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The genus *Cixius* Latreille, 1804 (Hemiptera, Fulgoromorpha, Cixiidae) in Lebanon with the description of two new species

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Abstract

A first list of *Cixius* fauna of Lebanon is here provided with the description of two new species: one within the subgenus *Acanthocixius*, *Cixius bifidispinus* **sp. nov.** and one within the subgenus *Ceratocixius Cixius superremotus* **sp. nov**. The standard morphological description is supplemented by sequence data of the mitochondrial cytochrome c oxidase subunit I (COI) gene fragment. Some notes on their distribution and economic importance are also reported.

Key words: taxonomy, planthopper, Auchenorrhyncha, Lebanese cixiid fauna, new taxa, DNA barcoding, COI, economic importance

Introduction

The Hemiptera fauna of the Middle East in general, and of Lebanon in particular, have been poorly studied in the past (Linnavuori, 1962; Asche & Hoch, 1986).

The planthopper family Cixiidae from Lebanon has been poorly investigated until nowadays, in fact hardly any literature about this topic is available, unlike for other families, e.g. in the Cicadomorpha group (Abdul-Nour, 2005).

Referring to the genus *Cixius* Latreille, 1804, the knowledge of its distribution in the Near East is restricted to a few countries. Turkey and Iran are probably the ones with the highest number of reported species. In Turkey eight species are known: *Cixius cunicularius* (Linnaeus, 1767), *Cixius distinguendus* Kirschbaum, 1868, *Cixius haupti* Dlabola, 1949, *Cixius nervosus* Linnaeus, 1758, *Cixius pallipes* Fieber, 1876, *Cixius remotus* Edwards, 1888, *Cixius simplex* (Herrich-Schaffer, 1835), *Cixius stigmaticus* (Germar, 1818) (Önder *et al*., 2011). Also in Iran eight species are reported: *C. stigmaticus*, *Cixius adornatus iranicus* Dlabola, 1979, *C. cunicularius*, *C. pallipes*, *Cixius rufus* Logvinenko, 1969, *C. simplex*, *Cixius persicus* Distant, 1907 (Mozaffarian & Wilson, 2011). In Lebanon only two species are known to occur that are *C. remotus* and *C. pallipes* (Asche & Hoch, 1986). In the neighbouring and bordering countries only in Israel and Palestine the genus *Cixius* was reported and in both cases with one species, *C. distinguendus* for the former and *C. nervosus* for the latter.

During a research project on integrated pest management of '*Candidatus* Phytoplasma phoenicium', causal agent of almond witches' broom (AlmWB), we concentrated our attention on the possible vectors involved in spreading this disease. The lethal almond disease has led to a rapid decline of almond trees in Northern Lebanon (Choueiri *et al.,* 2001, Abou-Jawdah *et al.,* 2002) and Iran (Salehi *et al.,* 2006). Phytoplasmas are known to be transmitted by sap-sucking insects, especially Auchenorrhyncha (Hemiptera), such as Cixiidae (Weber & Maixner, 1998; Alma *et al.,* 2002; Palermo *et al.,* 2004; Weintraub & Beanland, 2006, Jović *et al.,* 2007). Focusing on this family a number of specimens belonging to different genera were collected in almond and peach orchards. Among them the genus *Cixius* was identified. Most of the *Cixius* specimens belonged to a new species, whilst only one to

C. pallipes, and many of them tested positive to the AlmWB phytoplasma highlighting their potential role in spreading the pathogen (Tedeschi *et al*., 2015). In order to achieve a more complete faunistic study other *Cixius* species were sorted out from Dr. Hani Abdul-Nour private collection.

Here we provide the first overview of *Cixius* species of Lebanon including the description of two species new for science.

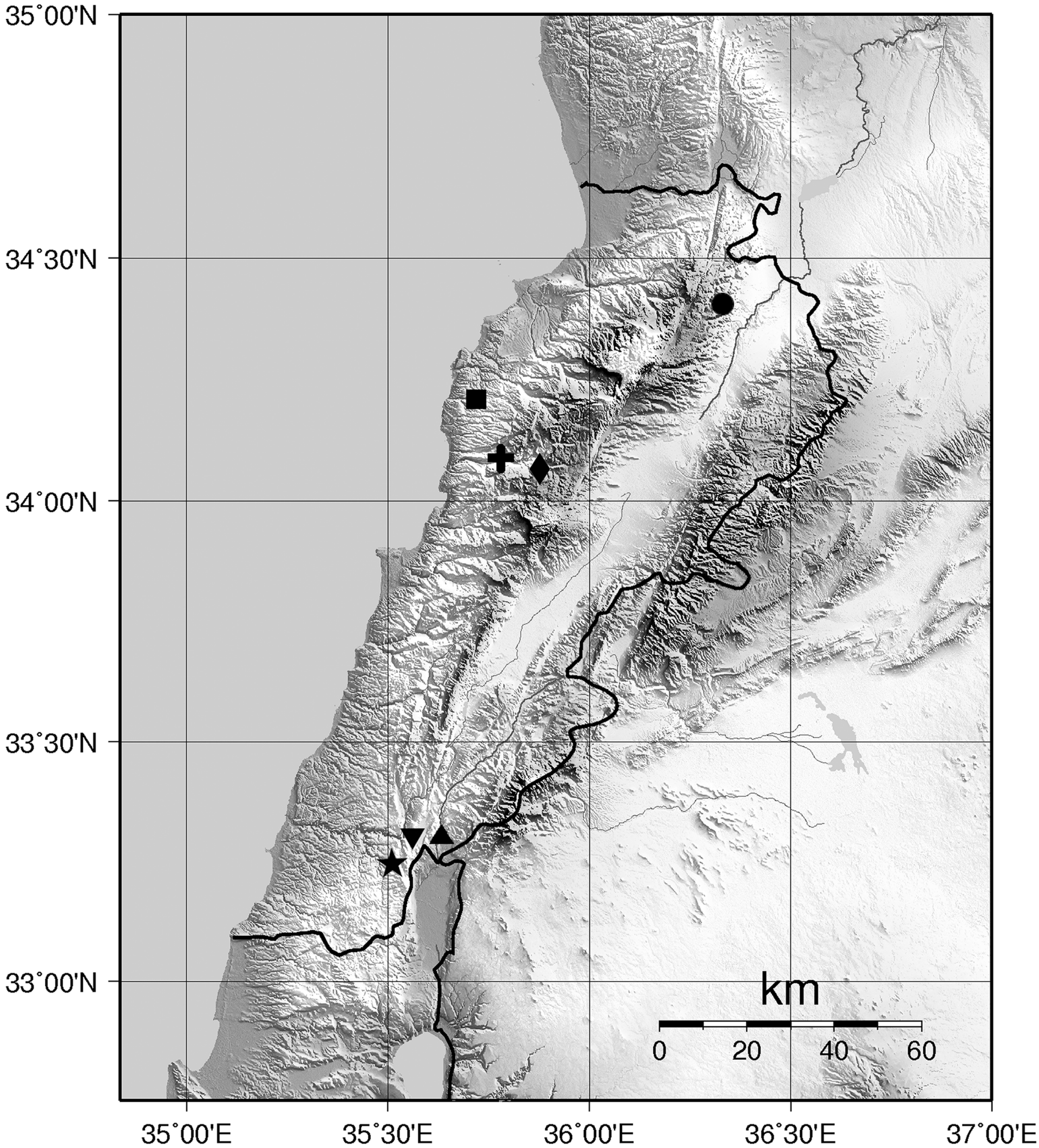


FIGURE 1. Physical map of Lebanon with collecting sites: ■ Feghal, Jbeil; ★ Kfarkila, Marjeyoun; ▼ Wadi Khansa, Marjeyoun; ● Jurd de Marjhine, Hermel; ▲ Khraibe, Marjeyoun; ♦ Jurd Aaqoura, Jbeil; ✚ Meeyane, Jbeil.

Material and methods

The *Cixius* specimens, collected in two AlmWB infected almond and nectarine orchards and their surroundings within the phytoplasma project, were aimed at two different uses. Among the 98 specimens, 97 belonged to one new species for science and among them only 27 males (among which 5 were completely processed for DNA extraction except the male genitalia) and 4 females were used to describe the new taxon (the given measurements come from the mean value obtained from all these specimens), since the others were used for molecular detection of AlmWB phytoplasma. The orchards were located in Feghal (Jbeil district), northern Lebanon, about 165m a.s.l., and in Kfarkela (Marjayoun district), southern Lebanon, at about 600m a.s.l.

The cixiids were collected during the 4-year period 2010–2013 by double-sided yellow sticky traps (10cm x 30cm), Malaise traps (165cm x 115cm x 190cm) and a hand-held mechanical aspirator (D-Vac Vacuum Insect Net-Model 122, Rincon-Vitova Insectaries, Ventura, CA, USA). All the specimens were mounted dry after dissection of the right fore and median legs which were preserved in pure ethanol for possible molecular analysis. Other additional specimens were collected in different years and localities, as below specified, by Malaise traps, sticky traps and sweep net. Some of them were kindly given in study by Dr. Hani Abdul-Nour (Fig 1).

The male genital segments were macerated in heated 10% KOH for 3 hours, washed in distilled water, dissected and transferred to glycerine for drawings. A camera lucida mounted on a Leica MZ16 A stereomicroscope was used for drawings. The morphological terminology is used according to Hoch and Asche (1993). The holotypes and the paratypes are deposited in University of Turin Collection of Dipartimento di Scienze Agrarie, Forestali e Alimentari ULF Entomologia Generale e Applicata (DISAFA–Entomology), Italy and Museum für Naturkunde, Berlin (MFN Berlin), Germany.

