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Review of the brachypterous species of *Alloxysta* Förster, 1869 (Hymenoptera: Cynipoidea: Figitidae: Charipinae) with a description of two new species

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Abstract: The aim of this study is to review the brachypterous species within the genus *Alloxysta* Förster, 1869. The known brachypterous species of *Alloxysta* have been compared with fully winged species in order to establish hypotheses regarding dimorphism for wing length and shape. This analysis is based only on the morphological features shared between species; breeding and genetic analyses will be necessary to test and refine these hypotheses. Two new brachypterous species are described here: *Alloxysta curta* Ferrer-Suay **sp. nov.** and *Alloxysta pseudoconsobrina* Ferrer-Suay **sp. nov.** Six species are revised. In total, there are now 8 brachypterous species known in this genus.

Key words: Hymenoptera, Charipinae, fully winged species, brachypterous species, morphological study

1. Introduction

Charipinae is a subfamily within the Figitidae (Hymenoptera: Cynipoidea). The Figitidae are characterized as parasitoids of other insects; the Charipinae are reported as secondary parasitoids of aphids and psyllids (Menke and Evenhuis, 1991). Members of this subfamily are very small wasps, with a shiny and smooth body, filiform antennae, and forewings with reduced venation. The Charipinae are widely distributed in all biogeographical regions (Ferrer-Suay et al., 2012a).

In early attempts on the taxonomy of the subfamily, the brachypterous species were grouped under the genera *Pezophycta* (Förster, 1869) and *Nephycta* (Förster, 1869). The species with short forewings without a radial cell were grouped as *Pezophycta*, and the species with a radial cell but with shorter forewings, not longer than the metasoma, were grouped into *Nephycta* (Kieffer, 1902). Hellén (1963) later synonymized these two genera with *Alloxysta* Förster, 1869 according to general morphological features. According to van Veen (1999, pers. comm.), the genus *Alloxysta* can be divided into macropterous (fully winged) and brachypterous (short-winged) species, but the possibility of intraspecific wing polymorphism should not be ignored.

Within *Alloxysta*, some brachypterous species have been described, although most species are fully winged.

According to Ferrer-Suay et al. (2012a), 111 species have been described within this genus, of which only 6 are brachypterous. The brachypterous species were, until now, only known from the Palearctic region (Ferrer-Suay et al., 2012a). Brachypterous specimens have usually been treated as new species. However, in many cases, there is evidence that the same species may have both morphotypes, short and long wings (van Veen, 1999, pers. comm.). van Veen's experiments focused on *Alloxysta halterata* (Thomson, 1862); according to his studies (van Veen, 1999, pers. comm.), males of this species are always short-winged, while the females may be either short-winged or long-winged. Results of these experiments point to a single-locus two-allele system determining wing morph in the females, with brachyptery dominant.

Here we attempt to review such brachypterous species and try to understand their association or similarities with corresponding fully winged species based on morphological features. Six brachypterous species of *Alloxysta* have been described previous to this study: *Alloxysta apteroidea* Hellén, 1963; *Alloxysta brachyptera* (Hartig, 1840); *Alloxysta glebaria* Hellén, 1963; *Alloxysta halterata* (Thomson, 1862); *Alloxysta marshalliana* (Kieffer, 1900); and *Alloxysta pedestris* (Curtis, 1838). As a result of our faunistic studies, two new species are described here: *Alloxysta curta* Ferrer-Suay **sp. nov.** and

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Alloxysta pseudoconsobrina Ferrer-Suay **sp. nov.** Therefore, we aimed to provide some hypotheses about the possible relation between these brachypterous and fully winged species.

2. Materials and methods

Specimens were studied using a stereomicroscope (NIKON SMZ-1) and environmental scanning electron microscope (FEI Quanta 200 ESEM) belonging to the scientific technical services of the University of Barcelona. The field-emission gun environmental scanning electron microscope was used for high-resolution imaging without gold-coating of the specimens.

Collections containing materials that were examined in this study are listed below:

- BMNH: Natural History Museum (London, United Kingdom).
- MVMA: National Museum of Victoria (Melbourne, Australia).
- MZH: Finnish Museum of Natural History (Helsinki, Finland).
- MZLU: Lund Museum of Zoology (Lund, Sweden).
- UB: University of Barcelona (Spain).
- ZSM: Zoologische Staatssammlung Museum (München, Germany).

Morphological terms used are taken from Paretas-Martínez et al. (2007). Measurements and abbreviations include F1–F12, the first and subsequent antennal flagellomeres. The width of the forewing radial cell is measured from the margin of the wing to the beginning of the Rs vein. The transfacial line is measured as the distance between the inner margins of the compound eyes, measured across the face through the antennal sockets. The malar space is measured by the distance from the lower part of the gena from the mouthparts to the ventral margin of the compound eye. Females and males of the species briefly described have the same characters except where indicated.

Diagnosis of the brachypterous species, comments about the shared characters with the fully winged species, and figures illustrating these characters are given.

3. Results

Alloxysta apteroidea Hellén, 1963

Alloxysta apteroidea Hellén, 1963: 23 (type material examined).

Type material. Holotype: ♀, deposited in MZH with the following labels: “Runsala”, “Hellén”, “157”, “*apteroidea*” (handwritten), “Typus *Alloxysta apteroidea* Hellén” (handwritten) (red label), “Mus. Zool. Helsinki, Loan No. HY 2012 - 1834” (yellow label), “*Alloxysta apteroidea* Hellén, 1963 ♀ M. Ferrer-Suay det. 2012”.

Diagnosis. *Alloxysta apteroidea* is mainly characterized as being a brachypterous species without a visible radial

cell, the forewing is practically absent, pronotal and propodeal carinae also absent, F1 shorter than pedicel, F1 longer than F2 and subequal to F3. It is similar to *A. pedestris* (Curtis, 1838), but they can be differentiated by the length of the forewing: very short, practically absent in *A. apteroidea*, while reaching the beginning of the metasoma in *A. pedestris*; relation between F1 and pedicel: F1 shorter than pedicel in *A. apteroidea*, but F1 longer than pedicel in *A. pedestris*.

Distribution. Palearctic: only known from Finland (Hellén, 1963: 23).

Alloxysta brachyptera (Hartig, 1840)

Xystus brachypterus Hartig, 1840: 200 (type material examined).

Allotria brachyptera: Giraud, 1860: 131.

Pezophycta brachyptera: Förster, 1869: 339.

Pezophycta brachyptera brachyptera: Dalla Torre & Kieffer, 1910: 292.

Alloxysta brachyptera: Hellén, 1931: 5.

