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A new species of *Disholcaspis* from Mexico: *D. crystalae* Pujade-Villar n. sp. (Hym., Cynipidae)

Uriel M. Barrera-Ruiz*, David Cibrián-Tovar** & Juli Pujade-Villar***

* Instituto de Fitosanidad. Colegio de Postgraduados. Km. 36.5 Carretera México-Texcoco. Montecillo, Texcoco, México. A/e: umbr757@gmail.com** División de Ciencias Forestales. Universidad Autónoma Chapingo. Km 38.5 Carretera México-Texcoco, Chapingo, Estado de México, México. A/e: dcibrian48@gmail.com*** Universitat de Barcelona. Facultat de Biologia. Departament de Biologia Animal. Avda. Diagonal, 645. 08028 Barcelona (Catalunya). A/e: jpujade@ub.eduCorresponding author: Juli Pujade-Villar. A/e: jpujade@ub.edu

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Abstract

A new species of *Disholcaspis* is described from Mexico. Only asexual females are known inducing spherical galls in *Q. laeta*. Data on the diagnosis, distribution and biology of the new species are given. Also *D. taumalipensis* is transferred again to *Disholcaspis* genus: *D. mexicana* (Beutenmüller) (= *Andricus taumalipensis* Pujade-Villar n. syn.).

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

Resum**Una nova espècie de *Disholcaspis* de Mèxic: *D. crystalae* Pujade-Villar n. sp. (Hym., Cynipidae)**

Es descriu de Mèxic una nova espècie de *Disholcaspis*. Només són conegudes les femelles asexuals que indueixen gales esfèriques a *Q. laeta*. Es proporcionen dades sobre la diagnosi, distribució i biologia de la nova espècie. També *D. taumalipensis* es transfereix de nou al gènere *Disholcaspis*: *D. mexicana* (Beutenmüller) (= *Andricus taumalipensis* Pujade-Villar n. syn.).

Paraules clau: Cynipidae, vespes cecidògenes, *Disholcaspis*, taxonomia, morfologia, distribució, biologia.

Introduction

Disholcaspis Dalla Torre & Kieffer 1910 (Cynipidae: Cynipini) is an American genus with 55 species: 41 from the United States and Canada (Burks, 1979; Melika & Abrahamson, 2002), 11 from Mexico (Kinsey 1937, 1938), two from Panama (Medianero & Nieves-Aldrey, 2011) and a single species in Costa Rica (Melika *et al.*, 2011). After Pujade-Villar *et al.* (2010) and Nicholls *et al.* (2018) all *Disholcaspis* species induce galls on white oaks (*Quercus*, section *Quercus*).

Adults of *Disholcaspis* are quite uniform and difficult to differentiate morphologically and many species are based in differences of coloration. Moreover, the descriptions made before the twenty-first century are poor or very poor, since important characters are missing for the specific identification. Remarkably enough, the agamic galls are usually quite distinctive.

All currently-known *Disholcaspis* species were described first from the asexual generation, given that only in four species the sexual generation is known. The first published description of a sexual generation for a *Disholcaspis* species was that of *Disholcaspis eldoradensis* (Beutenmüller) (Evans, 1972). The sexual generation is known but morpho-

logically undescribed for *Disholcaspis cinerosa* (Bassett) (Morgan & Frankie, 1982). The sexual generation has recently been described in *Disholcaspis quercusvirens* (Ashmead) (Bird *et al.*, 2013; Melika *et al.*, 2013) and in *D. quercusmamma* (Walsh & Riley) (McEwen *et al.*, 2014).

Here a new species of *Disholcaspis* is described from Mexico belonging to an asexual generation producing galls in *Q. laeta*. It is the third species of *Disholcaspis* in this host; previously are described *D. insulana* Kinsey and *D. laetae* Kinsey. Also *D. taumalipensis* is transferred again to *Disholcaspis* genus: *D. mexicana* (Beutenmüller) (= *Andricus taumalipensis* Pujade-Villar n. syn.).

Materials and methods

Adult gallwasps were reared from galls collected on *Quercus laeta* Liebm.

We follow the current terminology of morphological structures (Liljeblad & Ronquist, 1998; Melika, 2006). Abbreviations for fore wing 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.

Electron microscope images of adults were taken using a Scanning Electron Microscope (FEI Quanta 200 ESEM) at Universitat de Barcelona (Barcelona, Spain); specimens of the new species were previously dissected and covered with gold. Images of wasp habitus were produced with a Leica DFC450 digital microscope camera coupled to a Leica MZ160A binocular microscope. Gall images were taken by Irene Lobato.

