a) head in frontal view; b) head in dorsal view; c) antenna.

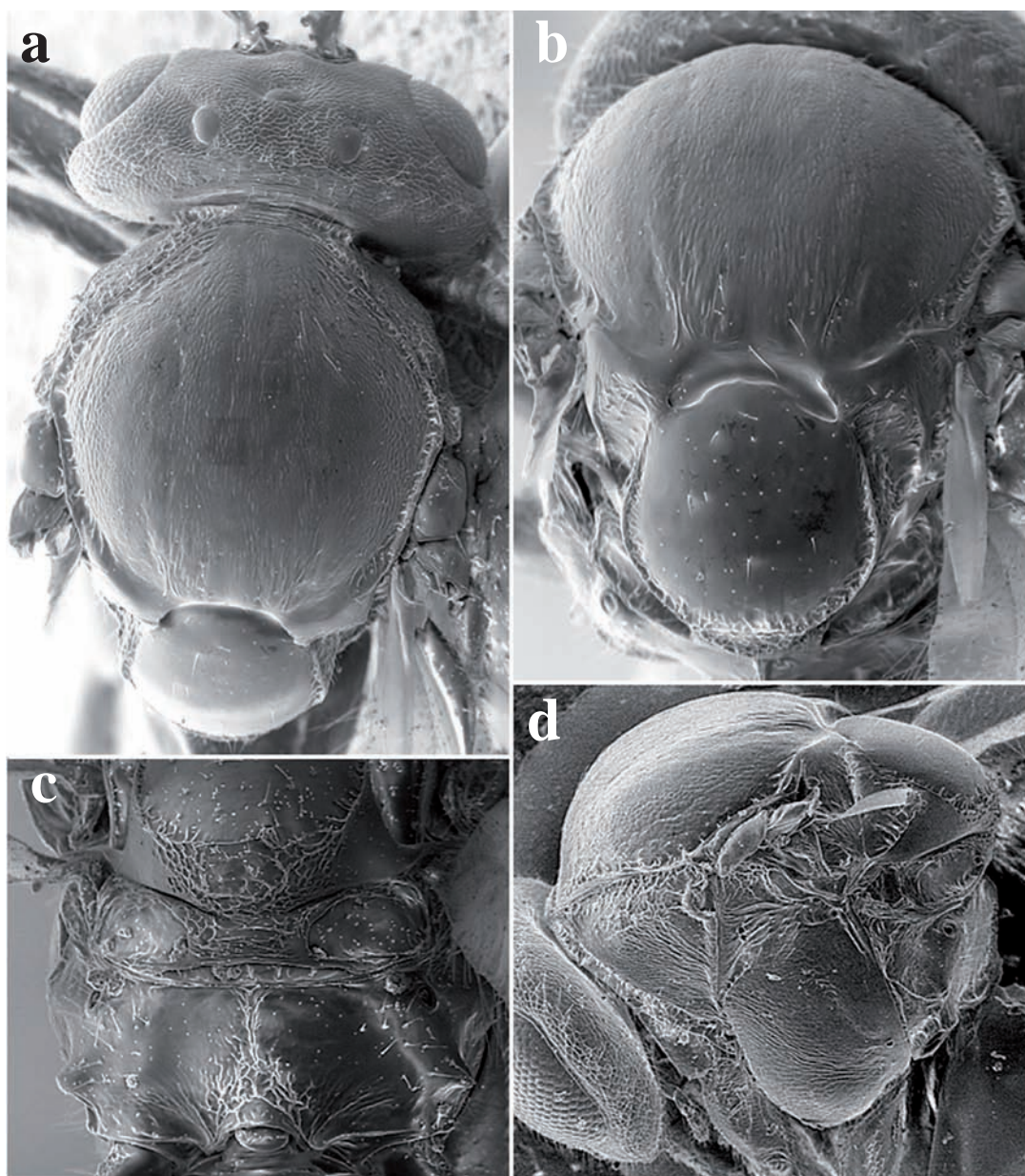


Figure 2. *Neuroterus titou* n. sp.: a-b) mesosoma in dorsal view; c) propodeum; d) mesosoma in lateral view.