Type material. Lectotype: ♂, designated by Evenhuis (1982), deposited in ZSM with the following labels: “210”, “♂”, “lectotype H. H. Evenhuis” (orange label), “*Xystus brachypterus* Hartig det. H.H. Evenhuis 1980”, “*Alloxysta brachyptera* (Hartig, 1841) ♂ M. Ferrer-Suay det. 2011”.

Paralectotype: ♂, with the following labels: “In collection Hartig as *Xystus brachypterus*”, “Paralectotype *Xystus brachypterus* Hartig, 1840 ♂” (red label), “*Alloxysta brachyptera* (Hartig, 1841) ♂ M. Ferrer-Suay det. 2011”. Also one nonconspecific paralectotype (see comments).

Diagnosis. *Alloxysta brachyptera*, as a brachypterous species, is mainly characterized by the absence of pronotal carinae, presence of propodeal carinae, and F1 shorter than pedicel (Figure 1). It is similar to *A. pedestris*, but they can be easily differentiated by the presence of propodeal carinae: present in *A. brachyptera* while absent in *A. pedestris*.

Distribution. Palearctic. Known from Austria (Giraud, 1860: 131), Belgium (Lameere, 1907), England (Dalla Torre and Kieffer, 1910: 292; Fergusson, 1986: 18; Müller et al., 1999), Finland (Hellén, 1931: 5), France (Dalla Torre and Kieffer, 1910: 292), Germany (Hartig, 1840: 200), Ireland (Fergusson, 1986: 18), Romania (Ionescu, 1969: 236), Scotland (Fergusson, 1986: 18), and Sweden (Thomson, 1862: 410).

Alloxysta curta Ferrer-Suay **sp. nov.** (Figure 2)

Type material. Holotype: ♂ deposited in UB with the following labels: “04/06/1996, Leonart (Argentina), greenhouse, *Macrosiphum euphorbiae* on *Solanum lycopersicum*”. “Holotype *Alloxysta curta* Ferrer-Suay ♂, Design. M. Ferrer-Suay, 2014”, “*Alloxysta curta* Ferrer-Suay ♂ M. Ferrer-Suay det. 2014”. **Paratypes** (5♂) deposited in UB with the following labels: “26/06/1995, Leonart (Argentina), greenhouse on *Solanum lycopersicum*”,

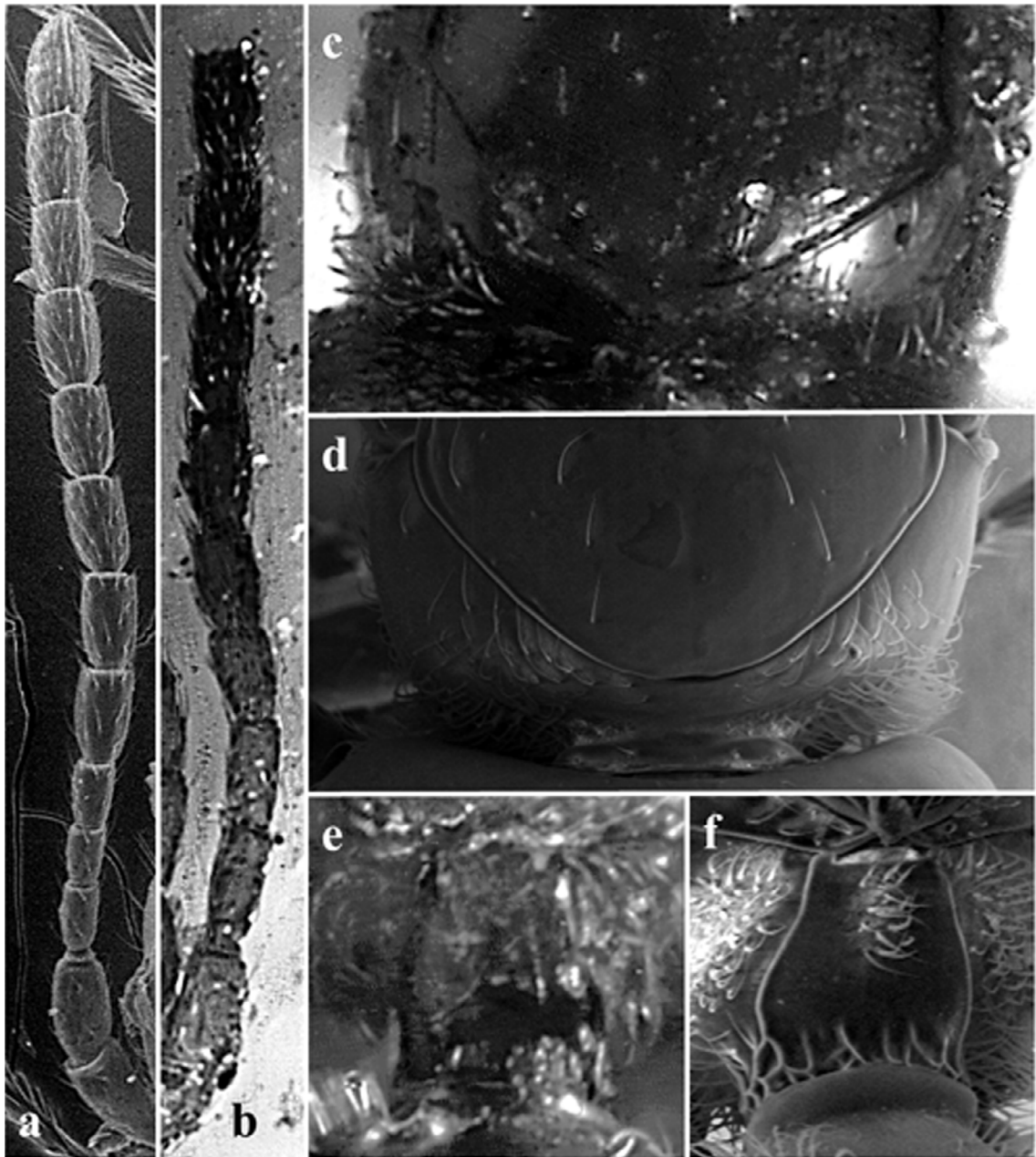


Figure 1. Comparison between *A. brachyptera* and *A. brevis*: a) antenna of *A. brevis*; b) antenna of *A. brachyptera*; c) pronotum of *A. brachyptera*; d) pronotum of *A. brevis*; e) propodeum of *A. brachyptera*; f) propodeum of *A. brevis*.

“Paratype *Alloxysta curta* Ferrer-Suay ♂”, “*Alloxysta curta* Ferrer-Suay ♂ M. Ferrer-Suay det. 2014”: 5♂.