At subgenus level, we follow the classification suggested by Holzinger *et al*. (2003) considering *Orinocixius* Wagner,1939, as synonym of *Acanthocixius* Wagner, 1939.

Total genomic DNA was extracted from single specimens, after the dissection of the male genitalia, in the case of *C. bifidispinus*, while for the other species, due to the low number of available specimens, only one leg was used for DNA extraction. A protocol adapted from Marzachì *et al*. (1998) was used and the DNA pellet resuspended in 100 µl (whole insect) or 10 µl (leg) TE. A region of the COI gene was amplified using the primers C1-J-2195 and TL2-N-3014 (Simon *et al.*, 1994). PCR was performed in a 25-µL reaction volume containing: 1 × PCR buffer (20 mM Tris-HCl pH 8.4, 50 mM KCl); 1.5 mM $MgCl_2$; 200 µM of each dNTP; 0.5 µM of each primer; 1 unit of Taq polymerase (Bioline, MA, USA). Amplicons were first checked on a 1% agarose gel stained with GelRed™ (Biotium, Hayward, CA, USA) then purified with the GenElute™ PCR Clean-Up Kit (Sigma-Aldrich, MO, USA). The purified products were then sequenced (Genechron, S. Maria di Galeria, Italy) in both directions using the respective forward and reverse primers. Contigs were aligned and assembled in ChromasPro v. 1.49 beta (Technelysium Pty Ltd.) and ClustalX v. 2 (Larkin *et al*., 2007). Sequence divergences were calculated using the Kimura two parameter (K2P) distance model (Kimura, 1980) with ABGD (Puillandre *et al.*, 2012).

Taxonomy

Family Cixiidae Spinola, 1839

Subfamily Cixiinae Spinola, 1839

Tribe Cixiini Spinola, 1839

Cixius (Acanthocixius) bifidispinus, sp. nov.

(Figs 2–12)

Type material. Holotype, 1♂, Lebanon, Feghal, Jbeil (Byblos), Malaise trap 1.IV.2010–15.IV.2010, 165m a.s.l., C. Mahfoud leg. (R14_229) DISAFA–Entomology.

Paratypes, ♂♂: 12, Lebanon, Feghal, Jbeil (Byblos), Malaise trap 1.IV.2010–15.IV.2010, 15.IV.2010–3.V.2010, 14.X.2010–1.XI.2010, 1.XI.2010–18.XI.2010, 18.XI.2010–8.XII.2010, 29.IV.2011–16.V.2011, 16.XI.2011–30.XI.2011, 165m a.s.l., C. Mahfoud leg.; 2, Lebanon, Feghal, Jbeil (Byblos), Malaise trap 15.V.2012–1.VI.2012, 15.X.2012–30.X.2012, 165m a.s.l., S. Kahlil leg.; 2, Lebanon, Feghal, Jbeil (Byblos), 1.IV.2010, 19.V.2010, 165m a.s.l., C. Mahfoud leg.; 2, Lebanon, Feghal, Jbeil (Byblos), 8.V.2012, 165m a.s.l., on *Smilax aspera*, L. Picciau leg.; 1, Lebanon, Wadi Khansa (Marjeyoun), 30.III.2010, 500m a.s.l., L. Picciau leg.; 1, Lebanon, Ehden, Juillet 2000, (Forèt) alt. 1500m, pièges gluant, H. Abdul-Nour leg.

♀♀: 1, Lebanon, Feghal, Jbeil (Byblos), Malaise trap 15.X.2012–30.X.2012, 165m a.s.l., S. Kahlil leg.; 1, Lebanon, Kfarkila, Marjeyoun, Glue trap 14.IX.2012–1.X.2012, 165m a.s.l., S. Kahlil leg. DISAFA–Entomology. 1♂, Lebanon, Feghal, Jbeil (Byblos), Malaise trap 16.XI.2011–30.XI.2011, 165m a.s.l., C. Mahfoud leg.; 1♀ Lebanon, Feghal, Jbeil (Byblos), Malaise trap 16.V.2011–30.V.2011, 165m a.s.l., C. Mahfoud leg. MFN Berlin.

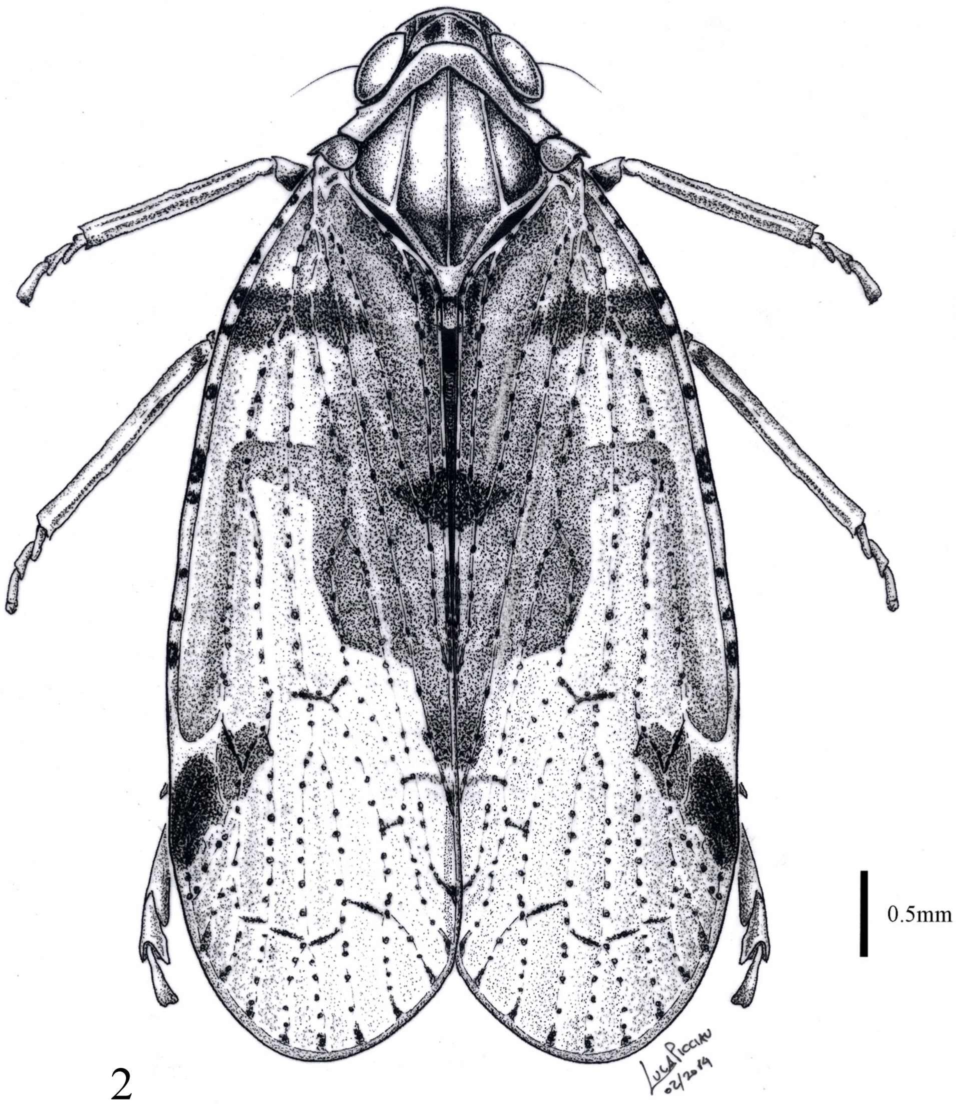
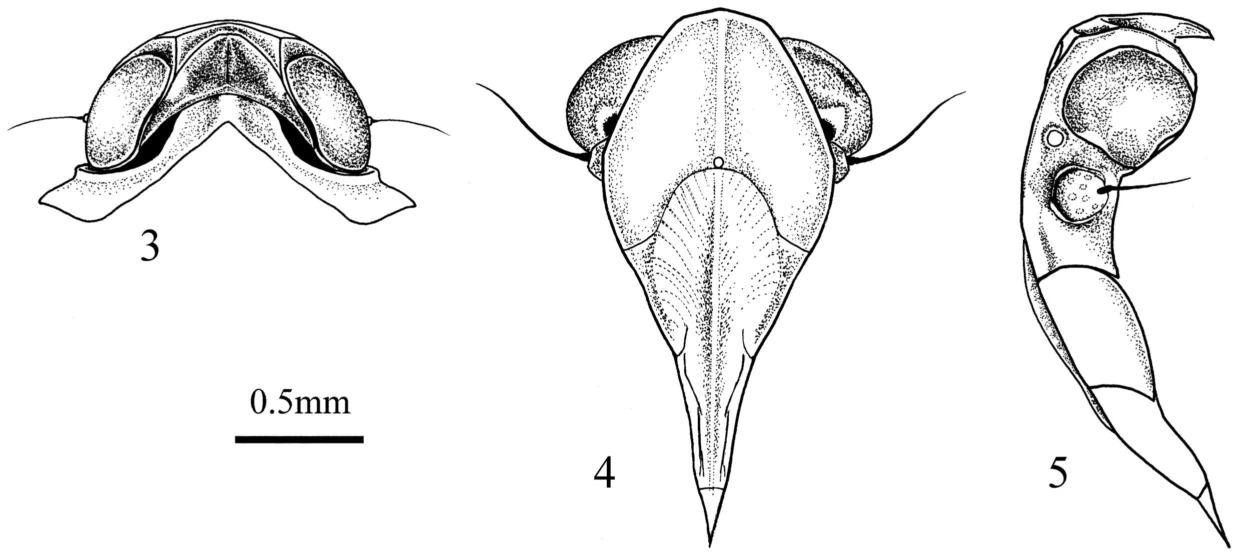


FIGURE 2. *Cixius bifidispinus* **sp. nov.** habitus, dorsal view.