flagellomeres and the mesoscutum is coriaceous and basally with some longitudinal rugae (11 flagellomeres and almost smooth mesoscutum in *N. pulchrigalla*). These morphological characters mentioned for the new species are also present in *N. glandiphilus* Nieves-Aldrey & Medianero, 2017 but the galls of this latter species occur in acorns. Morphologically, *N. titou* n. sp. differs from *N. glandiphilus* in the clypeus (rounded in *N. titou* n. sp., incised medially in *N. glandiphilus*), in the POL-OOL length (POL 2.0x as long as OOL and OOL 1.3x as long as diameter of lateral ocellus in *N. titou* n. sp., POL 1.6x as long as OOL and OOL 2.6x as long as diameter of lateral ocellus in *N. glandiphilus*) and in the forewings (radial cell 3.8x as long as broad in *N. titou* n. sp.; radial cell 4.3x as long as broad in *N. glandiphilus*). Also, the new species is an asexual form and *N. glandiphilus* a sexual form (see discussion).

Type material

HOLOTYPE deposited in UB (col. JP-V) with the following labels: 'Costa Rica, San José, Cerro de la Muerte. Est. Biol. Cuericí. 2600 m., ii.2000. P. Hanson' (white label); '*Q. copeyensis*, bristly cylinder' (white label); 'Holotype of *Neuroterus titou* Pujade-Villar & Hanson n. sp. ♂, desig. JP-V 2021' (red label). PARATYPES (6♂ deposited in UB, 3 in MZUCR): 6♂ with same data of holotype; 2♂ idem ii.1997; 1♂ idem ix.1997.

Description (Figs. 1-3, 4c-d)

Asexual Female

Body length, 1.7 – 2.0 mm (N=7)

Color

Body chestnut to dark brown. Scape, pedicel and F1 yellowish, remaining flagellomeres darker. Mandibles yellowish