Diagnosis. *Alloxysta curta*, a brachypterous species (Figure 2A), is very similar to *A. glebaria* Hellén, 1963 in having a small closed radial cell. However, *A. curta* can be differentiated by the presence of pronotal carinae: present in *A. curta* but absent in *A. glebaria*.

Description.

Length. Female unknown. Male: 0.7–1.0 mm.

Coloration. Head, mesosoma, and metasoma yellowish brown. Scape, pedicel, and F1–F3 yellow, F4–F12 yellowish brown. Legs yellow and veins yellowish brown.

Head. Transversally ovate, smooth and shiny, slightly wider than its height in frontal view. Few setae present below and between toruli, without setae above toruli. The area above the toruli, vertex with few scattered setae and face with many setae.

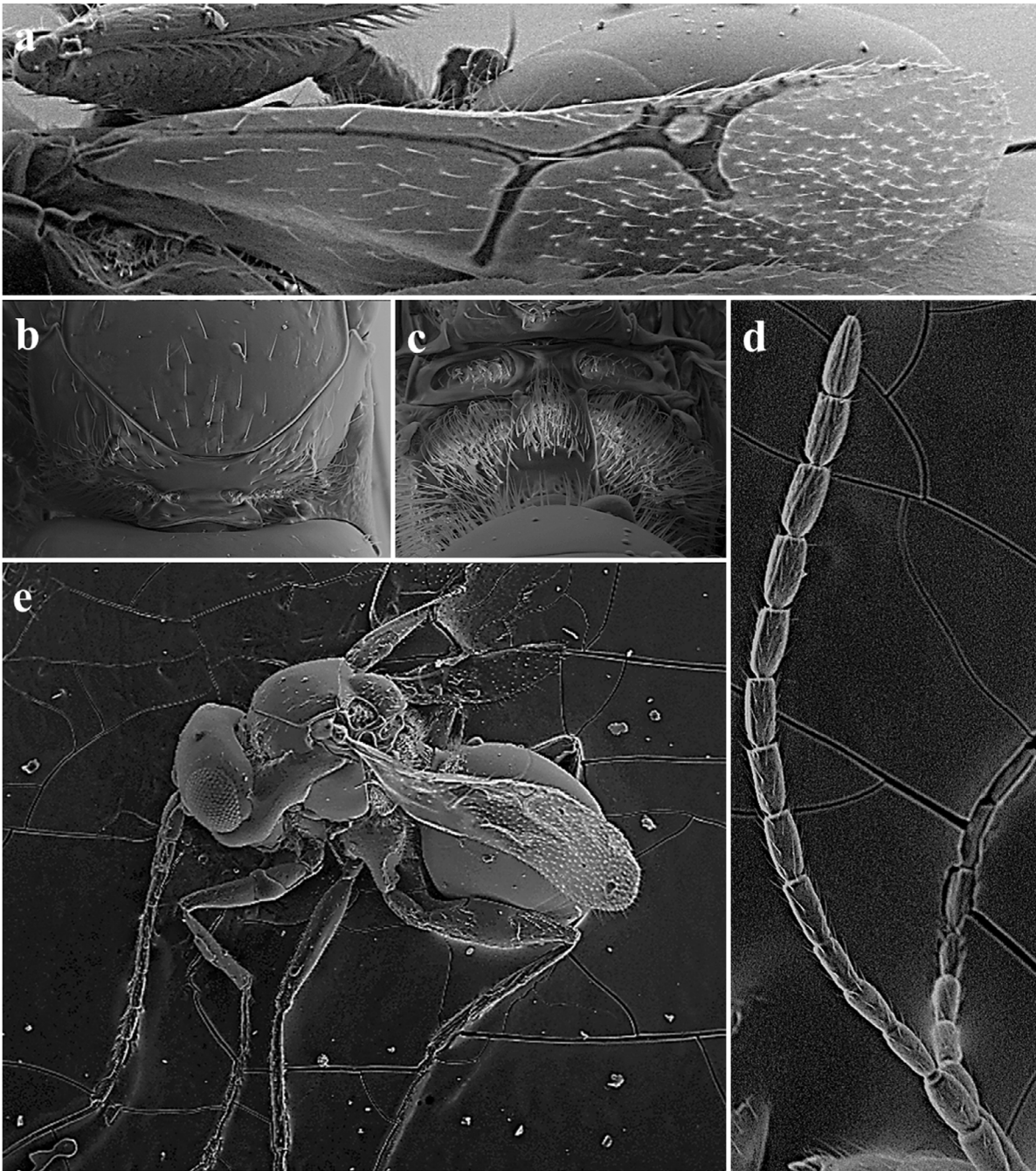


Figure 2. *Alloxysta curta* Ferrer-Suay sp. nov.: a) forewing; b) pronotum; c) propodeum; d) antennae; e) body.

Mesosoma. Pronotum covered by scattered setae, without setae at distolateral corners; two thick carinae clearly visible (Figure 2B). Mesoscutum smooth and shiny, round in dorsal view with few scattered setae. Scutellum smooth and shiny with scattered setae, being more abundant on apex of scutellum. Propodeum completely covered by many setae; two carinae present forming a plate with straight sides (Figure 2C).

Antenna. Female unknown. Male: 14-segmented, filiform. All antennomeres covered with sparse setae. F1–F4 smooth and thinner than remaining flagellomeres; F5–F11 with rhinaria and club-shaped. Antennal formula: 2.8 (1.5); 2.6 (1.1); 2.5 (1.2); 2.1 (1.0); 2.9 (1.2) (Figure 2D).

Forewing. Shorter than body, reaching the end of the metasoma (Figure 2E); marginal setae present. Radial cell closed, 1.5 times as long as wide. R1 and Rs short and slightly curved.

Metasoma. Proximal part with an incomplete ring of setae that is glabrous dorsally and wider laterally. Remainder of metasoma smooth and shiny with terga clearly visible.

Distribution. Palearctic: Spain.

Etymology. The new species is named based on the length of its forewings.

Alloxysta glebaria Hellén, 1963

Alloxysta glebaria Hellén, 1963: 22 (type material examined).

Type material. Holotype: ♀, deposited in MZH with the following labels: “Hammarland”, “Hellén”, “4622”, “Typus *Alloxysta glebaria* Hellén” (handwritten) (red label), “Sp2”, the rest not understandable (handwritten), “glebaria” (handwritten), “Mus. Zool. Helsinki, Loan No. HY 2012 -1827” (yellow label), “*Alloxysta glebaria* Hellén, 1963 ♀ M. Ferrer-Suay det. 2012”.