DNA voucher specimens: 1♀, Lebanon, Feghal, Jbeil (Byblos), Malaise trap 15.X.2012–30.X.2012, 165m a.s.l., S. Kahlil leg. (R14_31); only DNA and male genitalia; 5, Lebanon, Feghal, Jbeil (Byblos), Malaise trap 29.IV.2011–16.V.2011, 165m a.s.l., C. Mahfoud leg. (R12_40, R12_41, R12_42, R12_44, R12_45) DISAFA–Entomology.

Additional material (only DNA samples): 3♂♂, Lebanon, Feghal, Jbeil (Byblos), Malaise trap 1.IV.2010–14.IV.2010, 165m a.s.l., C. Mahfoud leg. (R0_224, R0_225, R0_226); 2♀♀, Lebanon, Feghal, Jbeil (Byblos), Malaise trap 14.X.2010–1.XI.2010, 165m a.s.l., C. Mahfoud leg. (R11_29, R11_30); 1♀ Lebanon, Feghal, Jbeil (Byblos), Malaise trap 16.V.2010–30.V.2010, 165m a.s.l., C. Mahfoud leg., (R12_47) DISAFA–Entomology.



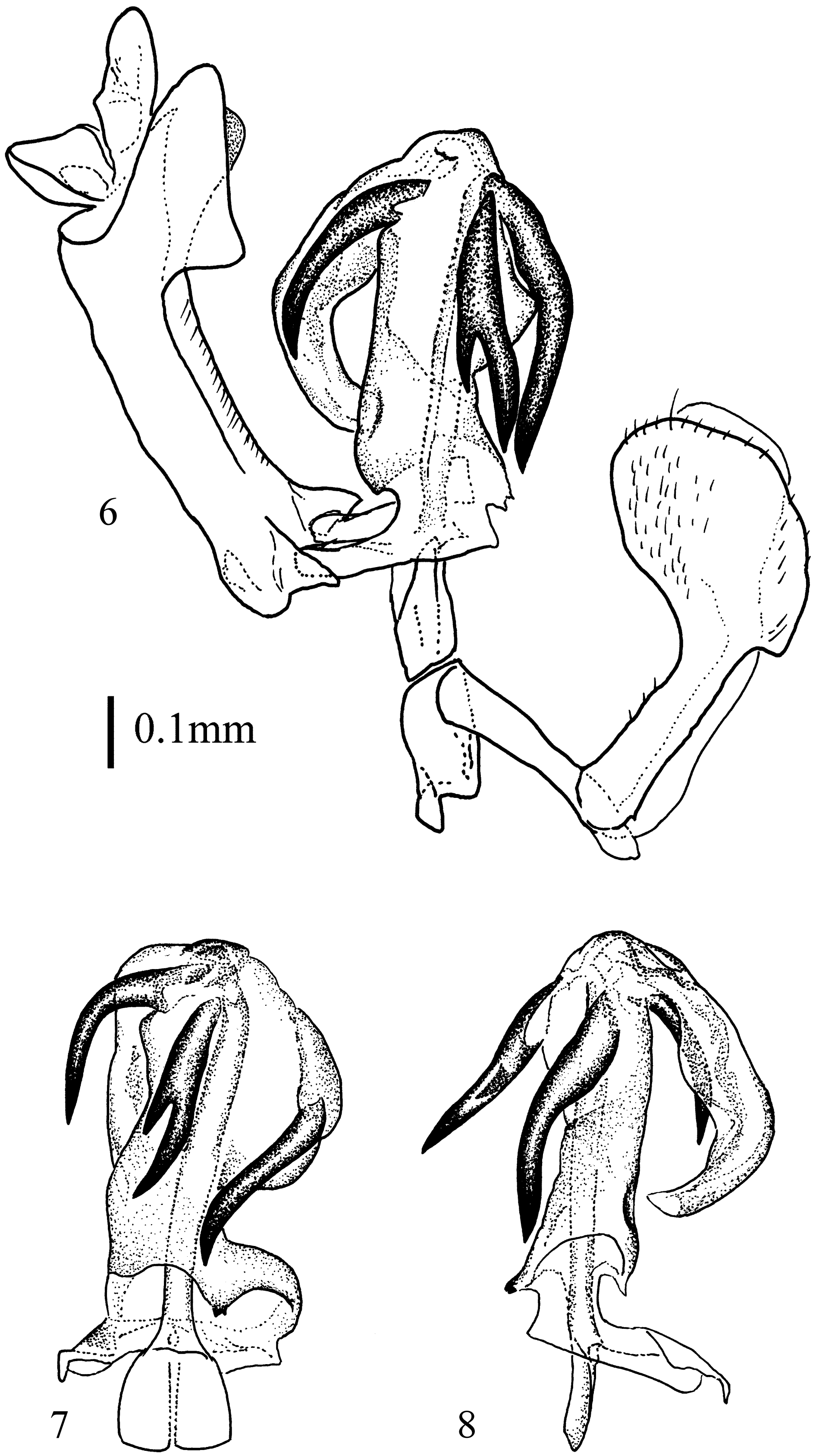
FIGURES 3–5. *Cixius bifidispinus* **sp. nov.** 3-head and pronotum, dorsal view; 4-head, frontal view; 5-head, lateral view.

Description. Moderately large cixiid (Fig 1). Head (Figs 3–5). Vertex short, about 1.6 times wide as its length in the middle, distinctly separated from frons by two strongly ridged transverse carinae. Frons rather flat and widest at the antennae level, about 1.4 times wider than medially high, lateral and median carina ridged. Clypeus longer than frons, with weakly carinated lateral margins continuing those ones of frons without interruption, strongly marked, raised median carina of postclypeus and proximal part of anteclypeus. Compound eyes and three ocelli present and well developed. Thorax. Pronotum short, medially about 0.7 times the length of the vertex, almost smooth, posterior margin rather right-angled. Mesonotum nearly planate, hollowed towards the posterior tip, clearly tricarinate, in midline about 8.7 times the length of pronotum. Tegulae well developed. Tegmina long, profusely exceeding the tip of abdomen, wings well developed.

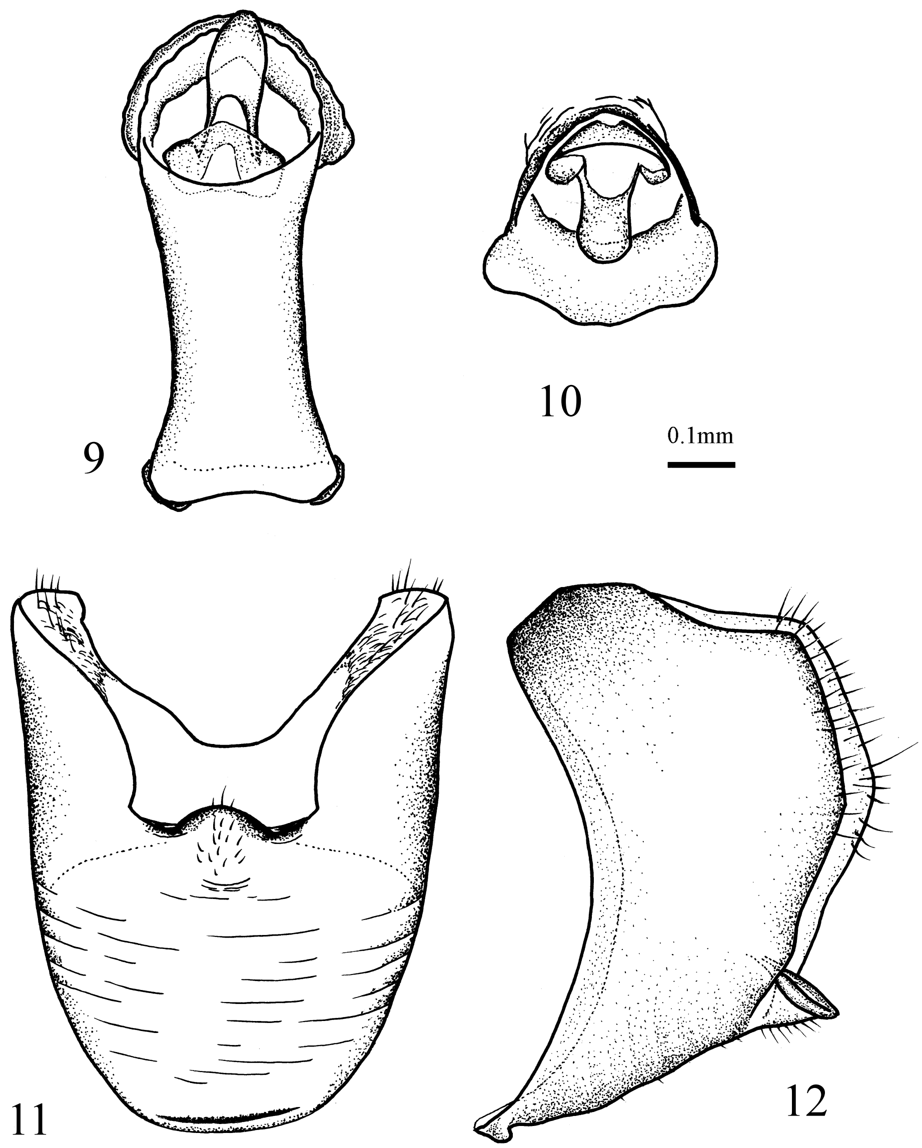
Measurements. Males. Body length: 5.87–7.17mm; maximum body width 1.51–1.82mm; length of vertex: 0.21–0.27mm; width of vertex: 0.39–0.52mm; width of head: 1.01–1.24mm; length of pronotum: 0.10–0.15mm; width of pronotum: 1.29–1.59mm; length of mesonotum: 1.25–1.65mm; width of mesonotum: 1.25–1.47mm; length of fore wings: 5.14–6.16mm; width of fore wings: 1.71–2.19mm; vertex ratio (length/width) range: 0.41–0.69; pronotum ratio range: 0.07–0.10; mesonotum ratio range: 1.00–1.12; fore wing ratio range: 2.82–3.15. Females. Body length 6.73–7.28mm; maximum body width: 1.66–1.82mm; length of vertex: 0.23–0.27mm; width of vertex: 0.43–0.48mm; width of head: 1.12–1.26mm; length of pronotum: 0.11–0.13mm; width of pronotum: 1.39–1.64mm; length of mesonotum: 1.35–1.61mm; width of mesonotum: 1.33–1.55mm; length of fore wings: 5.77–6.29mm; width of fore wings: 1.92–2.10mm; vertex ratio (length/width) range: 0.47–0.60; pronotum ratio range: 0.08–0.09; mesonotum ratio range: 0.98–1.09; fore wing ratio range: 2.99–3.05.