The type material is deposited in the following institutions: in the Universitat de Barcelona (UB, Barcelona, Catalonia); in the National Museum of Natural History of the Smithsonian Institution (NMNH, Washington D.C., USA), in the American Museum of Natural History (AMNH, New York, USA) and in the Universidad Autónoma Chapingo (UACH, Estado de México, México).

Results

Disholcaspis crystalae Pujade-Villar, new species (Figs 1-4)

Diagnosis

The new species has antennae with 12 flagellomeres as 7 species south of United States: *D. laetae* Kinsey, *D. potosina* Kinsey, *D. purpurea* Kinsey, *D. pulla* Kinsey, *D. purlans* Kinsey, *D. unicolor* Kinsey, *D. mexicana* (Beutenmüller) (= *Andricus taumalipensis* Pujade-Villar n. syn.) from Mexico, *D. costaricensis* Melika & Pujade-Villar from Costa Rica and *D. bisethiae* Medianero & Nieves-Aldrey from Panama. *Disholcaspis crystalae* n. sp. has the OOL around to 2.5 times diameter of lateral ocellus (similar to 3.0 lateral ocellus in *D. laetae*, *D. potosina*, *D. purpurea* and *D. unicolor*; 1.6 times in *D. bisethiae*), POL around 1.5 times OOL (around 2.0 times in *D. pulla* and *D. purlans*; 1.0 in *D. costaricensis*), with dark spots in mesoscutum and anterior parallel lines present (uniformly testaceous and anterior parallel lines inconspicuous in *D. unicolor*), OCO longer than diameter of lateral ocellus and mesoscutum uniformly punctuated (OCO similar to ocellus diameter and mesoscutum without punctures between notauli in *D. taumalipensis*) and head trapezoidal in front view (transversally oval in *D. bisethiae* and *D. unicolor*). Also, *Disholcaspis crystalae* n. sp. has propodeal caninae delimiting a transversal space (propodeal carinae undifferentiated in *D. potosina*, *D. purpurea* and *D. costaricensis*; circular in *D. taumalipensis*; circular with internal and circular carinae in *D. bisethiae*). *Disholcaspis regina* have sometimes the last flagellomere with a partial suture but in this case the mesoscutum has not punctures between notauli and the propodeal carinae have two subunits (with punctures and propodeal carinae without medial carinae in the new species).

Description asexual female

Body length 3.5-4.4 mm (n=10).

Colour (Figs 1a-b)

Head uniformly reddish brown, except darkish brown to black postocciput around occipital foramen and postgenal bridge; maxillary and labial palps, mandibles (except black tooth) and antennae (except dark flagellomeres F8-F12) uniformly yellowish. Pronotum and propleura reddish brown; mesoscutum reddish brown, except narrow black stripes along anterior parallel and parapsidal lines; mesoscutellum reddish brown and scutellar foveae black; mesopleuron and mesopleural triangle reddish brown; metapleuron, central propodeal area, metascutellum, metanotal troughs and nucha dark brown to black. Legs, including coxae, uniformly reddish brown. Mesosoma dorsally and ventrally dark brown to black; rest of metasoma and ventral spine of hypopygium uniformly reddish brown.

Head (Figs 2a-e)

Trapezoidal, around 2.5 times as broad as long from above and 1.3 times as broad as high and as broad as mesosoma in front view, with moderately dense white setae uniformly distributed on lower face, malar space, vertex, gena and postgena, with setae less dense on frons. Lower face and area between compound eye and antennal torulus delicately coriaceous, shiny. Gena microreticulate, broadened behind eye, visible in front view behind eye, broader than cross diameter of eye; malar space with striae without sulcus, length of malar space 0.38 times as length as high of compound eye. POL: OOL: OCO: Ø ocellus = 23: 15: 10: 6; POL 1.5 times as broad as OOL; OOL 2.5 times as long as length of lateral ocellus and 1.5 times as long as LOL; LOL 1.6 times as long as length of lateral ocellus; all ocelli nearly round, black. Transfacial distance 1.35 times as broad as height of eye; diameter of antennal torulus around 0.5 times as long as distance between toruli, distance between torulus and inner margin of eye 1.1 times as long as diameter of torulus; lower face delicately coriaceous, with some striae and punctures, with a narrow elevated coriaceous punctured median area. Clypeus trapezoidal, broader ventrally than dorsally, delicately coriaceous, with elevated smooth central area, ventrally slightly incised and emarginated pubescent in the lower half; anterior tentorial pits elongated, deep, epistomal sulcus and clypeo-pleurostomal line distinct, widely and deeply impressed. Frons, vertex, interocellar area and occiput uniformly strongly coriaceous, punctured, with some weak irregular carinae; frontal carina or elevated area next to central ocellus visible; interocellar area slightly elevated. Postocciput coriaceous, with weak longitudinal subparallel fragmented carinae around occipital foramen few impressed; postgena impressed and alutaceous with visible piliferous points; posterior tentorial pits large, deep, area around them strongly impressed; height of occipital foramen nearly equal to height of postgenal bridge; gular sulci present and free, well separated at hypostomata; hypostomal carina emarginate, not going around oral foramen, continuing into postgenal sulcus. Labial palpus 3-segmented, maxillary palpus 5-segmented.

