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The genus *Phasgonophora* Westwood, 1832 (Hymenoptera, Chalcididae) in Saudi Arabia: re-evaluation of its limits and description of three new species

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Abstract

A phylogenetic study based on 25 species of Phasgonophorinae (Hymenoptera: Chalcididae) and 36 characters was carried out for ensuring the generic placement of three new species from Saudi Arabia. As a result of this study, the genera *Trigonura* Sichel, 1866, *Bactrochalcis* Kieffer, 1912, *Centrochalcis* Cameron, 1913, *Centrochalcidia* Gahan & Fagan, 1923, *Chalcidellia* Girault, 1924, *Urochalcis* Nikol'skaya, 1952, *Trigonurella* Bouček, 1988, and *Muhabbetella* Koçak & Kemal, 2008 are synonymized with *Phasgonophora* Westwood, 1832. This genus is recorded in Saudi Arabia for the first time, represented here by *P. rubens* (Klug), and newly described species *P. baiocchii* Soliman & Gul, **sp. nov.**, *P. granulis* Delvare, **sp. nov.**, and *P. magnanii* Gadallah & Gul, **sp. nov.** An illustrated key to species of the Arabian Peninsula is provided. The relevant specimens were mostly reared from buprestid species infesting *Acacia* sp. and *Dodonaea viscosa* in Al-Baha, Asir and Riyadh regions, Saudi Arabia.

Keywords

Al-Baha, Asir, Riyadh, Buprestidae, new species, *Phasgonophora*, Phasgonophorini, phylogeny

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Introduction

Phasgonophorinae were first recognized as discrete group by Steffan (1951) who listed their features and classified them within Brachymeriinae. They were later classified within Chalcidinae (Bouček 1988, 1992; Narendran 1989; Wijesekara 1997a; Delvare 2017), but quite recently were raised to subfamily level (Cruaud et al. 2020) appearing as the sister group of Brachymeriinae *s.s.* (sensu Wijesekara 1997b, as Phasgonophorini). This rather small subfamily includes 66 described species, but many of them, particularly in *Phasgonophora*, still await description, especially in the tropics where the subfamily is the most diverse. The subfamily was extensively studied by Steffan (1951, 1956, 1973).

Phasgonophorinae are parasitoids of wood-boring beetles belonging to the families Buprestidae, Curculionidae (including Scolytinae), Cerambycidae and Anthribidae (Steffan 1951, 1973; Burks 1959; Mateu 1972; Bouček 1988, 1992; Narendran 1989; Roscoe 2014; Narendran and van Achterberg 2016).

The subfamily currently includes two tribes (Cruaud et al. 2020), Phasgonophorini and Stypiurini, namely the *Phasgonophora* and *Stypiura* groups of Steffan (1951). Phasgonophorini themselves would comprise a single genus based on the phylogenetic results using the ultra-conserved elements (UCE) (Cruaud et al. 2020). Furthermore, *Trigonura* appeared polyphyletic, merging on two different branches, the first one together with *Muhabbetella* Koçak & Kemal, 2008 (replacement name for *Trigonurella* Bouček, 1988 nec Maa, 1963) on one hand, and *Phasgonophora* Westwood, 1832 on the other hand.

Phasgonophorini have the following features: a hardly sclerotized body, most often with rasp-like sculpture on pronotum and mesonotum; malar sulcus absent; antennal scrobes quite deep and entirely delimited by carinae; antennal toruli on about the level of lower ocular line; both mandibles with three teeth; propodeum often strongly sloping; mesopleuron frequently with a ventral shelf that is regularly longer than epicnemium; procoxa with a deep depression anteriorly, delimited by an oblique carina raised into a flange; metatibia without spur; postmarginal vein short, only surpassing stigmal vein in length; petiole very short, either entirely concealed dorsally or visible here as a ring-like sclerite, but better visible ventrally; first tergite with dorsolateral costulae and syntergum often elongated into a stylus; ovipositor sheaths and valvulae straight.

Phasgonophora with 38 described species is distributed in arid and temperate zones of Asia (21 species), New World (11 species), Africa (2 species) and Australia (4 species). The genus parasitizes xylophagous beetles of the families Anthribidae, Buprestidae, Cerambycidae and Curculionidae (including Scolytinae) (Waterston 1922; Steffan 1951; Burks 1959; Mateu 1972; Narendran and van Achterberg 2016).