Diagnosis. *Alloxysta glebaria* as a brachypterous species is mainly characterized by the presence of the radial cell (Figure 3). According to this feature, *A. glebaria* is very similar to brachypterous species of *A. marshalliana* (Kieffer, 1900), but they can be easily differentiated by the shape of the radial cell, closed in *A. glebaria* and completely open in *A. marshalliana*.

Distribution. Palearctic: known only from Finland (Hellén, 1963: 22).

Alloxysta halterata (Thomson, 1862)

Allotria halterata Thomson, 1862: 410 (type material examined).

Pezophycta halterata (Thomson) Kieffer, 1900: 114.

Alloxysta halterata (Thomson) Hellén, 1963: 20.

Pezophycta luteipes Ionescu, 1969: 232. Synonymized by Ferrer-Suay et al. (2012c: 279).

Alloxysta luteipes (Ionescu) Ferrer-Suay et al. 2012a: 28, non *Alloxysta luteipes* (Kieffer).

Species was recently studied (Ferrer-Suay et al., 2013a), where it was redescribed and illustrated.

Type material. Lectotype: ♂, designated in Ferrer-Suay et al. 2013a, deposited in MZLU with the following labels: “1969, 97” (green label), “1984, 408” (green label), “sintype *A. halterata* Thomson, det. N.D.M. Fergusson, 1984”, “ZML 2000, 002” (green label), “Lectotype *Allotria halterata* Thomson, 1862 ♂ desig. M. Ferrer-Suay 2011” (red label), “*Alloxysta halterata* (Thomson, 1862) ♂ M. Ferrer-Suay det. 2011”.

Diagnosis. *Alloxysta halterata* is easily differentiated from the other brachypterous *Alloxysta* species (*A. brachyptera*, *A. pedestris*, and *A. apteroidea*) by having pronotal carinae while the others have not (Figure 4).

Distribution. Palearctic. Known from England (Hellén, 1963: 20; Müller et al., 1999: 346), Finland (Hellén, 1963: 20), Germany (Hübner et al., 2002: 507),

Madeira (Ferrer-Suay et al., 2012b: 11), Romania (Ionescu, 1969: 233), Scotland (Cameron, 1886: 88), and Sweden (Thomson, 1862: 410).

Alloxysta marshalliana (Kieffer, 1900)

Nephycta marshalliana Kieffer, 1900: 114 (type material examined).

Alloxysta marshalliana (Kieffer) Hellén, 1931: 5.

Type material. Lectotype: ♂, designated by Quinlan, deposited in BMNH with the following labels: “Lectotype” (round label with blue in the margin), “*Nephycta marshalliana* Kieffer = *Alloxysta brachyptera* ♂ (nec Hartig)” (handwritten, orange label), “Cameron 96-76 Clober Wa”, Lectotype *Nephycta marshalliana* K. ♂, det. J. Quinlan, 1977”, “B.M. Type Hym 7.173”.

Diagnosis. *Alloxysta marshalliana* is mainly characterized being a brachypterous species with the radial cell present (Figure 5). According to these features, *A. marshalliana* is very similar to *A. glebaria*, but they can be easily differentiated by the shape of the radial cell, which is completely open in *A. marshalliana* (Figure 5A) and closed in *A. glebaria* (Figure 3E).

Distribution. Palearctic. Known only from England (Kieffer, 1900: 114) and Romania (Ionescu, 1969: 236).

Alloxysta pedestris (Curtis, 1838)

Cynips pedestris Curtis, 1838: 688.

Allotria pedestris (Curtis) Cameron, 1886: 88.

Nephycta pedestris (Curtis) Kieffer, 1900: 114.

Alloxysta pedestris (Curtis) Hellén, 1963: 19.

Species was recently studied (Ferrer-Suay et al., 2013b), where it was redescribed and illustrated.

Type material. Lectotype: ♂, designated by Quinlan & Fergusson (1981: 255), deposited in MVM with the following labels: “Lectotype” (round label with blue in the margin), “Holotype of *Cynips pedestris* Curt. det Fergusson & Quinlan 1980”, “ENT-936”, “*Alloxysta pedestris* (Curtis, 1838) ♂ M. Ferrer-Suay det. 2011”. **Paralectotype:** “Paralectotype” (round label with blue in the margin), “Type” (round label with red in the margin), “Type of *Cynips pedestris* Curt., G.J. Kerrich det. 1948, = *Pezophycta* p. ♀”, “MUS. VIC. ENTO 2011-IIL” (green label), “*Alloxysta pedestris* (Curtis, 1838) ♀ M. Ferrer-Suay det. 2011”.

Diagnosis. *Alloxysta pedestris* as a brachypterous species is mainly characterized by the absence of the radial cell; pronotal and propodeal carinae also absent, F1 longer than pedicel and F2, F2 subequal to F3. It is similar to *A. apteroidea* but they can be differentiated by the following characters: forewing reaches the beginning of the metasoma in *A. pedestris* while they are very short, practically absent, in *A. apteroidea*; the relation between F1/pedicel: F1 longer than pedicel in *A. pedestris* but F1 shorter than pedicel in *A. apteroidea*.