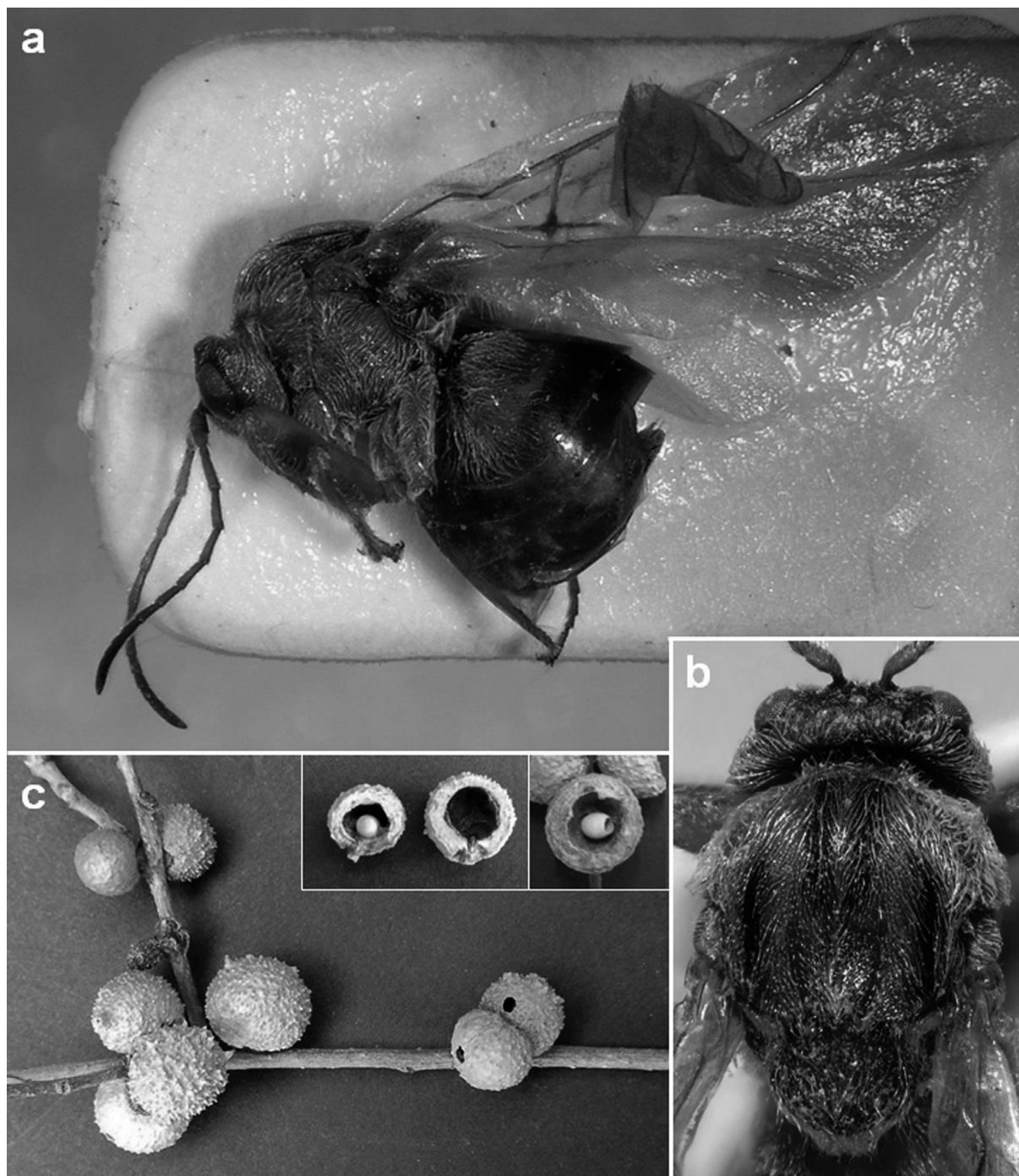


Figure 1. *Disholcaspis crystalae* n. sp.: a) habitus in dorsal view; b) head and thorax in dorsal view; c) gall.