Until now *Phasgonophora* was represented by only two species in the Arabian Peninsula, *P. ninae* (Nikol'skaya, 1952) and *P. rubens* (Klug, 1834), reported by Delvare (2017) from the United Arab Emirates (under *Trigonura*). In the present study, the genus is recorded for the first time from Saudi Arabia (from Al-Baha, Asir and Riyadh regions) with four species, namely *P. rubens* (Klug), and the newly described *P. baiocchii* Soliman & Gul, sp. nov., *P. granulis* Delvare, sp. nov., and *P. magnanii* Gadallah & Gul, sp. nov., mainly reared from Buprestidae attacking *Acacia* sp. (Fabaceae) or *Dodonaea viscosa* (L.) Jacq. (Sapindaceae) dead wood.

A phylogenetic study based on morphology was carried out for exploring the possible congruence between molecular and morphological data and hypothesizing the systematic placement of the species collected in Saudi Arabia.

Material and methods

Phylogenetic study

***Sampling* (Table 1)**. Outgroups include *Brachymeria minuta* (Linnaeus, 1761) (Brachymeriinae), and within the Phasgonophorinae, three species of Stypiurini, namely *Kopinata partirubra* Bouček, 1988, and two *Stypiura* species that were chosen together with 21 species of Phasgonophorini belonging to the genera presently recognized. *Phasgonophora sulcata* Westwood, 1835, *Phasgonophora* (*Trigonura*) *crassicauda* Sichel, 1866, and *Chalcis euthyrrhini* Dodd, 1921, respectively type species of *Phasgonophora* Westwood, 1832, *Trigonura* Sichel, 1866, and *Chalcidellia* Girault, 1924 are included in the sample, which also comprises the specimens that were used for the phylogenetic inference with Ultra Conserved Elements (UCE) (Cruaud et al. 2020). The material from Saudi Arabia was reared from xylophagous Coleoptera of the family Buprestidae (*Chrysobothris* sp.) attacking *Acacia* sp. and *D. viscosa* dead wood collected by Daniele Baiocchi and Gianluca Magnani (Roma, Italy) or collected using sweep net on *Calotropis procera* (Aiton) (Apocynaceae) trees from different wadis in Al Baha, Asir and Riyadh regions.

Table 1. Specimens used for the phylogenetic study. Generic names as in the present literature.

Specimen	Specimen status	Subfamily	Tribe	Country	Year collect	Molecular code
Brachymeria minuta (Linnaeus, 1761)		Brachymeriinae	Brachymeriini	France	1986	
Kopinata partirubra Boucek, 1988	paratype	Phasgonophorinae	Stypiurini	PNG	1981	
Stypiura GDEL00236		Phasgonophorinae	Stypiurini	French Guiana	2005	GDEL00236
Stypiura GDEL00580		Phasgonophorinae	Stypiurini	French Guiana	2010	GDEL00580
Trigonura GDEL00487		Phasgonophorinae	Phasgonophorini	Cameroon	2003	GDEL00487
Trigonura GDEL00489		Phasgonophorinae	Phasgonophorini	Cameroon	2003	GDEL00489
Trigonura steffani Narendran, 1987	holotype	Phasgonophorinae	Phasgonophorini	India, Kerala	1985	
Trigonura javensis Narendran, 1987	holotype	Phasgonophorinae	Phasgonophorini	Indonesia, Java	1930	
Trigonura bakeri Masi, 1926	holotype	Phasgonophorinae	Phasgonophorini	Philippines		
Trigonura tarsata (Dalla Torre, 1898)		Phasgonophorinae	Phasgonophorini	Canada, Quebec	1948	
Trigonura elegans (Provancher, 1887)		Phasgonophorinae	Phasgonophorini	USA		
Trigonura nishidai Narendran, 1989		Phasgonophorinae	Phasgonophorini	Laos	2013	JRAS5401_0101
Muhabbetella JRAS5401_0301		Phasgonophorinae	Phasgonophorini	Laos	2013	JRAS5401_0301
Trigonura rubens (Klug, 1834)		Phasgonophorinae	Phasgonophorini	Saudi Arabia	2017	
Trigonura ninae (Nikols'kaya, 1952)		Phasgonophorinae	Phasgonophorini	UAE	2006	
Phasgonophora ruficaudis (Cameron, 1905)		Phasgonophorinae	Phasgonophorini	Guinea	1986	
Trigonura euthyrrhini (Dodd, 1921)		Phasgonophorinae	Phasgonophorini	PNG	2018	JRAS7369
Trigonura crassicauda (Sichel, 1866)	holotype	Phasgonophorinae	Phasgonophorini	Mexico		
Phasgonophora baiochii sp. nov.	holotype	Phasgonophorinae	Phasgonophorini	Saudi Arabia	2017	
Phasgonophora magnanii sp. nov.	holotype	Phasgonophorinae	Phasgonophorini	Saudi Arabia	2016	
Phasgonophora granulis sp. nov.	holotype	Phasgonophorinae	Phasgonophorini	Saudi Arabia	2016	
Trigonura Nkolbisson		Phasgonophorinae	Phasgonophorini	Cameroon	1965	
Trigonura Kenya Mt Elgon		Phasgonophorinae	Phasgonophorini	Kenya	2011	
Phasgonophora sulcata Westwood, 1832		Phasgonophorinae	Phasgonophorini	USA, Virginia	1986	
Phasgonophora nr. *sulcata* Westwood, 1832		Phasgonophorinae	Phasgonophorini	USA, North Carolina	2014	JRAS5708_0101