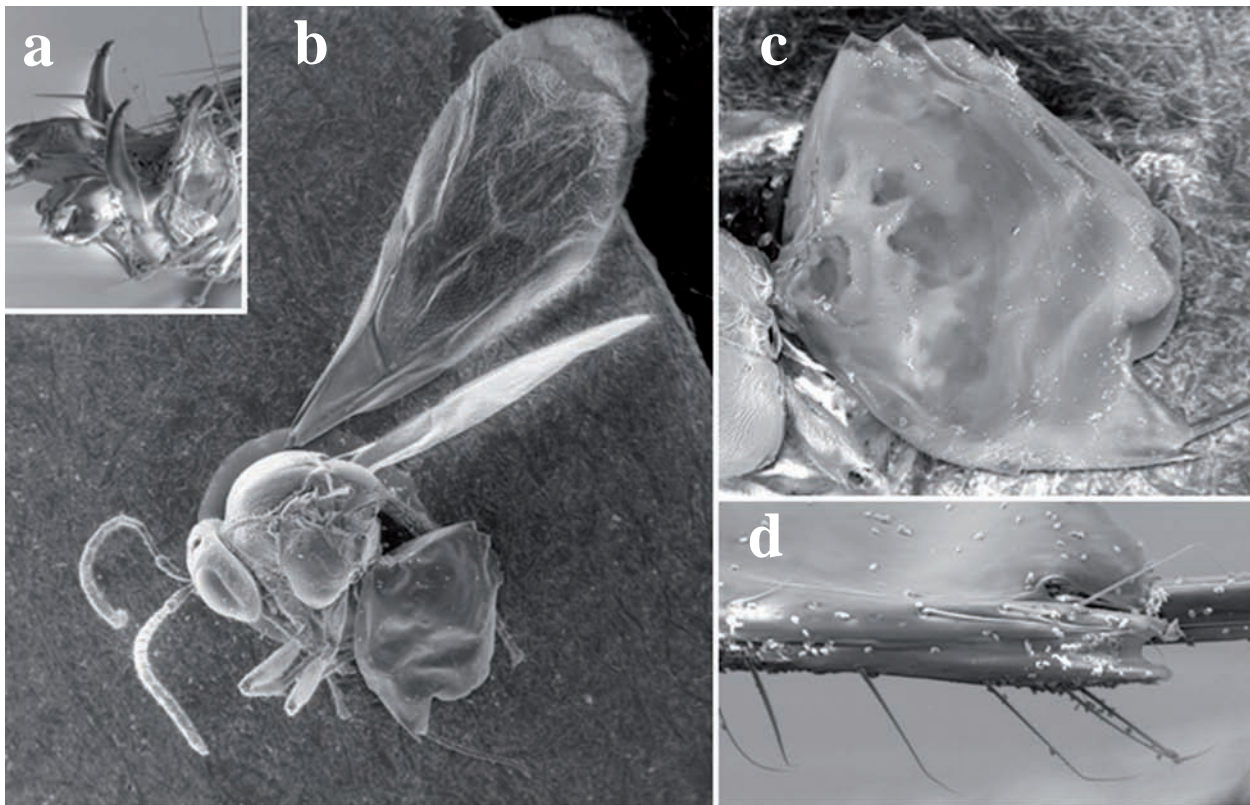


Figure 3. *Neuroterus titou* n. sp.: a) tarsal claws; b) habitus; c) metasoma in lateral view; d) ventral spine of hypopygium in ventral view.

with red tooth with black margin. Legs predominantly brown-yellowish, with coxae distally, trochanters, distal femora and metatibiae darker. Forewings hyaline with veins brown.

Head

Transversely oval in frontal view, 1.2x as high as broad; in dorsal view 2.5x as broad as long and as broad as mesosoma. Vertex, frons and face uniformly coriaceous; vertex and frons without setae, face with sparse white setae in the centre. Genae very slightly expanded behind eyes. Clypeus trapezoidal, as wide as high, shining, moderately pubescent, ventral margin rounded and projecting over mandibles; median area of clypeus with alutaceous sculpture; lateral and ventral projecting areas smooth. Anterior tentorial pits conspicuous; epistomal sulcus present and clypeo-pleurostomal lines inconspicuous. Malar space 0.3x the height of compound eye, with a distinctive, complete and well-impressed malar sulcus running through a smooth or nearly smooth area. Transfacial line 1.2x as long as height of eye. Compound eyes slightly converging ventrally. Toruli located at mid-height of head, diameter of antennal torulus 1.3x as long as distance between them, distance between torulus and eye as long as diameter of torulus. Ocellar plate slightly raised. POL 2.0x as long as OOL, OOL 1.3x as long as diameter of lateral ocellus and longer than LOL; all ocelli ovate and of the same size.

Antenna

Longer than head+mesosoma, with 12 flagellomeres; pedicel 1.5x as long as broad; F1 2.0x as long as pedicel and

1.3x as long as F2; F2 1.1x as long as F3; F3=F4, F5=F6 but slightly shorter than F4, F7 to F12 slightly shorter than F6 and subequal. Relative lengths of antennal segments: 5/3/6/4.5/4/4/3.5/3.5/3/3/3/3/3/3. Placodeal sensilla white, distinct on F3–F12.