Colouration. Forebody reddish, head mainly pale brownish, vertex with two whitish spots, pronotum pale yellow, mesonotum reddish-brown with the two external areas darker. Abdomen black and pale yellow intersegmental membranes. Tegmina transparent with distinct dark transverse marking running from Sc to claval suture at R-M bifurcation vein level and a shorter one on stigma. Three elongated markings along the commissural border. Veins whitish.

Male genitalia (Figs 6–12). Genital segment about 1.45 times higher than wide. Anal segment about 2.8 times longer than wide, distal portion slightly bent ventrally, laterodistal margins slightly asymmetric. Parameres moderately long, narrow in basal half, then gradually expanding. Aedeagus basal part (shaft) slightly compressed, slender; ventrally near base two minute, rigid spines directed proximally, right margin forming almost at distal half a rounded projection directed laterally; dorsal side of basal part subapically forming a weak concave depression. Shaft apically with three movable spinose processes: left lateral one moderately curved directed basally; right lateral one slightly sinuate, in repose directed basally; ventral one bi-forked, left tine shorter, right tine almost twice as long as the left one. Distal part of aedeagus (velum) apically curved, in repose reflected basally with the tip fitting the hollow at dorsal base of shaft.



FIGURES 6–8. *Cixius bifidispinus* **sp. nov.** 6-male genitalia (without pygofer), left lateral view; 7-aedeagus, ventral view; 8-aedeagus, right lateral view.



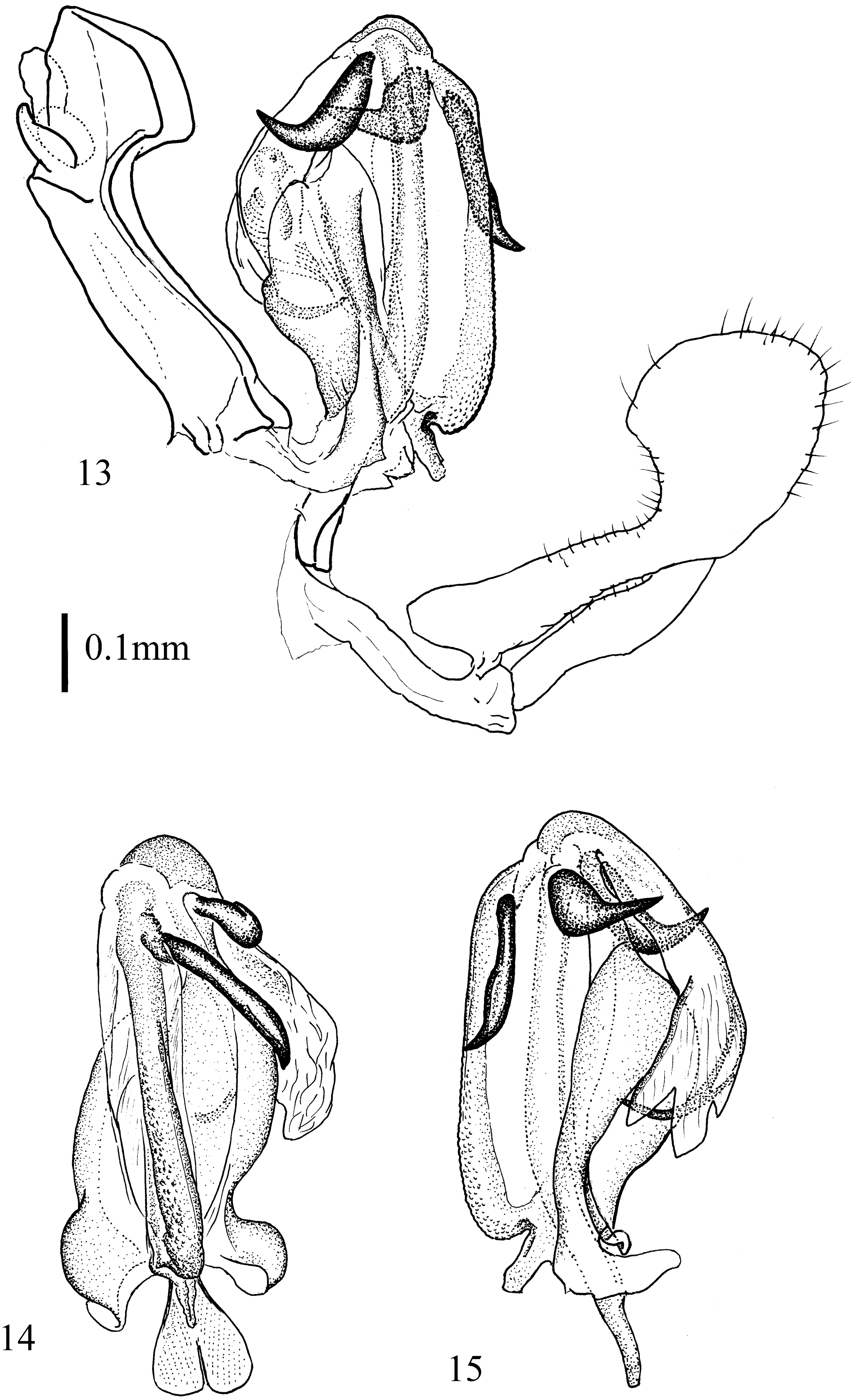
FIGURES 9–12. *Cixius bifidispinus* **sp. nov.** 9-anal tube, dorsal view; 10-anal tube, caudal view; 11-pygofer, ventral view; 12-pygofer, left lateral view.

Female genitalia. VII sternite crescent-shaped, with caudal margin straight, tergite IX truncate, broadly ovoid, slightly concave, wax plate distinct, medially not divided; ovipositor sword-like, caudally distinctly surpassing tip of anal segment, gently curved caudodorsally; anal segment elongate, dorsoventrally compressed, in caudal aspect subtriangular; gonoplacs (lateral gonapohyses IX) laterally with rather elongate, sturdy bristles.

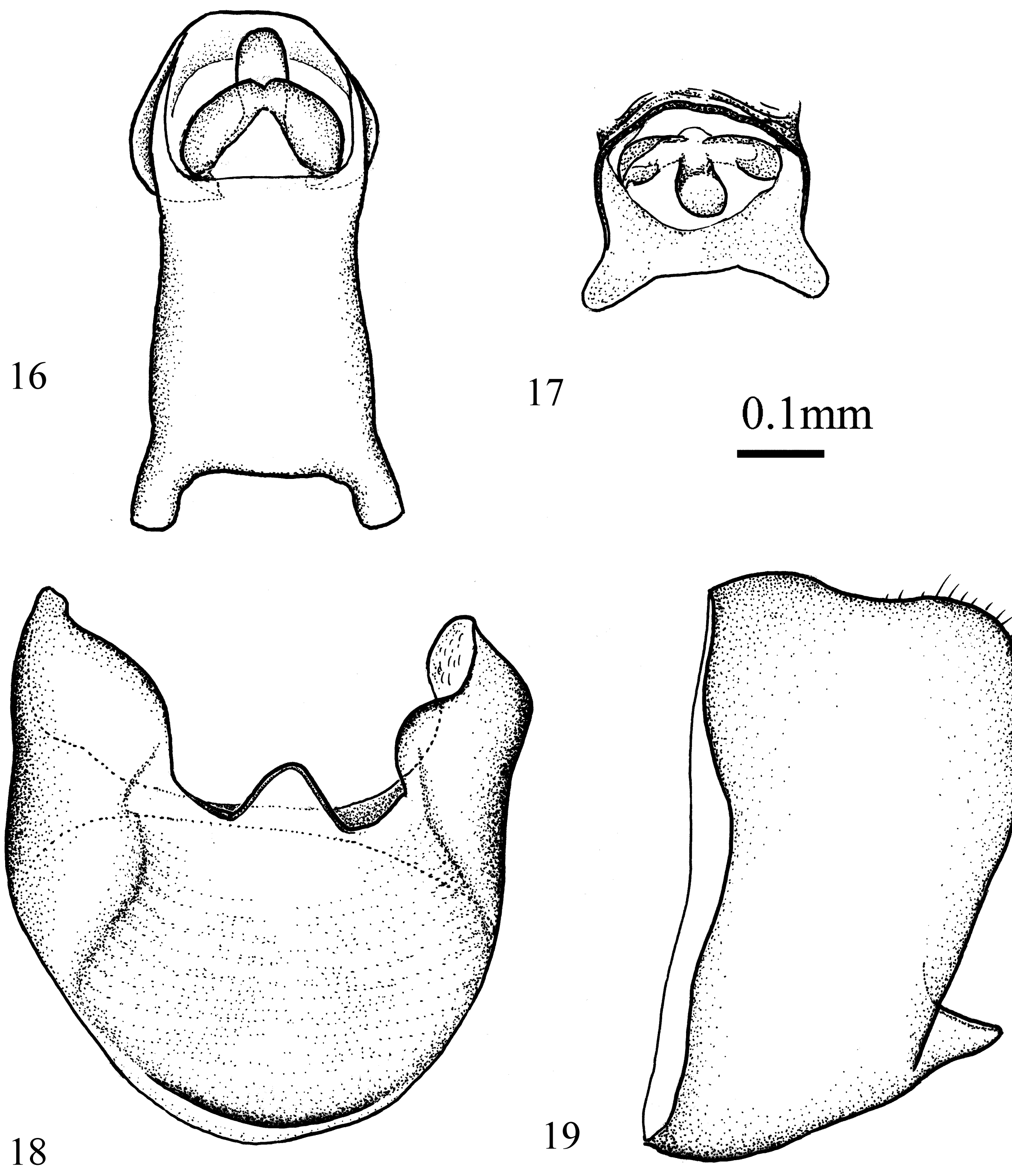
Diagnosis. Habitus resembling other congeners, but displaying a unique configuration of the male genitalia: aedeagus with ventral movable spinose process distinctly bifurcate.