Phylogenetic inference. A matrix of 36 characters (Tables 2, 3) was analyzed with maximum parsimony in PAUP* version 4.0a (Swofford 2001). PAUP analysis was first performed with equally weighted and non-additive character states. Eight characters that were initially stated irreversible, as reversals involving a separation of claval segments and gastral tergites following their fusion or the reappearance of the metatibial spur after its loss, are biologically inconceivable. A traditional heuristic search was conducted using 100 random addition sequences (RAS) to obtain an initial tree and "tree bisection and reconnection (TBR)" as branch swapping option. We then used a successive weighting method with the weight assigned to each character proportional to the maximum rescaled consistency index. We also screened the effect of ordering/non-ordering of characters. Robustness of the topology (equally weighted characters) was assessed by bootstrap procedures (100 replicates).

Examination and imaging

Specimens were examined using a Leica M205 C stereomicroscope. Some specimens were photographed using a digital microscope Keyence VHX-5000. Photographs were digitally optimized (artifacts removal, background standardization) using the photoshop V-program. The photos made with the aforementioned equipment were used for measurements of the types (holotypes and some paratypes). Further photographs were taken using Canon EOS camera attached to a Leica MZ 125 stereomicroscope. Individual source images were then stacked using HeliconFocus v.6.22 (HeliconSoft Ltd) extended depth of field software. Further image processing was done using the software Adobe photoshop CS5.1 (v.12.1) and Adobe photoshop Lightroom v.5.2 Final [ChingLiu]. The distribution of *Phasgonophora* species in Saudi Arabia was plotted (Fig. 17) using DIVA-GIS (v.7.17).

Morphological terminology

Morphological terminology follows Burks (1959) and Delvare (2017); body sculpture terminology follows Harris (1979).

Species identification

We examined the types of 18 species of *Phasgonophora sensu lato*, thus including those described in *Trigonura*. The relevant species included all those described from the New World, the west Palaearctic and the Afrotropical regions, and part of those described from the Oriental region. We used keys and descriptions provided by Narendran (1989), Narendran and van Achterberg (2016) for comparison of species described from Saudi Arabia to the rest of the Oriental species.

Table 2. Characters and their states used for phylogenetic inference of the Phasgonophorini.