Mesosoma

Short, around 1.2x as long as broad in dorsal view, very slightly longer than high in lateral view and with dorsal margin strongly convex. Pronotum medially very short, pronotal plate indistinct, with coriaceous sculpture in lateral view with some carinae on posterior margin; glabrous, pubescent only on the anterior margin. Mesoscutum coriaceous, glabrous, basally with some longitudinal rugae visible. Notauli indistinct but shortly traceable basally; median mesoscutal impression absent; anteroadmedian signa reaching 3/4 mesoscutal length, parapsidal signa absent; parascutal carina broad, reaching anterior part of mesoscutum. Transcutellar suture absent. Scutellum nearly circular or very slightly longer than broad, approximately 0.6x as long as mesoscutum, smooth on dorsal surface and disk sparsely pubescent, circumscutellar carina present with some short rugae; coriaceous and rugose distally behind the circumscutellar carina. Scutellar foveae in form of deep, transverse, shining, inverted V-shaped groove. Scutellum not overlapping metascutelium posteriorly in lateral view. Mesopleuron (including speculum) weakly coriaceous, alutaceous in the lower part and glabrous on entire surface; mesopleural triangle alutaceous with some carinae, sparsely pubescent. Metapleural

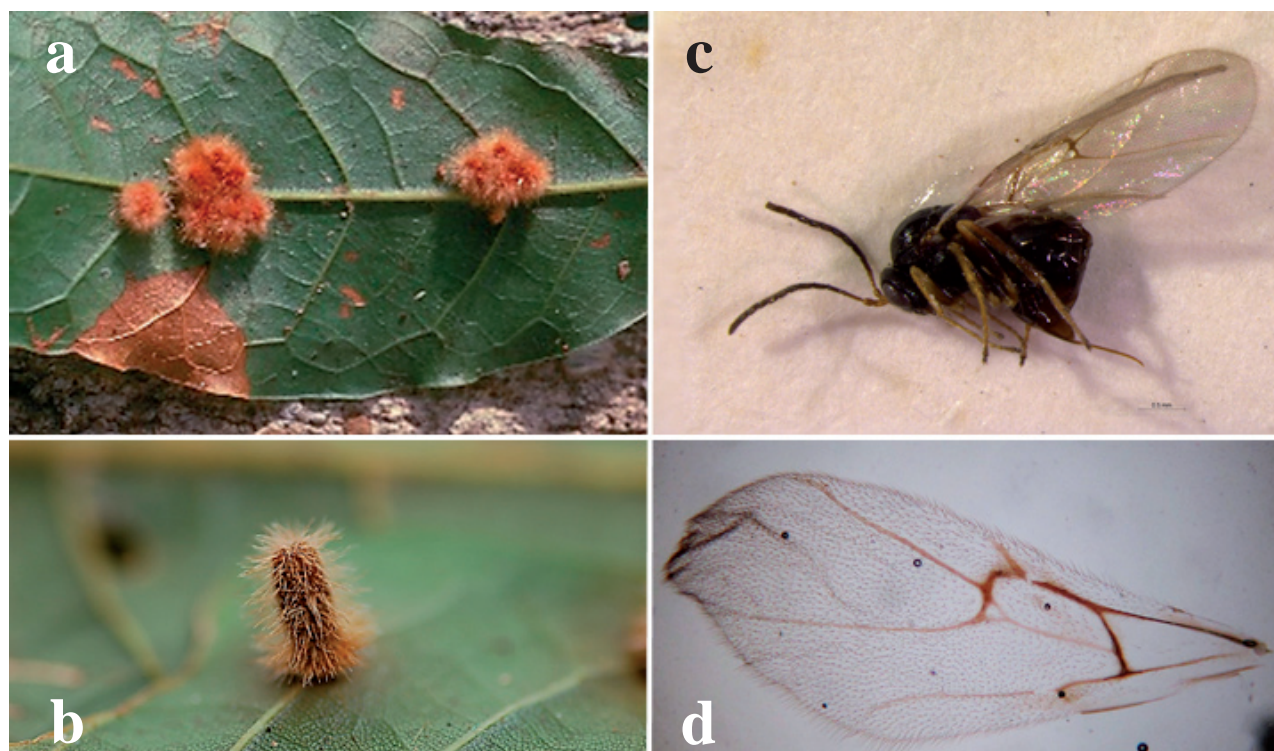


Figure 4. Galls of *Neuroterus titou* n. sp.: a) several galls on the underside of *Q. copeyensis* leaf; b) detail of an old gall; c) habitus; d) forewing.