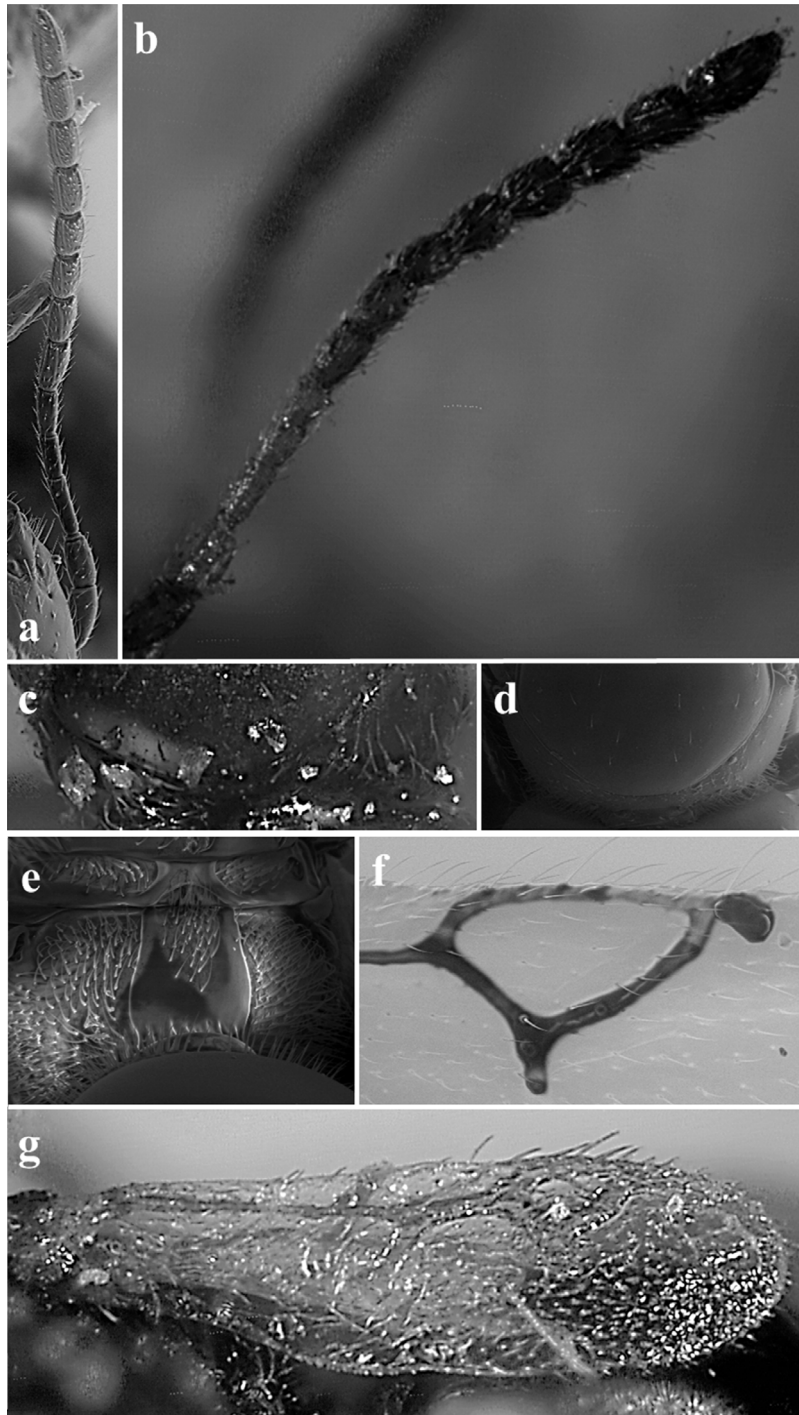


Figure 3. Comparison between *A. glebaria* and *A. mullensis*: a) antenna of *A. mullensis*; b) antenna of *A. glebaria*; c) pronotum of *A. glebaria*; d) pronotum of *A. mullensis*; e) forewing of *A. glebaria*; f) propodeum of *A. mullensis*; g) radial cell of *A. mullensis*.

Distribution. Palearctic. Known from Austria (Hellén, 1963: 19), Denmark (Hellén, 1963: 19), England (Curtis, 1838: 688), Finland (Hellén, 1963: 19), Germany (Hellén, 1963: 19), Ireland (O'Connor and Nash, 1997; O'Connor,

2002: 122), Madeira (Borges et al., 2008), Norway (Hellén, 1966: 393), Romania (Ionescu, 1969: 237), Scotland (Cameron, 1886: 88), and Sweden (Dalla Torre & Kieffer, 1910: 292).

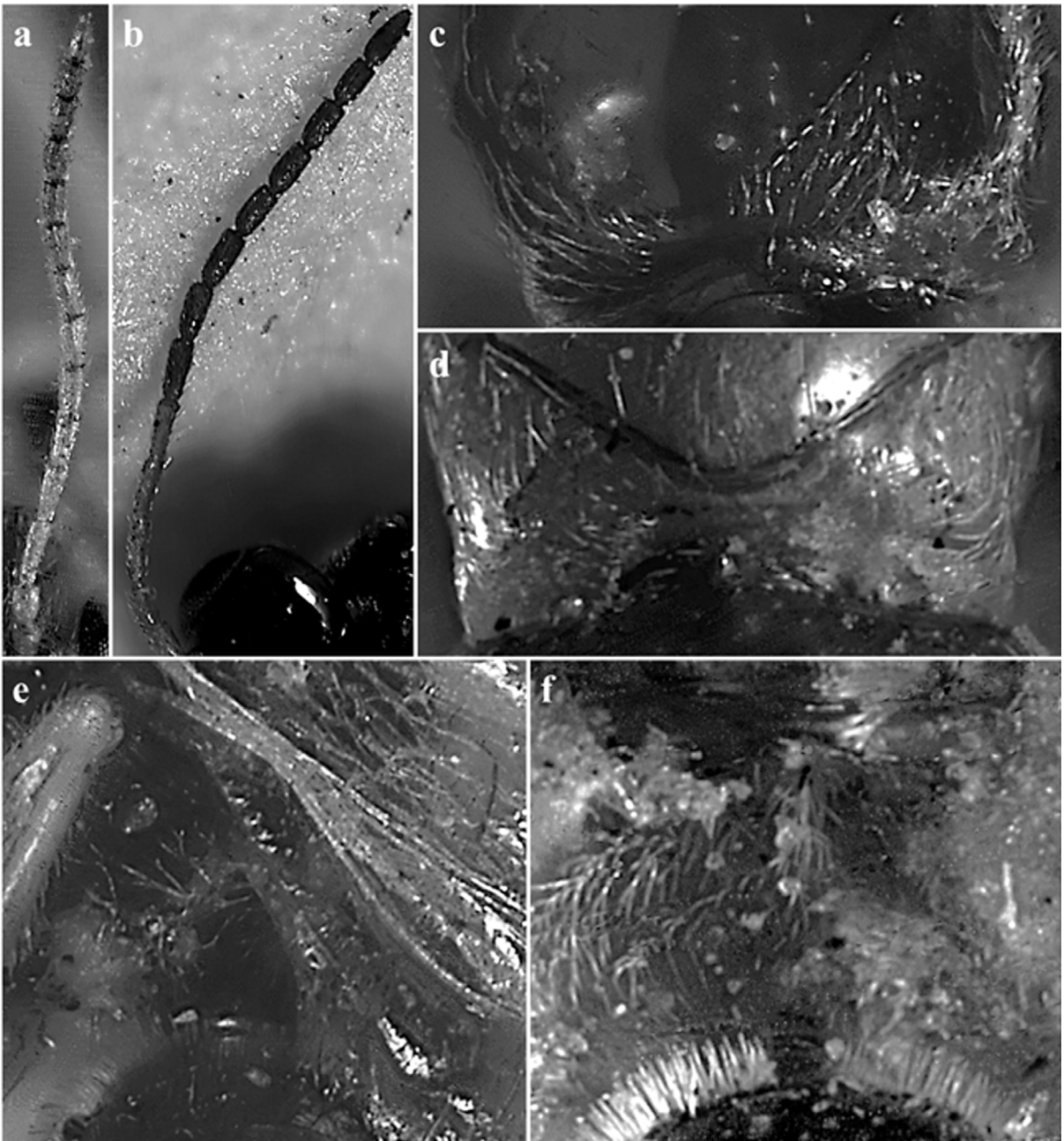


Figure 4. Comparison between *A. halterata* and *A. crassa*: a) antenna of *A. halterata*; b) antenna of *A. crassa*; c) pronotum of *A. crassa*; d) pronotum of *A. halterata*; e) propodeum of *A. crassa*; f) propodeum of *A. halterata*.