Antenna (Fig. 2f)

With 12 flagellomeres, suture between F11 and F12 present but sometimes difficult to see or incomplete; slightly longer than head + mesosoma; scape+pedicel slightly shorter than F1, pedicel slightly longer than broad; F1 slightly longer than F2, F2 1.2 times as long as F3; F3 aubequal to F4, subsequent flagellomeres shorter, F12 1.6 times as long as F11; placodeal sensilla on F6-F12 weak impressed (more impressed F9-F12), absent on F1-F5. Antennal formula: 15: 8: 28: 24: 20: 19: 15: 14; 10: 9: 7: 6: 5: 8.

Mesosoma (Fig. 3)

Slightly longer than high (1.2x). Pronotum dorsally and laterally delicately coriaceous, with weak parallel striae along the impressed anterolateral margin of pronotum; propleuron punctuated, dorsally coriaceous and basally transversally carinated. Mesoscutum with dense white setae, shiny, delicately coriaceous to alutaceous, with visible piliferous points in all surface; as long as broad in dorsal view (largest width measured across mesoscutum at the level of the base of tegulae). Notauli extending to half length of mesoscutum, with smooth

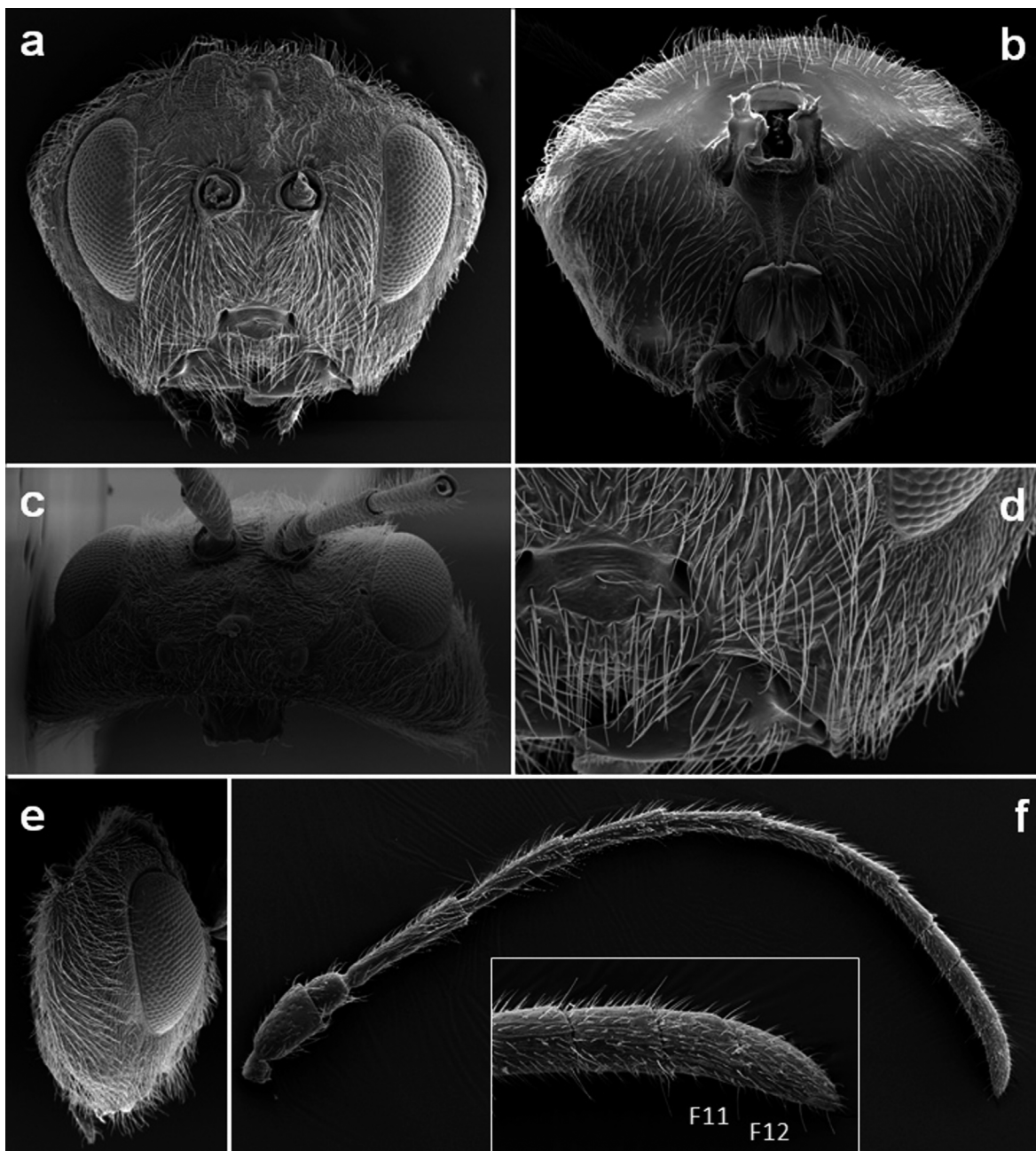


Figure 2. *Disholcaspis crystalae* n. sp.: a) head in front view; b) head in posterior view; c) head in dorsal view; d) detail of lower face; e) head in lateral view; f) antenna with detail of flagellomeres 11 and 12.