sulcus poorly defined, reaching posterior margin of mesopectus at about half the distance from ventral margin, lower part glabrous, delimiting smooth area with some weak rugae, upper part of sulcus absent. Metascutellar carinae rugose with strongly coriaceous sculpture; metanotal trough smooth and glabrous. Propodeum almost smooth and very slightly pubescent on the sides; lateral propodeal carinae absent; medial area with an inconspicuous medial coriaceous carina and with a coriaceous rugose area next to the nucha; basally and laterally with some weak radiating carinae; nucha very short inconspicuously sculptured.

Legs

Tarsal claws simple, without a basal lobe or tooth.

Forewing

1.7x as long as body, hyaline, setose; apical margin with a fringe of long setae. Radial cell 3.8x as long as broad, open along anterior margin, areolet triangular, closed and distinct; R1 and Rs reaching margin of wing; Rs not expanded at apex but continuing slightly parallel to the margin; Rs+M complete or almost reaching the basal vein at its midpoint. First abscissa of radius (2r) curved. Basal cell glabrous and costal cell setose.

Metasoma

Shorter than head + mesosoma combined; as long as high in lateral view. All metasomal tergites smooth, glabrous, second metasomal tergum extending to 2/3 length of metasoma in dorsal view, with very few and sparse short white setae anterolaterally; all terga and hypopygium without micropunctures, prominent part of ventral spine of hypopygium slightly longer than broad in ventral view; lateral margins of

hypopygial spine with setae, the subapical ones slightly projected over apical end of the spine.

Galls (Fig. 4a-b).

The galls produced by this species have the form of upright cylinders, measuring 4.5×2.0 mm., unilocular, located on the undersides of the leaves, inserted on a primary or secondary vein. The gall surface is covered with long, erect and dense yellowish to brown hairs. The color is yellow when fresh, orange when mature and brown when old. The galls are generally found in clusters and are oriented side by side; they are rarely isolated. Internally, two parts are visible; an ovoid larval cell at the attachment of the gall on the leaf and an apical empty part.

Biology

N. titou n. sp. induces galls on *Q. copeyensis* CH Mull. (section *Quercus*), and only the asexual form is known. Trees were not examined throughout the year and so the phenology is incompletely known. However, the vast majority of adults emerged in February.

Distribution

Currently only known from Costa Rica (Cerro de la Muerte).

Etymology

Named in honour of our friend and French biologist recently deceased: Roger Folliot (25th November 1925 - 23th of July 2021). 'Titou' was the nickname he had during the resistance in WWII (<http://asaapicardie3945.fr/index.php/english/rescuers/219-roger-folliot>).

Discussion

The new species described here, and the species described from Panama (Medianero & Nieves-Aldrey, 2017), show some important morphological diagnostic characters that do not fit with those defining *Neuroterus* given by Melika *et al.* (2010). According to Medianero & Nieves-Aldrey (2017) the anomalous characters are mainly the simple tarsal claws, antenna with 11/12 flagellomeres and the propodeal sculpture.

The morphology of the asexual form described here resembles the sexual form of *N. glandiphilus* (see diagnosis), which occurs in acorn galls. Thus, it is possible that the new species could be the asexual form of *N. glandiphilus*. Nevertheless, *Neuroterus* species are extremely uniform in morphology, and finding reliable diagnostic characters that allow for their identification is extremely difficult (Medianero & Nieves-Aldrey, 2017). Also, Medianero & Nieves-Aldrey (2017) mentioned that although the asexual generation is unknown in *N. glandiphilus*, a damaged female, presumably asexual according its morphology, was collected from different, smaller galls in the acorn cup, which may be the alternating form of *N. glandiphilus*. Both *N. titou* n. sp. and *N. glandiphilus* belong to the subgenus *Diplobius* of Kinsey (1923), but differ from the American species included in this subgenus in the number of antennal segments (13 in the subgenus *Diplobius*, 13-14 in *N. glandiphilus* and 14 in *N. titou* n. sp.). Kinsey (1923) mentions that the sexual and asexual forms of species belonging to the subgenus *Diplobius* have nearly identical galls, but the galls of *N. titou* n. sp. occur on leaves and the galls of *N. glandiphilus* are in acorns.