Etymology. The specific name derives from the bifurcation of the ventral movable spinose process of the aedeagus.

Distribution and ecology. *Cixius bifidispinus* **sp. nov.** is known from two different districts: Jbeil situated in the north of Lebanon at about 165m a.s.l and Marjayoun located in the south of Lebanon, close to Israel boundaries, at about 600m a.s.l. All the specimens were collected by traps or an hand-held mechanical aspirator in two orchards, almond trees in the North and nectarine trees in the South, were many different weed species were present, in particular the perennial *Smilax aspera* L. The adult hand-collected specimens were found only on this creeping plant.



FIGURES 13–15. *Cixius granulatus*. 13-male genitalia (without pygofer), left lateral view; 14-aedeagus, ventral view; 15-aedeagus, right lateral view.

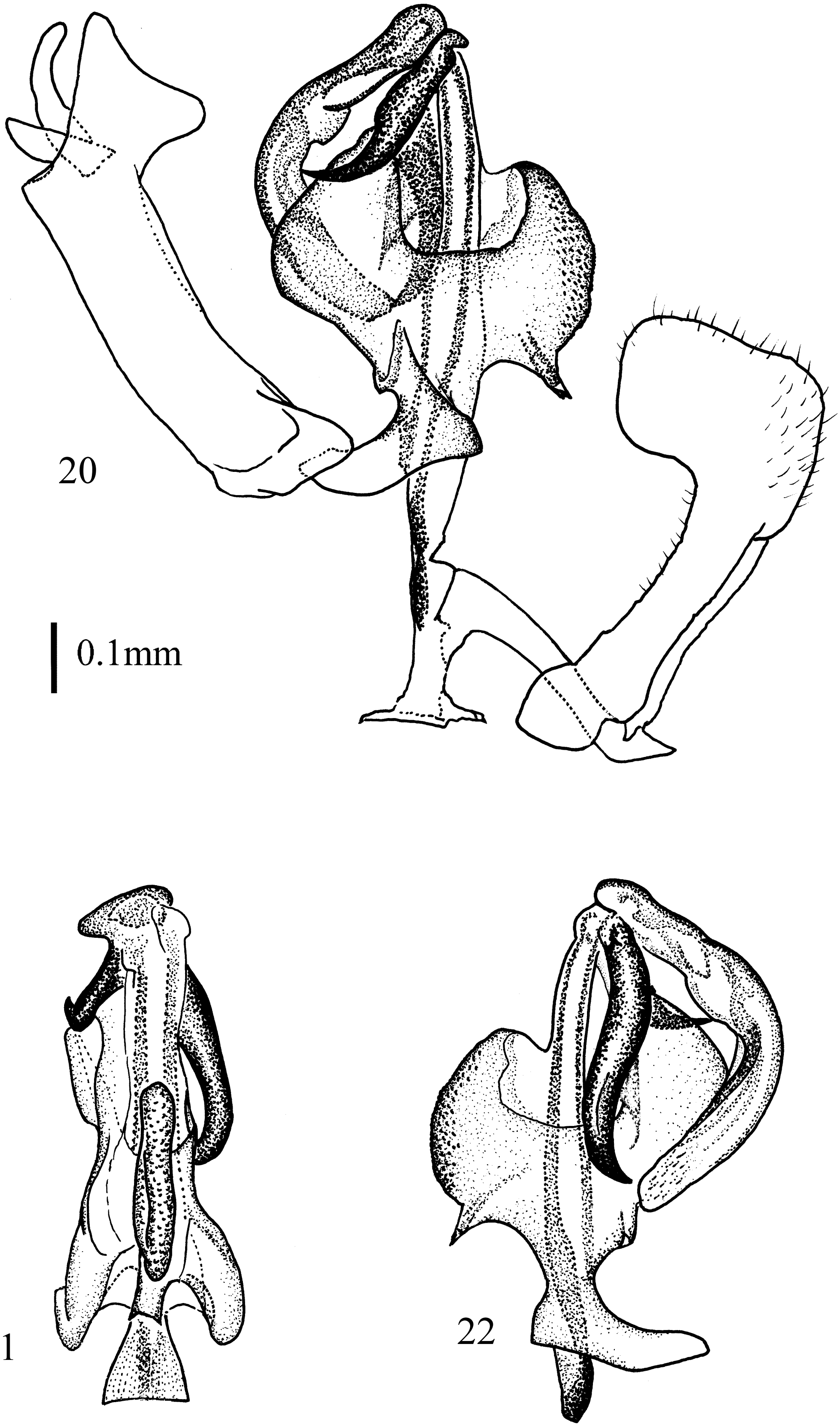


FIGURES 16–19. *Cixius granulatus*. 16-anal tube, dorsal view; 17-anal tube caudal view; 18-pygofer, ventral view; 19-pygofer, left lateral view.

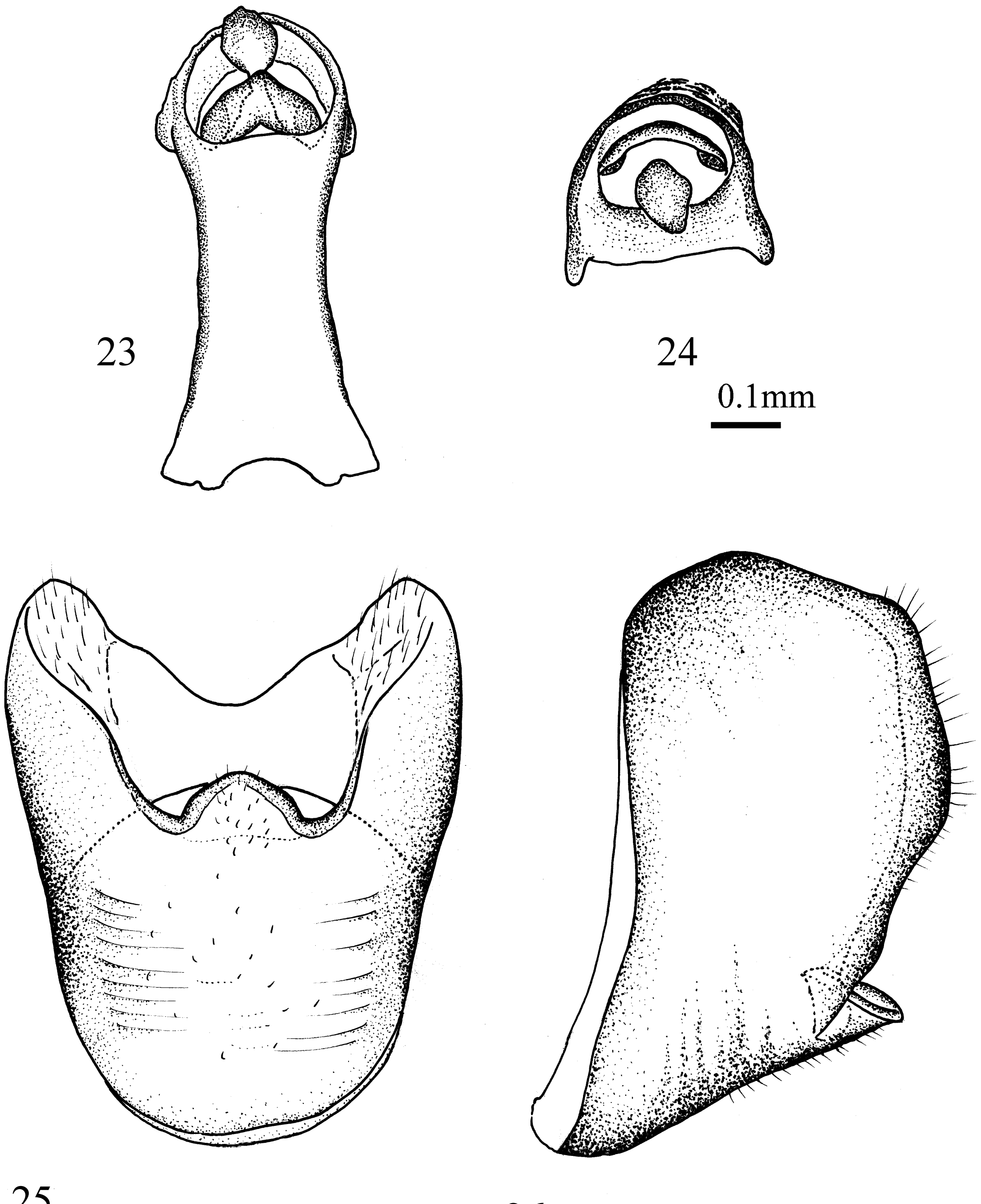
Cixius (Acanthocixius) granulatus **Horvath, 1897**
(Figs 13–19)

Material examined. 1♂: Liban, Jurd de Marjhine (Hermel). Alt 2000m 1–15/8/2004 /piège Malaise, H. Abdul-Nour leg. DISAFA–Entomology.