shiny bottom, slightly converging posteriorly; anterior parallel lines distinct, shiny, without forming a groove, punctured laterally in some internal areas then not clearly visible in all length, extending to next one half of mesoscutum length, parapsidal lines distinct, alutaceous, shiny and broad, starting away from posterior margin and extending at least half length of mesoscutum; median mesoscutal line absent; parascutal carina distinct only to the base of tegula; transscutal fissure distinct, slightly elevated in a form of distinct sharp carina. Mesoscutellum subglobular, as long as broad, the broadest part in the middle height, uniformly coriaceous with rugae, overhanging metanotum; scutellar foveae visible but not clearly defined, indistinctly delimited from mesoscutel-

lar disk, narrow, ovate, with coriaceous and shiny bottom, without median carina. Mesopleuron uniformly coriaceous to reticulate anteriorly, with very dense white setae and piliferous points, speculum smooth and punctured; mesopleural triangle coriaceous; dorsal axillar area coriaceous with very dense white setae; lateral axillar area alutaceous, shiny; axillula coriaceous, pubescent; subaxillular bar smooth, shiny, triangular shaped, highest posteriorly, its height nearly equal to height of metanotal trough; postalar process short; metapleural sulcus reaching mesopleuron above middle height. Metascutellum uniformly microreticulate, rectangular and incised basally; metanotal trough smooth but punctured, shiny, with dense white setae; ventral impressed area coria-