Alloxysta pseudoconsobrina Ferrer-Suay sp. nov. (Figure 6)

Type material: Holotype ♂ deposited in BMNH with the following label: “ENGLAND: Surrey: Barnes Common: 12.ix.2009: J.S. Noyes, BMNH (E) 2008-118”.

Diagnosis. *Alloxysta pseudoconsobrina* as a brachypterous species is very similar to *A. curta*. They can be differentiated by the propodeal carinae, present in *A. curta* while absent in *A. pseudoconsobrina*, and the relation

between F1/pedicel; F1 subequal to pedicel in *A. curta* but F1 longer than pedicel in *A. pseudoconsobrina*.

Description.

Length. Female unknown. Male: 0.75 mm.

Coloration. Head, mesosoma, and metasoma yellowish brown. Scape, pedicel, and F1 dark yellow, F3–F12 yellowish brown. Legs yellow and veins yellowish brown.

Head. Transversally ovate, smooth and shiny, slightly wider than its height in frontal view. Few setae present

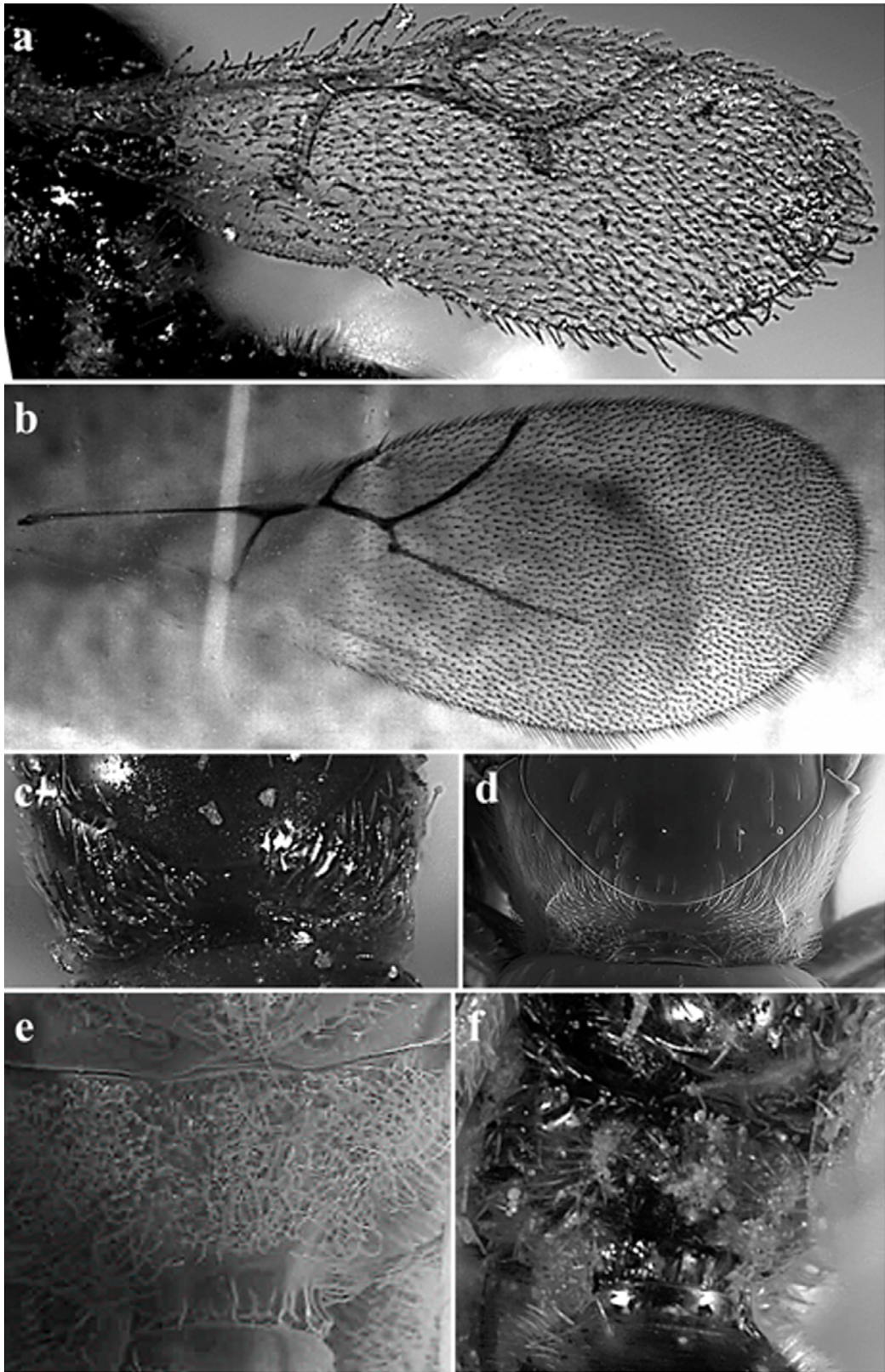


Figure 5. Comparison between *A. marshalliana* and *A. macrophadna*: a) forewing of *A. marshalliana*; b) forewing of *A. macrophadna*; c) pronotum of *A. marshalliana*; d) pronotum of *A. macrophadna*; e) propodeum of *A. macrophadna*; f) propodeum of *A. marshalliana*.