The gall of the new species described here is extremely similar (almost identical) to that of *N. pulchrigalla* described and illustrated by Medianero & Nieves-Aldrey (2017), which is also an asexual form. However, females of *N. titou* n. sp. have a 14 segmented antenna whereas *N. pulchrigalla* have a 13-segmented antenna. The mesoscutum of the former has a coriaceous mesoscutum whereas the latter species has a nearly smooth mesoscutum.

Finally, it should be noted that *Neuroterus titou* n. sp. was collected from galls on *Q. copeyensis* CH Mull. but, according to Medianero & Nieves-Aldrey (2017), *N. glandiphilus* and *N. pulchrigalla* were collected on *Q. bumelioides* Liebm. These authors, based on Kappelle (1996), considered *Q. copeyensis* to be a synonym of *Q. bumelioides*. The name *Q. bumelioides* was also used instead of *Q. copeyensis* in the manual of plants of Costa Rica (Morales, 2010). However, *Q. bumelioides* is currently considered to be a synonym of *Q. sapatifolia* Liebm. (Hélaridot, 2020), which belongs the section Lobatae whereas *Q. copeyensis* belongs to the section Quercus. Based on the illustrations in Medianero & Nieves-Aldrey (2017), we believe that they also collected from *Q. copeyensis*.

Acknowledgements

We are very grateful to Víctor Cuesta-Porta (Facultat de Biologia. Departament de Biologia Evolutiva, Ecologia i

Ciències Ambientals, UB) for taking the photograph of the habitus shown in figure 4c.