Measurements. Body length: 5.16mm; maximum body width: 1.34mm; length of vertex: 0.18mm; width of vertex: 0.40mm; width of head: 0.99mm; length of pronotum: 0.09mm; width of pronotum: 1.14mm; length of mesonotum: 1.14mm; width of mesonotum: 1.12mm; length of fore wings: 4.35mm; width of fore wings: 1.41mm; vertex ratio (length/width): 0.46; pronotum ratio: 0.08; mesonotum ratio: 1.01; fore wing ratio: 3.09.



FIGURES 20–22. *Cixius pallipes*. 20-male genitalia (without pygofer), left lateral view; 21-aedeagus, ventral view; 22-aedeagus, right lateral view.

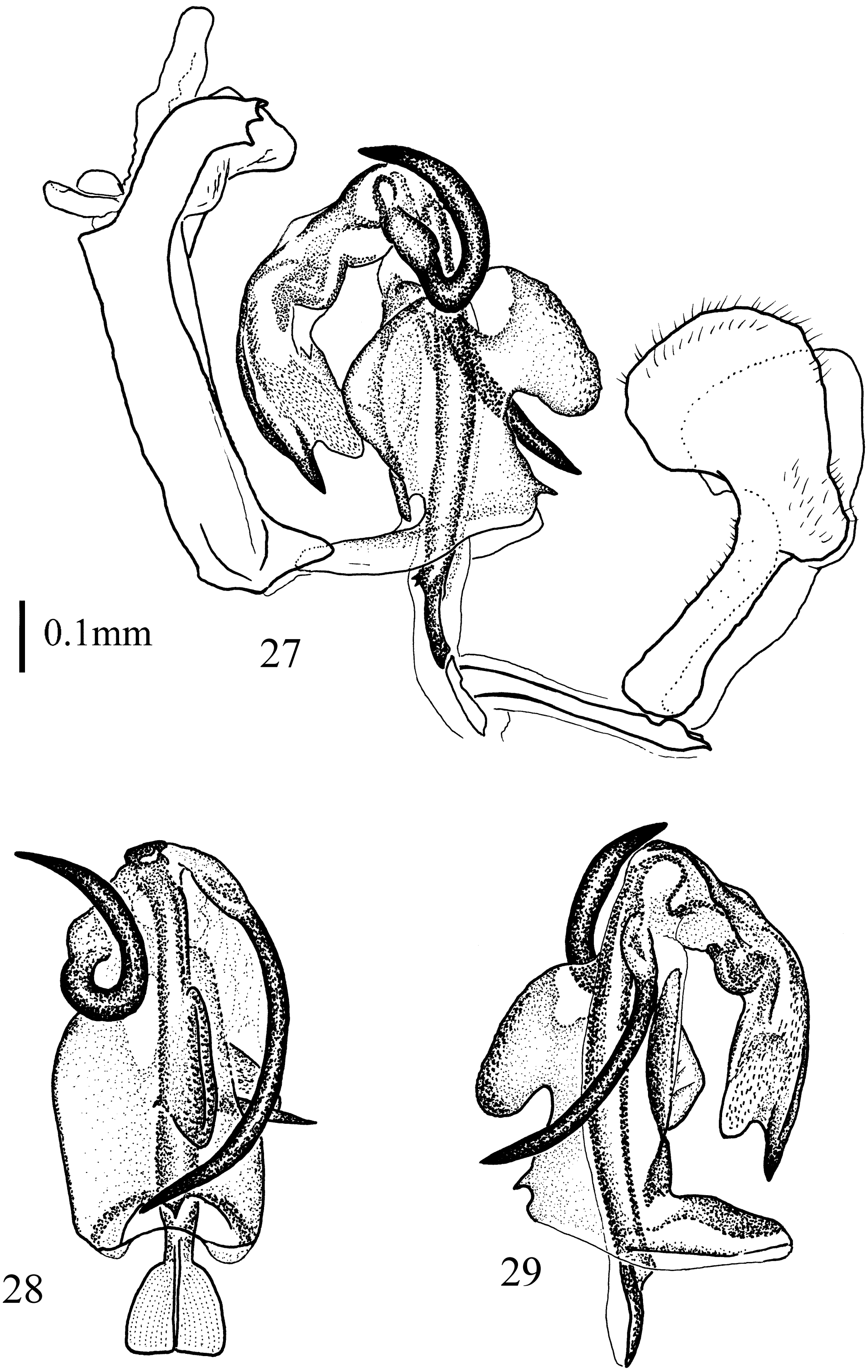


FIGURES 23–26. *Cixius pallipes*. 23-anal tube, dorsal view; 24-anal tube, caudal view; 25-pygofer, ventral view; 26-pygofer, left lateral view.

Cixius (Ceratocixius) pallipes **Fieber, 1876**
(Figs 20–26)

Material examined. 1♂: Lebanon, Khraibe, Marjeyoun, 7.XI.2013, 600m a.s.l., on *Smilax aspera*, L. Picciau leg. DISAFA–Entomology.

Measurements. Body length: 6.2mm; maximum body width: 1.51mm; length of vertex: 0.24mm; width of vertex: 0.39mm; width of head: 1.07mm; length of pronotum: 0.13mm; width of pronotum: 1.29mm; length of mesonotum: 1.40mm; width of mesonotum: 1.20mm; length of fore wings: 5.43mm; width of fore wings: 1.66mm; vertex ratio (length/width): 0.62; pronotum ratio: 0.10; mesonotum ratio: 1.17; fore wing ratio: 3.28.



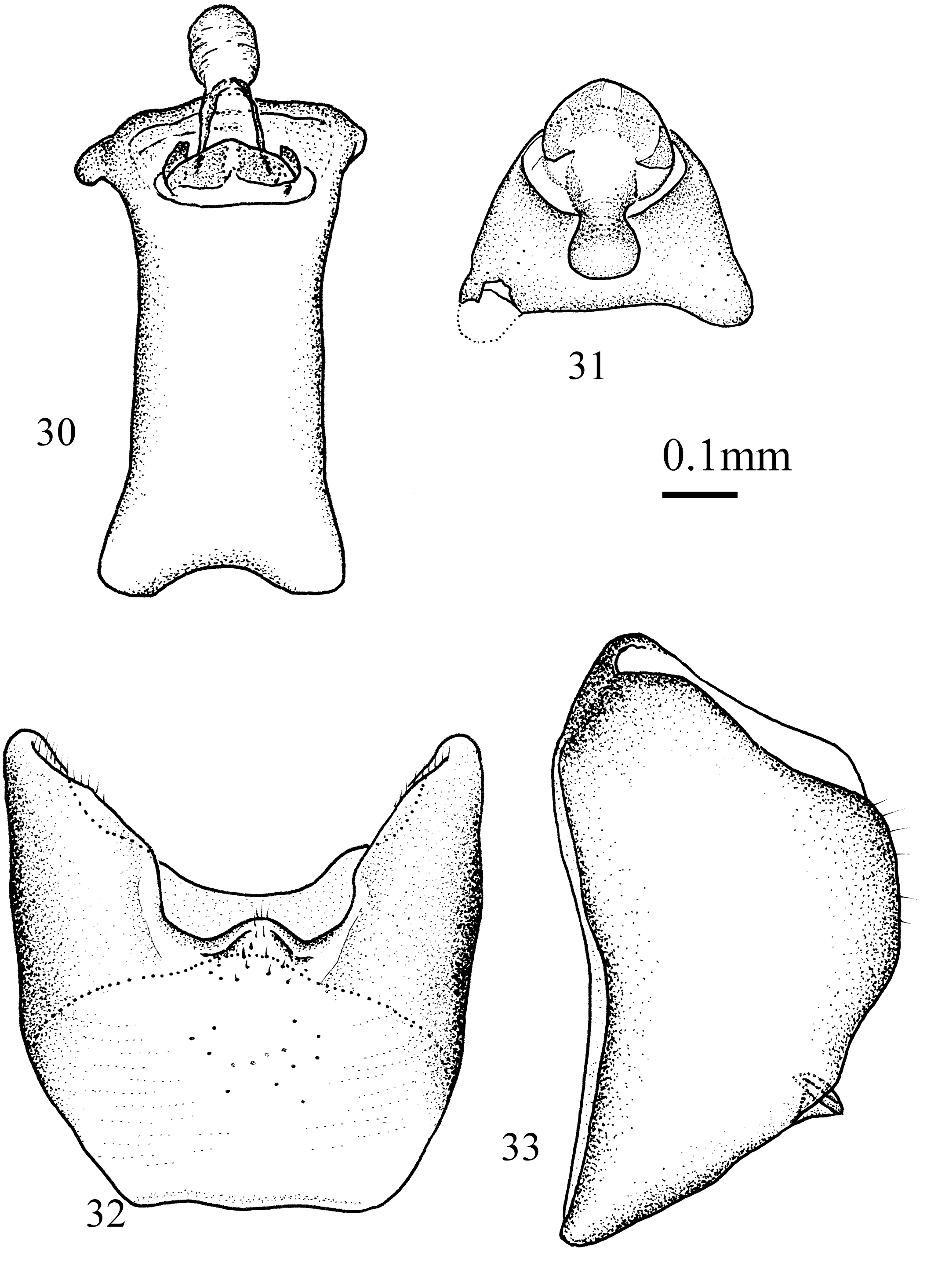
FIGURES 27–29. *Cixius remotus*. 27-male genitalia (without pygofer), left lateral view; 28-aedeagus, ventral view; 29-aedeagus, right lateral view.