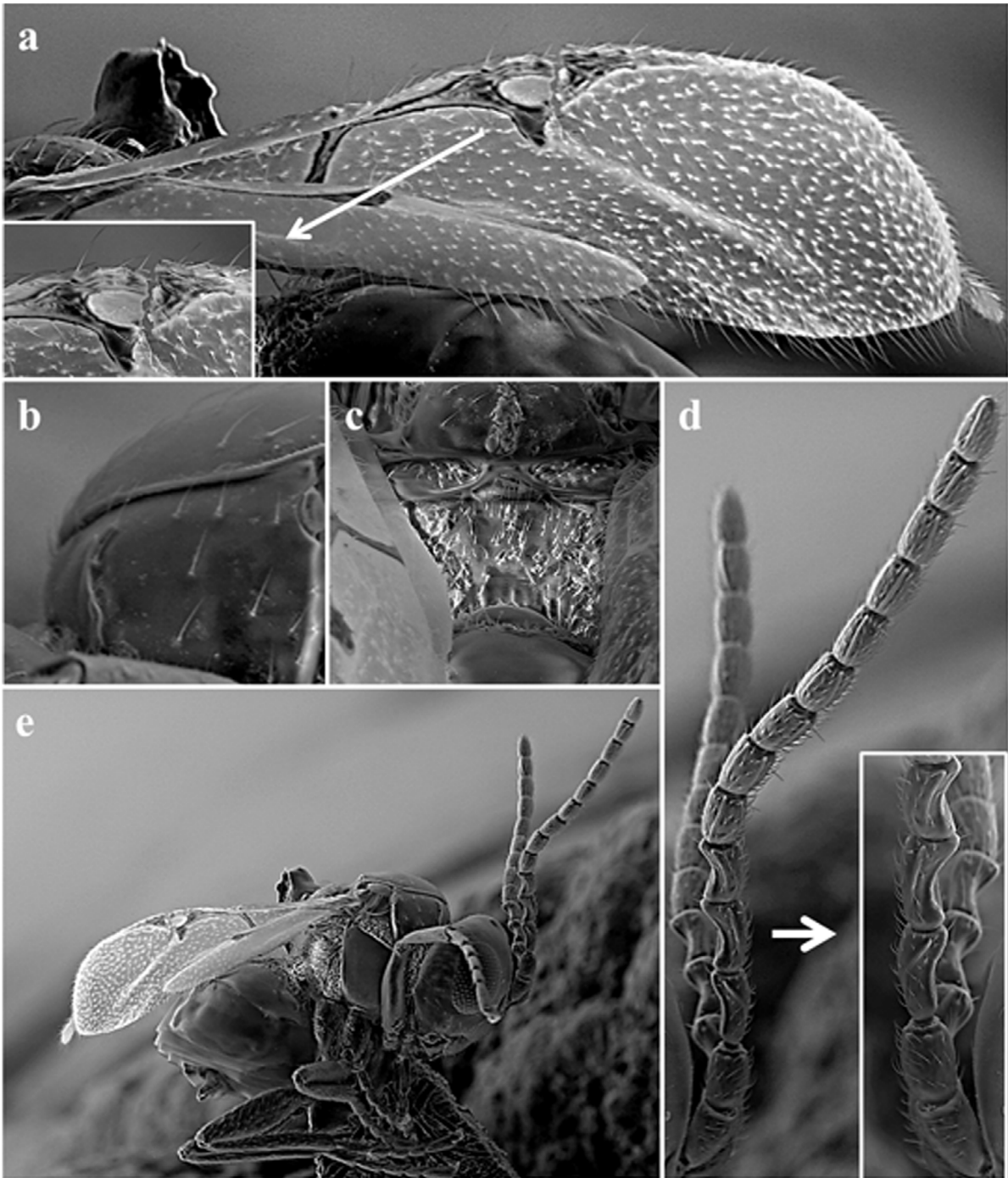


Figure 6. *Alloxysta pseudoconsobrina* Ferrer-Suay sp. nov.: a) forewing; b) pronotum; c) propodeum; d) antenna; e) body.

below and between toruli, without setae above toruli. The area above the toruli and vertex with few scattered setae, face with many. Transfacial line 1.2 times height of compound eyes. Malar space 0.4 times height of compound eyes.

Forewing. Shorter than body, reaching the end of the metasoma; marginal setae present (Figure 6A). Radial cell

closed, 2.5 times as long as wide (Figure 6A). R1 and Rs short and slightly curved.

Mesosoma. Pronotum covered by few sparse setae, with two thick carinae clearly visible (Figure 6B). Mesoscutum smooth and shiny, round in dorsal view with few scattered setae. Scutellum smooth and shiny with scattered setae, being more abundant on apex of scutellum. Propodeum

covered by many setae, without carinae present (Figure 6C).

Antenna. Female unknown. Male: 14-segmented, filiform. All antennomeres covered with sparse setae. F1–F12 with rhinaria and club-shaped. F1-F3 curved. Antennal formula: 3.5 (2.0); 4.2 (1.7); 4.3 (1.8); 3.5 (1.9); 3.29 (2.0) (Figure 6D).

Metasoma. Proximal part with an incomplete ring of setae, which is glabrous in the center and wider laterally. Remainder of metasoma smooth and shiny with terga clearly visible (Figure 6E).

Distribution. England.

Etymology. The new species is named after the species with full wings that it resembles, *A. consobrina*.

4. Discussion

With the idea that some species could be dimorphic for wing length, we have compared the known brachypterous species with other fully winged species in order to establish some hypotheses, based on morphological features, about wing dimorphism in these species. The list of the hypothetical matches is presented in the table below (Table), based on their small similarity-phenetic groups.

Without taking into account the radial cell (which is not present in this species), we have not been able to associate *A. apteroidea* with a fully winged species within the three morphological groups (radial cell open, partially open, or closed). Within these three groups there is no species with the following combination of features: pronotal carinae absent, propodeal carinae absent, and F1 shorter than pedicel. For this reason, *A. apteroidea* lacks a hypothesized association with other fully winged species.

When compared to fully winged species, *Alloxysta brachyptera* resembles *A. brevis* (Tomson, 1862). It is not possible to compare the radial cell, because in *A. brachyptera* it is not visible. However, they share the rest of the diagnostic morphological features, such as rhinaria and club-shaped in F4 (Figures 1A and 1B), absence of pronotal carinae (Figures 1C and 1D), presence of propodeal carinae forming a plate (Figures 1E and 1F), and

F1 shorter than pedicel and subequal to F2 and F3. Until now, no females of *A. brachyptera* have been found; only the males are known. Based on these features, we postulate that *A. brachyptera* males correspond to the brachypterous males of *A. brevis*.

Compared with the fully winged species, *Alloxysta curta* resembles *A. ramulifera*. In this case, the radial cell is visible; it is small and closed as in *A. ramulifera*. As for the rest of the important morphological features, they also share the presence of small pronotal carinae (Figures 2C and 2D), propodeal plate present with straight sides (Figures 2A and 2B), and F1 subequal to pedicel and slightly longer than F2 and F3 (Figures 2C and 2D). As in the case of *A. brachyptera*, only males of *A. curta* have been known to date, so it could be hypothesized that this species could be some of the brachypterous males of *A. ramulifera*.