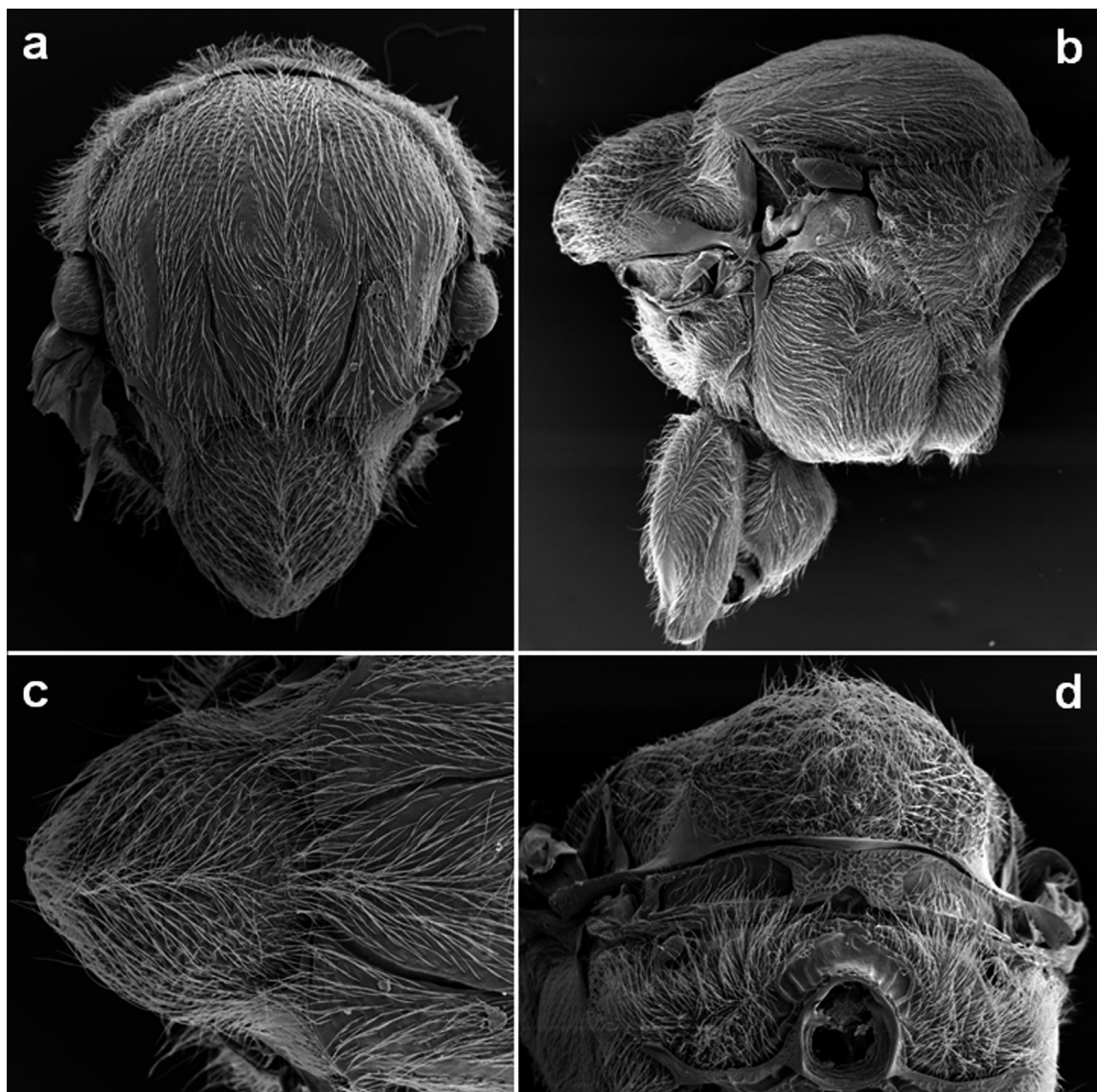


Figure 3. *Disholcaspis crystalae* n. sp.: a) mesosoma in dorsal view; b) mesosoma in lateral view; c) detail of anterior part; d) detail of posterior part; e) mesosoma in posterior view.

ceous, with longitudinally orientated delicate rugae; central propodeal area smooth, shiny, without some delicate irradiating striae, delimited from rest of propodeum by the absence of setae; lateral propodeal carinae present, delimiting a transversal circular area; lateral propodeal area delicately coriaceous, with dense white setae; nucha coriaceous, shiny, with lateral striae.

Legs

All tarsi with dense uniform long white setae; all tarsal claws with distinct basal lobe (Fig. 4e).

Wings

Forewing (Fig. 4a) longer than body (67:55), hyaline, with moderately long dense cilia on margin, radial cell around 2.9 times as long as broad; R1 and Rs nearly reaching wing margin; Rs expanded distally and prolonged parallel to the margin; areolet big, triangular, closed and distinct; projection of M di-

recting but not reaching basalis slightly below 1/2 of its height. Rs well pigmented, slightly curved, vein 2r slightly angulated and slightly prolonged by a stump into the radial cell.

Metasoma (Figs 4b-d)

Slightly shorter than head + mesosoma, slightly longer than high in lateral view, smooth and shiny; 2nd metasomal tergite dorsally occupying nearly 2/3 of metasoma length, with large patch of dense white setae laterally; subsequent tergites uniformly smooth, shiny, without setae. Ventral spine of hypopygium long, needle-like, prominent part nearly 4.0 times as long as broad in ventral view, with long white dense setae, located in two rows from both lateral sides of spine; apical setae extending beyond apex of spine but not forming a tuft.

Gall (Fig. 1c)

Globular, spherical, lignified, growing in clusters of two to five galls. Green when young and growing, turning brown