Bibliography

- Burks, B. D. 1979. *Superfamily Cynipoidea*. In: K. V. Krombein, P. D. Hurd Jr., D. R. Smith & B. D. Burks (eds.). *Catalog of Hymenoptera in America of North of Mexico. Volume 1. Symphyta and Apocrita*. Smithsonian Institution Press. Washington: 1045-1107.
- Harris, R. 1979. A glossary of surface sculpturing. *Occasional Papers in Entomology*, 28: 1-31.
- Hartig, T. 1840. Ueber die Familie der Gallwespen. III. *Zeitschrift für Entomologie* (Germar), 2: 176-209.
- Hélaridot, J. L. 2020. *Oaks of the world*. Disponible en: <http://oaks.of.the.world.free.fr> [Last consulted: 21-08-2021].
- Kappelle, M. 1996. *Los Bosques de Roble (Quercus) de la Cordillera de Talamanca, Costa Rica: biodiversidad, ecología, conservación y desarrollo*. Instituto Nacional de Biodiversidad y Universidad de Amsterdam. Heredia. 336 p.
- Kinsey, A. C., 1923. The gall wasp genus *Neuroterus* (Hymenoptera). *Indiana University Studies*, 58: 1-150.
- Liljeblad, J. & Ronquist, F. 1998. A phylogenetic analysis of higher-level gall wasp relationships (Hymenoptera: Cynipidae). *Systematic Entomology*, 23, 229-252. <https://doi.org/10.1046/j.1365-3113.1998.00053.x>
- Liljeblad, J., Ronquist, F., Nieves-Aldrey, J. L., Fontal-Cazalla, F., Ros-Farre, P., Gaitros, D. & Pujade-Villar, J. 2008. A fully web-illustrated morphological phylogenetic study of relationships among oak gall wasps and their closest relatives (Hymenoptera: Cynipidae). *Zootaxa*, 1796: 1-73.
- Mayr, G. 1907. Zwei Cynipiden, *Marcellia*, 6: 3-7.
- Medianero, E. & Nieves-Aldrey, J. L. 2017. First record of the oak gall wasp genus *Neuroterus* Hartig, 1840 (Hymenoptera, Cynipidae, Cynipini) from Central America with description of three new species from Panama and Costa Rica. *Graellsia*, 73 (1): e057. <http://dx.doi.org/10.3989/graelisia.2017.v73.178>.
- Melika, G. 2006. Gall wasps of Ukraine. Cynipidae. *Vestnik Zoologii*, suppl., 21 (1): 1-300.
- Melika, G. & Abrahamson, W. G. 1997. Descriptions of four new species of cynipid gall wasps of the genus *Neuroterus* (Hymenoptera: Cynipidae) with redescrptions of some known species from the eastern United States. *Proceedings of the Entomological Society of Washington*, 99: 560-573.
- Melika, G., Pujade-Villar, J., Abe, Y., Tang, C. T., Nicholls, J., Wachi, N., Ide, T., Yang, M. M., Péntzes, Z. S., Csóka, G. Y. & Stone, G. N. 2010. Palaearctic oak gallwasps galling oaks (*Quercus*) in the section Cerris: re-appraisal of generic limits, with descriptions of new genera and species (Hymenoptera: Cynipidae: Cynipini). *Zootaxa*, 2470: 1-79.
- Morales, J. F. 2010. Fagaceae. In: B. E. Hammel, M. H. Grayum, C. Herrera & N. Zamora (eds.). *Manual de Plantas de Costa Rica, Vol. V. Dicotiledóneas (Clusiaceae – Gunneraceae)*. *Monographs in Systematic Botany from the Missouri Botanical Garden*, 119: 776-781.
- Péntzes, Z., Tang, C. T., Stone, G. N., Nicholls, J. A., Schwéger, S., Bozsó, M. & Melika, G. 2018. Current status of the oak gallwasp (Hymenoptera: Cynipidae: Cynipini) fauna of the Eastern Palaearctic and Oriental Regions. *Zootaxa*, 4433 (2): 245-289. <https://dx.doi.org/10.11646/zootaxa.4433.2.2>
- Pujade-Villar, J., Cibrián-Tovar, D., Barrera-Ruiz, U. M. & Cuesta-Porta, V. 2018. Las especies de *Neuroterus* (Hartig, 1840) de México, con la descripción de una especie nueva (Hym., Cynipidae). *Entomología mexicana*, 5: 453-461.

- Pujade-Villar, J., Cibrián-Tovar, D., Barrera-Ruíz, U. M. & Melika, G. 2015. First record of *Neuroterus* galls on twigs in Mexico with description of two new species (Hym.: Cynipidae). *Butlletí de la Institució Catalana d'Història Natural*, 78 (2014): 3-8.
- Pujade-Villar, J., Kovalev, O. & Liljeblad, J. 2004. Status of *Pseudoneuroterus* Kinsey, 1923 and remarks on closely related genera (Hymenoptera, Cynipidae). *Nouvelle Revue d'Entomologie* (Nouvelle Série), 20: 353-360.
- Ronquist, F. & Nordlander, G. 1989. Skeletal morphology of an archaic cynipoid, *Ibalia rufipes* (Hymenoptera: Ibalidae). *Entomologica Scandinavica*, Supplement, 33: 1-60.
- Stone, G. N., Schönrogge, K., Atkinson, R. J., Bellido, D. & Pujade-Villar, J. 2002. The population biology of oak gall wasps (Hymenoptera: Cynipidae). *Annual Review of Entomology*, 47: 633-668.
- Tang, C. T., Melika, G., Nicholls, J. A., Yang, M. M. & Stone, G. N. 2011. A new genus of oak gallwasps, *Cycloneuroterus* Melika & Tang, with the description of five new species from Taiwan (Hymenoptera: Cynipidae: Cynipini). *Zootaxa*, 3008 (1): 33-62. <https://dx.doi.org/10.11646/zootaxa.3008.1.2>