Alloxysta glebaria could be associated with the fully winged species *A. mullensis* (Cameron 1883). They share all diagnostic morphological features, only differing in the length of the forewing. They share the following morphological features: F1 subequal to pedicel and longer than F2 (Figures 3A and 3B), pronotal carinae absent (Figures 3C and 3D), propodeal carinae present forming a plate (Figure 3E), rhinaria and club-shaped in F4, and closed radial cell (Figures 3F and 3G).

Frank van Veen's experiments focused on wing dimorphism of *Alloxysta halterata*. According to his studies, males of this species are always short-winged, while the females occur in both short-winged and long-winged types. *Alloxysta halterata* could be associated with the fully winged species of *A. crassa* (Cameron, 1889). It is not possible to compare the radial cell because in *A. halterata* it is not visible. However, they share other morphological features, such as F1 longer than pedicel and F2 (Figures 4A and 4B), pronotal carinae present (Figures 4C and 4D), and propodeal carinae absent (Figures 4E and 4F).

Alloxysta marshalliana could be associated with the fully winged species *A. macrophadna* (Hartig, 1841). This species was synonymized with *A. macrophadna* by

Table. Phenetic relation between *Alloxysta* fully winged and brachypterous species.

Brachypterous species	Fully winged species
<i>A. brachyptera</i>	<i>A. brevis</i>
<i>A. curta</i>	<i>A. ramulifera</i>
<i>A. glebaria</i>	<i>A. mullensis</i>
<i>A. halterata</i>	<i>A. crassa</i>
<i>A. marshalliana</i>	<i>A. macrophadna</i>
<i>A. pedestris</i>	<i>A. coloradensis</i> , <i>A. soluta</i> , or <i>A. kovilovica</i>
<i>A. pseudoconsobrina</i>	<i>A. consobrina</i>

Fergusson (1986), but van Veen (1999, pers. comm.) considered it a valid species due to the short length of the forewing and the open radial cell. This synonymy was accepted after the revision of this type material. In this work, which has established a hypothesis about the correlation between fully winged and short-winged species, *A. marshalliana* is proposed as the possible brachypterous male of *A. macrophadna* (Figure 5B). They share the following morphological features: pronotal carinae present (Figures 5C and 5D), propodeal carinae absent (Figures 5E and 5F), male with F2–F3 strongly curved.

In the case of *A. pedestris*, comparison with the fully winged species is not so easily made because the radial cell is not present; it could be the brachypterous form of different species, taking into account the three possibilities of the radial cell state (open, partially open, or closed). Among the species with the radial cell completely open, it could be compared with *A. coloradensis* Ferrer-Suay & Pujade-Villar, 2014, a species recently described from the Nearctic region; among the species with the radial cell partially open, it could be associated with *A. soluta* Hellén, 1963; compared with the species with a closed radial cell, it could be associated with *A. kovilovica* Ferrer-Suay & Pujade-Villar, 2013, a species also recently described from the Balkan Peninsula. All of these species have in common the absence of pronotal and propodeal carinae and F1 longer than pedicel. Thus, in this case, it is more important to complete the cycle and rear plenty of specimens to determine if this species really belongs to another fully winged species.

Alloxysta pseudoconsobrina could be associated with the fully winged species *A. consobrina* (Zetterstedt, 1838). They share all diagnostic features except for the length of the forewing. They share the following morphological features: pronotal carinae present, propodeal carinae absent, rhinaria and club-shaped beginning in F1, male with F1–F3 curved.

Key to the *Alloxysta* brachypterous species:

1. Forewing reaching the end of the metasoma; with visible radial cell. 2
 - Forewing reaching the beginning of the metasoma; without visible radial cell. 5
2. Radial cell completely open (Figure 5A).
 - *A. marshalliana* (Kieffer, 1900)
 - Radial cell closed 3
3. Pronotal carinae absent (Figure 3C).
 - *A. glebaria* Hellén, 1963
 - Pronotal carinae present. 4
4. Propodeal carinae absent (Figure 6C).
 - *A. pseudoconsobrina* Ferrer-Suay **sp. nov.**
 - Propodeal carinae present (Figure 2E).
 - *A. curta* Ferrer-Suay **sp. nov.**

5. Pronotal carinae present (Figure 4D); propodeal carinae absent (Figure 4F). Males always brachypterous, females sometimes brachypterous. Fully winged female with closed radial cell being 2.4 times as long as wide.
..... *A. halterata* (Thomson, 1862)

- Pronotal carinae absent; propodeal carinae absent or present. When it is known, female always brachypterous. 6

6. Propodeal carinae present at the base. Male: F1 shorter than pedicel (Figure 1B). Female unknown.
..... *A. brachyptera* (Hartig, 1840)

- Propodeal carinae absent. F1 shorter or longer than pedicel. 7

7. Forewing reaching the beginning of metasoma. Female: F1 longer than pedicel and F2, F2 subequal to F3. Male: F1 subequal or slightly longer than pedicel, F1–F4 subequal in length.
..... *A. pedestris* (Curtis, 1838)

- Forewing very short, practically absent. Female: F1 shorter than pedicel, F1 longer than F2, F2 subequal to F3. Male unknown.
..... *A. apteroidea* Hellén, 1963

According to van Veen (pers. comm.), the maintenance of wing dimorphism is generally thought to depend on the heterogeneity of the habitat and the tradeoff between wing morph and life history traits. The dimorphism in *A. halterata* is probably maintained because of the variation in patch quality and the differences in life history between morphs.

It must be taken into account that in this manuscript the comparison between fully winged and brachypterous species is only based on morphological features. This is the first attempt to elucidate the possible wing dimorphism between some *Alloxysta* species. It is necessary to complete this study from a deeper perspective using breeding and genetic experiments. For this reason, the species are kept separate currently and two new species have been described, until deeper studies can be carried out to shed light on the wing dimorphism hypotheses.

The main conclusions of this manuscript are:

- The *Alloxysta* brachypterous species have been compared with fully winged species in order to establish hypotheses regarding dimorphism for wing length and shape.

- Two new brachypterous species are here described: *Alloxysta curta* Ferrer-Suay **sp. nov.** and *Alloxysta pseudoconsobrina* Ferrer-Suay **sp. nov.**

- In total, there are now eight brachypterous species known in this genus.

- Breeding and genetic analyses are necessary to test and refine these hypotheses.

Nomenclatural acts: This work and the nomenclatural acts it contains have been registered in ZooBank. The ZooBank Life Science Identifier (LSID) for this publication is: <http://zoobank.org/urn:lsid:zoobank.org:pub:85074AE2-8714-4FDD-A2FA-4B1C3E422820>

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