Cixius (Ceratocixius) remotus **Edwards, 1888**
(Figs 27–33, 42–45)

Material examined. ♂♂: 4, Lebanon, Jurd Aaqoura, Jbeil (Byblos), Alt. 2000m, 29/V/2005, H. Abdul-Nour leg.; ♀♀: 2, Lebanon, Jurd Aaqoura, Jbeil (Byblos), Alt. 2000m, 29/V/2005, H. Abdul-Nour leg. DISAFA–Entomology.

1, Lebanon, Chabrouh, 27.11.1983, H. Abdul-Nour leg.; 1, Greece, Nomos Florina, Mikra Prespa Lake, supra Psarades, 1.150m, 3.9.1983, M. Asche & H. Hoch leg.; 1, Greece, Nomos Pieria, Varikon, coastal area, 21.8. 1983, M. Asche & H. Hoch leg.; 1, Greece, Nomos Pieria, Olymbos Mt., near Prionia, ca. 460m, on *Quercus coccifera*, 17.8.1983, M. Asche & H. Hoch leg. MFN Berlin.

Measurement. Body length: 6.43mm; maximum body width: 1.56mm; length of vertex: 0.22mm; width of vertex: 0.46mm; width of head: 1.20mm; length of pronotum: 0.10mm; width of pronotum: 1.35mm; length of mesonotum: 1.47mm; width of mesonotum: 1.23mm; length of fore wings: 5.45mm; width of fore wings: 1.66mm; vertex ratio (length/width): 0.49; pronotum ratio: 0.08; mesonotum ratio: 1.20; fore wing ratio: 3.27.



FIGURES 30–33. *Cixius remotus*. 30-anal tube, dorsal view; 31-anal tube, caudal view; 32-pygofer, ventral view; 33-pygofer, left lateral view.

***Cixius (Ceratocixius) superremotus*, sp. nov.**
(Figs 34–41, 46)

Type material. Holotype, 1♂: Lebanon, Meeyane, Jbeil (Byblos), 600m, 28.X.1984, plaques, H. Abdul-Nour leg. (R14_15) MFN Berlin.

Paratype, ♂: 1, Lebanon, Jurd Aaqoura, Jbeil (Byblos), Alt. 2000m, 29/V/2005, H. Abdul-Nour leg. DISAFA–Entomology.

Description. Moderately large cixiid. Head. Vertex short, about 2.49 times wide as its length in the middle, distinctly separated from frons by two strongly ridged transverse carinae. Frons rather flat and widest just below the antennae level, about 1.29 times wider than medially high, lateral and median carina ridged. Clypeus longer than frons, with weakly carinated lateral margins continuing those ones of frons without interruption, strongly marked, raised median carina of postclypeus and proximal part of anteclypeus. Compound eyes and three ocelli present and well developed. Thorax. Pronotum short, about 0.8 times the length of the vertex, almost smooth, posterior margin rather right-angled. Mesonotum nearly planate, hollowed towards the posterior tip, clearly tricarinate, in midline about 10.8 times the length of pronotum. Tegulae well developed, tegmina long, profusely exceeding the tip of abdomen, wings well developed.

Measurements. Body length: 6.46mm; maximum body width 1.54mm; length of vertex: 0.17mm; width of vertex: 0.43mm; width of head: 1.18mm; length of pronotum: 0.14mm; width of pronotum: 1.33mm; length of mesonotum: 1.57mm; width of mesonotum: 1.27mm; length of fore wings: 5.71mm; width of fore wings: 1.79mm; vertex ratio (length/width): 0.40; pronotum ratio: 0.11; mesonotum ratio: 1.23; fore wing ratio: 3.20.

Colouration. Forebody dark brownish, head mainly blackish with brown carinae, pronotum pale brown, mesonotum reddish-blackish with brownish median carina and external margin. Abdomen black. Tegmina transparent with whitish veins.

Male genitalia (Figs 34–41). Genital segment about 1.3 times higher than wide. Anal segment about 3 times longer than wide, distal portion bent ventrally, laterodistal margins slightly asymmetric. Parameres moderately long, narrow in basal half, then gradually expanding in a ear-shaped distal lobe. Aedeagus basal part (shaft) slightly compressed, slender; ventrally near base one minute, rigid spine directed ventrally, left margin forming almost at basal half a curved projection directed laterally; dorsal side almost plane. Shaft apically with two movable spinose processes: left lateral one strongly curved, curly, directed ventrally, crossing beneath the ventral keeled margin; right lateral one slightly curved, in repose directed to the left. Distal part of aedeagus (velum) curved, bearing a spine at the tip, in repose reflected basally.

Females unknown.

Etymology. The specific name is due to the curly overdeveloped left spinose process compared to the equivalent one of *Cixius remotus*.

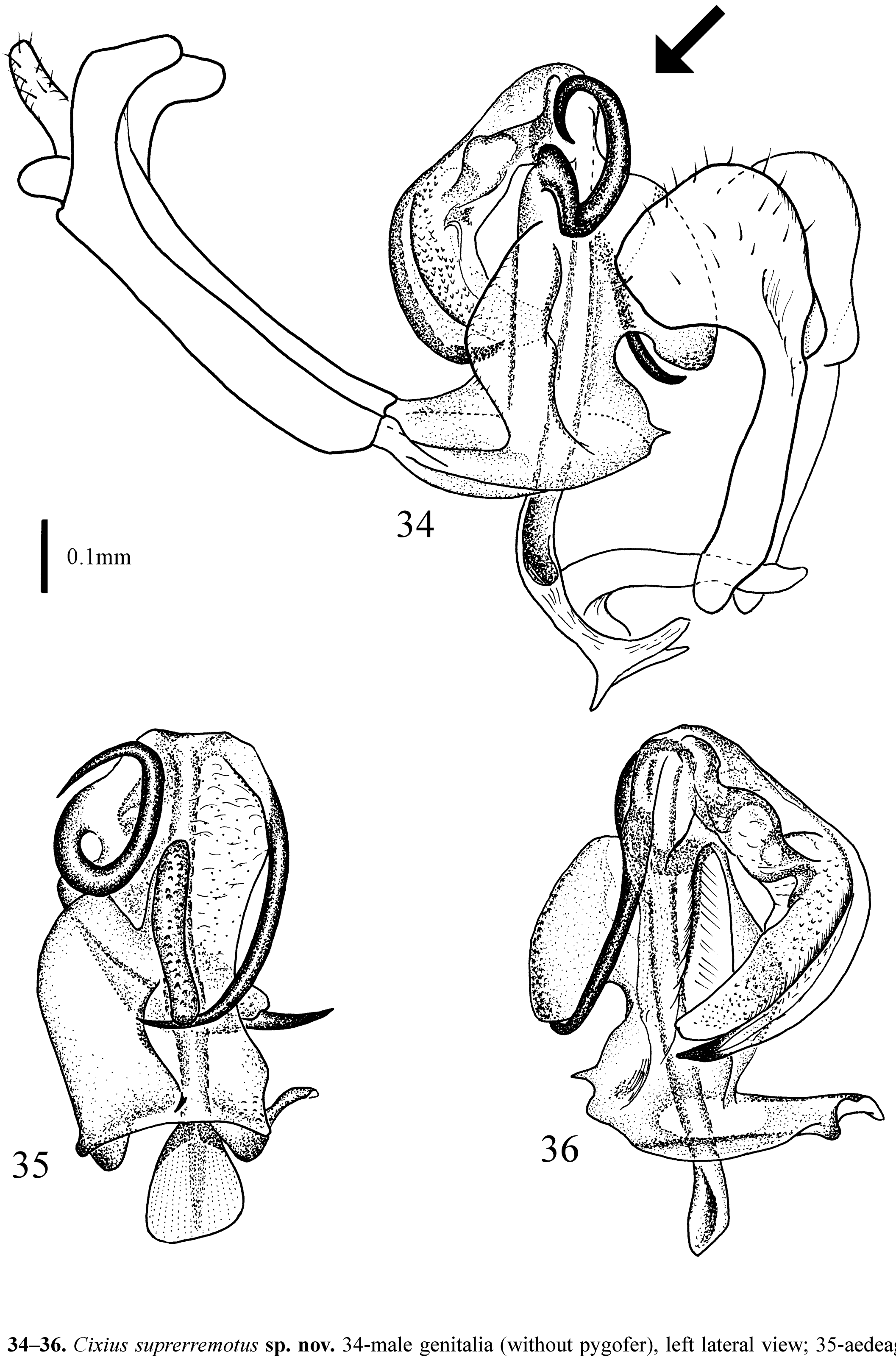
Distribution and ecology. The two known specimens were collected from two different localities Meeyane and Jurd Aaqoura in the district of Jbeil.

Remarks.