[1]	Mandibular formula. (0) mandibles 2.2; (1) mandibles 3.3. [unordered]
[2]	Upper tooth of mandible. (0) sharp or narrowly rounded at apex; (1) truncate at apex. [unordered]
[3]	Lower face: presence of differentiate median stripe. (0) strip absent; (1) alutaceous strip present; (2) narrow, non-sculptured strip present. [unordered]
[4]	Preorbital carina or ridge. (0) absent; (1) present. [unordered]
[5]	Malar sulcus. (0) present, at least partly; (1) completely absent. [irreversible]
[6]	Antennal insertion. (0) not or hardly above lower ocular line; (1) much above lower ocular line. [unordered]
[7]	Interantennal projection. (0) ventral surface triangular, not compressed ventrally; (1) ventral surface moderately compressed laterally; (2) ventral surface strongly compressed, forming a lamina. [unordered]
[8]	Interocellar distance (between median and lateral ocellus). (0) not especially short, at least as large as ocellus diameter; (1) very short, shorter than ocellus diameter. [unordered]
[9]	Carina behind ocellar triangle. (0) carina absent; (1) carina present; (2) carina present and raised to form a bump behind ocellar triangle. [unordered]
[10]	Sculpture of occiput behind ocellar triangle. (0) occiput punctured behind ocellar triangle; (1) occiput punctured strigulose mesally behind ocellar triangle; (2) occiput strigulose mesally behind ocellar triangle (with vertical carinulae there). [unordered]
[11]	Sculpture of occiput on lateral surface. (0) occiput punctured; (1) occiput punctured strigulose, the puncturation alternating with vertical carinulae; (2) occiput entirely strigulose. [unordered]
[12]	Length of flagellomeres. (0) flagellomeres relatively short, F1 at most 1.5× as long as wide; (1) flagellomeres elongate, F1 more than 2× as long as wide. [unordered]
[13]	Segmentation of clava. (0) clava 3-segmented; (1) clava at most 2-segmented (rarely 1-segmented). [irreversible]
[14]	Pronotum: median depression. (0) absent; (1) present. [unordered]
[15]	Pronotal collar: anterior margin. (0) collar with rounded or blunt anterior margin sometimes not differentiate mesally; (1) collar strongly angulate with collum, angle acute; (2) pronotum sloping from posterior margin, collar not differentiate, at least mesally.[unordered]
[16]	Pronotum: hind margin. (0) margin slightly concave; (1) margin strongly concave. [unordered]
[17]	Mesonotum: sculpture. (0) mesonotum entirely punctured; (1) mesonotum at least partly cristate; (2) mesonotum entirely strigose. [unordered]
[18]	Mesoscutellum: anterior margin. (0) mesoscutellum truncate anteriorly on transscutal line; (1) anterior margin of mesoscutellum forming a blunt angle as the axillar grooves are meeting or almost so on transscutal line. [unordered]
[19]	Setation of axilla. (0) sparse to moderately dense; (1) quite dense. [unordered]
[20]	Mesodiscrimen. (0) visible as raised carina dorsally and a fovea ventrally on mesal surface of epicnemium; (1) visible as a low ridge on mesal surface of epicnemium. [unordered]
[21]	Epicnemial carina laterally. (0) not or moderately raised; (1) strongly raised. [unordered]
[22]	Epicnemial carina ventrally. (0) not or slightly raised, not forming or forming small tooth in lateral view; (1) strongly raised forming a projecting tooth in lateral view. [unordered]
[23]	Length of ventral shelf of mesepisternum. (0) ventral shelf not or not much longer than epicnemium; (1) ventral shelf much longer than epicnemium and several times long as long as mesocoxa. [unordered]
[24]	Procoxa. (0) coxa depressed on front side, depression margined posterodorsally by faint carina; (1) coxa deeply depressed on front side, depression margined posterodorsally by raised carina forming flange. [unordered]
[25]	Dorso-apical margin of protibia. (0) not forming projection; (1) forming a short and apically blunt projection; (2) well expanded with sharp apex. [unordered]
[26]	Outer dorsal surface of metacoxa. (0) flattened posteriorly, on less than half-length; (1) convex. [unordered]
[27]	Metatibia spur. (0) one spur present; (1) spur absent. [irreversible]
[28]	Postmarginal vein. (0) longer than marginal vein; (1) about twice as long as stigmal vein (not or hardly longer than marginal vein). [irreversible]
[29]	Number of gastral tergites in female. (0) seven, Gt1 and Gt2 not fused; (1) less than seven as Gt1 and Gt2 are fused. [irreversible]
[30]	First gastral tergite ornamentation. (0) no ornamentation, tergite regularly convex dorsally; (1) tergite with basal transverse carina and longitudinal ridges joining it.
[31]	First tergite: lateral line. (0) absent; (1) present. [unordered]
[32]	Penultimate tergite: depth of puncturation. (0) deep as usual; (1) superficial. [unordered]
[33]	Spiracle on penultimate tergite. (0) of usual size, quite visible; (1) very small with aperture smaller than diameter of punctures. [unordered]
[34]	Syntergum length. (0) syntergum not especially elongate, not more than 2 times as long as its basal width; (1) syntergum elongate as a stylus much more than twice its basal width. [unordered]
[35]	Position of cercal plates. (0) near anterior margin of syntergum; (1) situated about at mid length of syntergum; (2) situated near apex of syntergum. [unordered]
[36]	Ovipositor sheaths. (0) sheaths as usual, not especially curved; (1) sheaths curved downwards. [unordered]