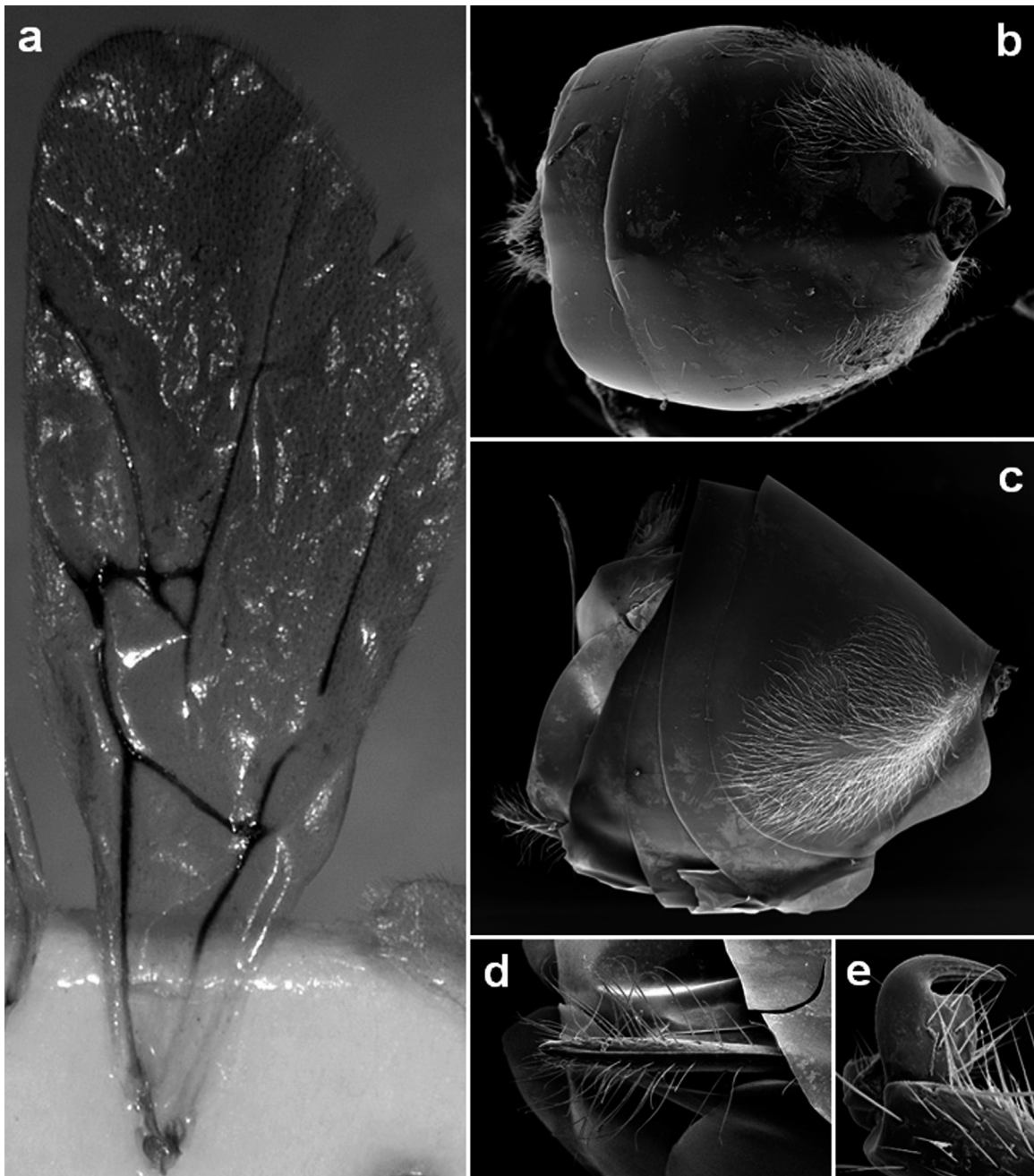


Figure 4. *Disholcaspis crystalae* n. sp.: a) Forewings; b) metasoma in dorsal view; c) metasoma in lateral view; d) ventral spine in ventral view; e) tarsal claws.

when old. Surface provided with a large number of short protuberances reminding the fruit of *Arbutus unedo* L. or the gall of the agamic form of *Cynips quercusfolii*; rarely protuberances scarce or almost non-existent. Diameter 8 to 14 mm. Easy to cut, external wall (2mm) is not hard, corky texture. Internally with a large air chamber in which the yellow, oval and friable larval chamber is housed in the lower part. The larval chamber detaches easily, being free in the internal chamber.

Type material

HOLOTYPE asexual female: ♀ deposited in JP-V col. (UB) with the following labels: “MEX, Sta. Fe (DF), 2585

m., 19° 21' 07.06" N 99° 15' 01.38" O, *Q. laeta*, (28.vi.2016) 21.xii.2016-10.i.2017” (white label); Holotype *Disholcaspis crystalae* Pujade-Villar n. sp., desig. JP-V 2018” (red label). Paratypes (9♂): 7♂ same data as holotype; 1-20.i.2016: 2♂.

Additional material

Same data of holotype (20.iii.2018) extr. 13.vii.2018: 15♂ (3♂ cut to SEM)

Biology

Only asexual females are known, inducing galls on *Quercus laeta* Liebm. (*Quercus* Section *Quercus*, white oaks), endemic to Mexico (Valencia, 2004; Romero-Rangel *et al.*,

2015). Galls were collected early in end June, and adults emerged in December to January. Further study is needed to determine the phenology of this species.

Etymology

This species is dedicated to Crystal Cooke-McEwen, for the studies carried out in northern Mexico about the genus *Disholcaspis* and also for comments about Mexican species.