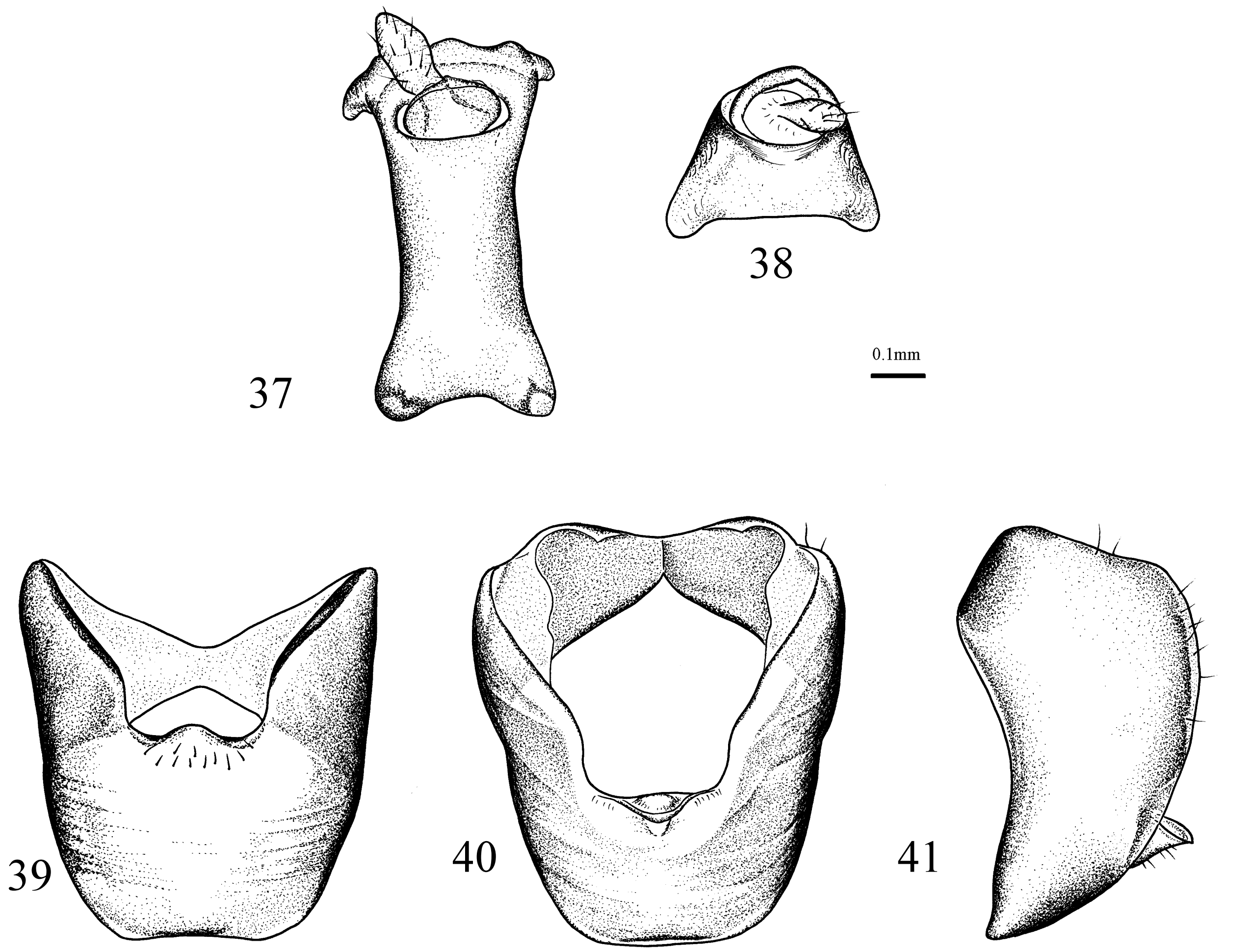
Cixius remotus is widely distributed in the Western Palearctic (Holzinger et al. 2003): southern England, France, and Balkan Peninsula, and is now also reported from Lebanon. Throughout its distribution, male specimens of *C. remotus* show a certain degree of variation in the shape of the left lateral subapical aedeagal spinose process: it is strongly curved, forming more than a half circle, however, never a full circle (Figs 42–45). The two specimens discovered in Lebanon, from two different localities, and described here as *C. superremotus*, do display a circularly curved spinose process (Fig. 46). Although they occur—in part—syntopically with *C. remotus*, we consider the morphological non-overlap as an indication for interrupted gene-flow between them and *C. remotus*, and therefore assume the existence of two reproductively isolated entities sensu Remane (1968).

DNA barcode.

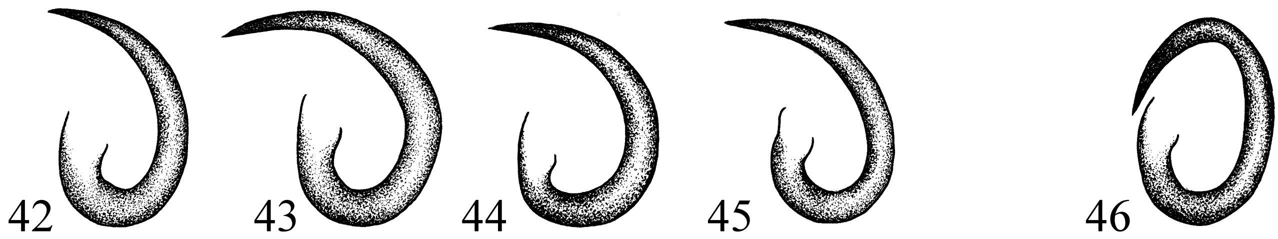
The sequence of a 690-bp fragment of the mitochondrial COI gene was obtained from 6 paratypes (5 males and 1 female) and the 6 additional specimens of *C. bifidispinus* and from the only male of *C. pallipes*. On the contrary we failed to obtain COI amplification from *C. remotus* and *C. superremotus*. All obtained sequences were deposited in GenBank (KP974663-KP974668 for paratypes and KP974669-KP974674 for additional material of *C. bifidispinus* respectively; KP974675 for *C. pallipes*). The K2P genetic distance within all *C. bifidispinus* sequences was 0%, while the genetic distance between *C. bifidispinus* and *C. pallipes* was 9.99%.



FIGURES 34–36. *Cixius suprerremotus* **sp. nov.** 34-male genitalia (without pygofer), left lateral view; 35-aedeagus, ventral view; 36-aedeagus, right lateral view.



FIGURES 37–41. *Cixius suprerremotus* **sp. nov.** 37-anal tube, dorsal view; 38-anal tube, caudal view; 39-pygofer, ventral view; 40-pygofer, ventrocaudal view; 41-pygofer, left lateral view.



FIGURES 42–46. Left lateral movable spinose process of aedeagus. 42-*Cixius remotus*, from Varikon (Nomos Pieria), Greece; 43-*Cixius remotus*, from Mikra Prespa Lake supra Psarades (Nomos Florina), Greece; 44-*Cixius remotus*, from Olympus Mt. near Prionia (Nomos Pieria), Greece; 45-*Cixius remotus*, from Lebanon, Chabrouh; 46-*Cixius superremotus* **sp. nov.**, from Meeyane, Lebanon.

Discussion

The interesting geographic position of Lebanon makes this territory a potential overlapping area of Palaearctic, Oriental and Ethiopian faunae (Asche & Hoch, 1986) and the peculiar position of a high mountainous chain, about 3000m a.s.l., at the 35th parallel on the Mediterranean eastern coast could explain the subtropical tendency climate of the coast which facilitates the establishment of species hailing from warm areas (Abdul-Nour, 2005). Its geomorphology shows a small land surface rich of mountainous contours, Lebanon and Anti-Lebanon mountains separated by the Beqaa valley, that can provide suitable environmental conditions both for endemism development and shelter areas (Asche & Hoch, 1986). Nevertheless, only a couple of *Cixius* species, *C. remotus* and *C. pallipes*, were known for Lebanon despite the high potential biodiversity (Asche & Hoch, 1986). Above all this, during the AlmWB phytoplasma project, we were able to collect 98 *Cixius* specimens, 97 of which subsequently named as *C. bifidispinus* **sp. nov.** and one as *C. pallipes*. Additional specimens, originally collected by H. Abdul-Nour and now accomodated partly in the Museum für Naturkunde and partly in the DISAFA–Entomology collection, were included in the study. These specimens were recognized to belong to three different species. One of them was identified as new species and named *Cixius superremotus* **sp. nov.** after being compared to the close related species *C. remotus*.

The sequence data of the mitochondrial cytochrome c oxidase subunit I (COI) gene fragment supported the conventional description of *C. bifidispinus* as a new species, showing genetic uniformity within *C. bifidispinus* specimens, but a K2P genetic distance between *C. bifidispinus* and *C. pallipes* (9.99%). Unfortunately the failure in amplifying COI fragments from *C. remotus* and *C. superremotus*, probably due to preservation procedures of the original material, prevented us to perform further comparisons.

A total of 5 *Cixius* species are now listed for Lebanon, a number which can be certainly considered underestimated since the cixiid fauna is far from being well known in this interesting region. This apparently contradictory result is definitely due to the limited investigated area which was defined according to the aim of the project focused on the identification of AlmWB phytoplasma vectors. Therefore further investigation should be taken into account to fill the faunistic gap, since obviously many more taxa remain to be discovered and described.

Within this frame it is notable that many of *C. bifidispinus* **sp. nov.** tested positive to the AlmWB phytoplasma, '*Ca.* Phytoplasma phoenicium', highlighting its potential role in spreading the pathogen (Tedeschi *et al*., 2015).

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