Distribution

Currently known only from Mexico.

Discussion

As Medianero & Nieves-Aldrey (2011) comment the nomenclature and classification within this genus has been unstable; the differences enabling recognition of the true *Disholcaspis* are not clear. Burks (1979) cited 38 species and one variety from the United States & Canada. Dailey & Menke (1980) transferred *D. truckeensis* Ashmead to *Andricus* Hartig. Melika & Abrahamson (2002) transferred three *Andricus* species to *Disholcaspis*: *A. lasius* Ashmead, *A. reniformis* McCracken & Egbert and *A. spectabilis* Kinsey, but this taxonomic act was later considered erroneous (Pujade-Villar *et al.* 2010) and recently *D. spectabilis* is transferred to the new genus *Protobalandricus* Melika, Nicholls & Stone (Nicholls *et al.*, 2018). Additionally, *Disholcaspis chrysolepidis* Beutenmüller, *D. canescens* Bassett, *D. conalis* Weld, *D. corallina* Bassett, *D. plumbella* Kinsey, *D. sulcata* Ashmead and *D. washingtonensis* Gillette differ in some aspects of the diagnosis typical of the genus (Weld 1952), and according to Burnett (1977) (in Melika & Abrahamson, 2002) eventually could be transferred to other genera. More recently, one species described from Mexico, *D. lapiei* Kieffer, has been transferred to the new genus *Kinseyella* Pujade-Villar & Melika (Pujade-Villar *et al.*, 2010). Finally, in Pujade-Villar *et al.* (2016) *Disholcaspis mexicana* was transferred to *Andricus* genus as *A. taumalipensis* Pujade-Villar because this species has irradiating striae from clypeus, but after examining pictures of several species from Mexico and North America, the absence of irradiating striae is not a characteristic present in all the species of the genus, unlike what happens in the rest of genera of Cynipini. In addition, the mentioned striae may be present but they are not very marked (inconspicuous) in other *Disholcaspis* species. It is not a good character to recognize this genus. Then, *D. taumalipensis* is transferred here *de novo* to *Disholcaspis* genus: *D. mexicana* (Beutenmüller) (= *Andricus taumalipensis* Pujade-Villar n. syn.).

The adults of the asexual generation of *Disholcaspis* are recognized as follows (see also Melika & Abrahamson 2002; Medianero & Nieves-Aldrey, 2011): robust and pubescent specimens, antenna 13–14 segmented, with scape stout, and short pedicel (usually globular), flagellomeres F1–F6 long and slender, gradually decreasing in length, last flagellomeres somewhat thickened; without a malar sulcus and with or without (inconspicuous) radiating striae from clypeus; mesonotum punctuated with notauli incomplete, faintly ante-

riorly; scutellum rounded, convex, overhanging metanotum; scutellar foveae not well differentiated, indistinctly separated medially, usually forming a shallow transverse depression, sometimes virtually absent and rarely present; lateral propodeal carinae fragmented sometimes almost absent or bowed sometimes forming a circular area or angulated or curved; second metasomal tergum conspicuously pubescent at its lateral area, dorsally and all following terga without setae; projecting part of hypopygial spine short to moderately long (2.0 - 4.5 x as long as broad), hypopygial setae long, not forming an apical tuff; metatarsal claws with a secondary basal tooth (rarely simple); forewings developed, pubescent and ciliated.

According to these characters we can eventually recognise *Disholcaspis* in front other genera morphologically closed (as *Aphelonyx* Mayr or *Andricus* Hartig) according to antennae (slightly longer than head + mesosoma), notauli (always incomplete), mesoscutum (coriaceous and strongly punctuated), scutellar fovea (usually absent), propodeal carinae (usually forming a circular area or fragmented), second metasomal tergum (largely pubescent laterally) and tarsal claws (with a basal tooth, except in one species). Due to the variability that *Disholcaspis* presents in some fundamental characters in the definition of the genera of Cynipini, we do not rule out that there may be genera to be described that include any of the species currently located in *Disholcaspis*.

The galls do not escape this problem because there are presumably different species that have very similar galls. In Mexico, *D. laetae*, *D. pulla* and *D. purlans* are very similar; these galls are swollen breast-shaped, the irregularly globose base terminating in a bluntly conical tip. In addition, *D. purpurea* and some galls of *D. laeta*, *D. regina*, *D. purlans* and *D. potosina* are more spherical and may be confused with each other. Moreover, the species described here presents a gall unmistakable with the other species known.

The new species was collected in *Q. laeta*, then this host has three *Disholcaspis* species: *D. insulana*, *D. laetae* and *D. crystalae*.

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