Acronyms for museums and other institutions

Natural History Museum, London, United Kingdom (**BMNH**); Efflatoun Bey collection, Entomology Department, Faculty of Science, Giza, Egypt (**EFC**); King Saud

University for Arthropods, Plant Protection Department, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia (**KSMA**); Museum für Naturkunde, Berlin, Germany (**MNB**); National Museum of Natural History, Smithsonian Institution, Washington, United States of America (**USNM**).

Table 3. Data matrix for the phylogenetic inference of the Phasgonophorini (Chalcididae).

									1	1	1	1	1		1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6
Brachymeria minuta	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0
Kopinata partirubra	0	0	0	0	0	0	0	1	0	2	1	1	0	0	0	1	2	0	0	?	?	?	?	1	1	0	?	2	1	0	0	1	0	1	1	1
Stypiura GDEL00236	0	0	1	0	1	1	0	1	1	2	0	1	0	0	0	1	0	1	0	1	0	0	0	1	1	0	0	2	0	0	0	1	1	1	1	2
Stypiura GDEL00580	0	0	1	0	1	1	1	1	1	2	0	1	0	0	0	1	0	0	0	1	0	0	0	1	1	0	0	2	0	0	0	1	1	1	1	2
Trigonura GDEL00487	1	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	0	1	2	0	0	1	0	0	0	0	0
Trigonura GDEL00489	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	0	1	2	0	0	1	0	0	0	0	0
Trigonura euthyrrhini	1	1	0	0	1	0	1	0	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	0	1	2	0	0	1	0	0	0	0	0
Muhabbetella JRAS5401	1	0	1	1	1	0	1	1	0	1	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	0	1	2	0	0	1	0	0	0	0	0
Trigonura steffani	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	1	0	0	?	0	0	0	1	1	0	1	2	0	0	1	0	0	0	0	0
Trigonura javensis	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0	1	1	0	0	?	0	0	0	1	1	0	1	2	0	0	1	0	0	0	0	0
Trigonura tarsata	1	0	1	0	1	0	0	0	0	1	0	1	0	0	0	1	1	0	0	1	0	0	0	1	1	0	1	2	0	0	1	1	0	1	0	0
Trigonura elegans	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	1	1	1	0	1	0	0	0	1	1	0	1	2	0	0	1	1	0	0	0	0
Trigonura nishidai	1	0	0	0	1	0	1	0	0	2	0	0	1	0	0	1	1	0	0	?	1	?	0	1	2	0	1	2	0	0	1	0	0	1	0	1
Trigonura bakeri	1	0	0	0	1	0	2	0	0	1	0	1	1	0	0	1	1	1	0	2	0	0	0	1	2	0	1	2	0	0	1	1	0	1	0	1
Trigonura Nkolbisson	1	1	2	0	2	0	2	0	2	2	2	1	1	0	1	1	1	1	0	1	0	0	1	1	1	0	1	2	0	0	1	1	1	0	0	1
Trigonura Kenya Mt Elgon	1	1	2	0	2	0	2	0	2	2	2	1	1	0	1	1	1	1	0	1	0	0	1	1	2	0	1	2	0	0	1	1	1	1	0	2
Trigonura ninae	1	0	0	0	1	0	2	1	0	0	0	1	1	0	0	1	1	1	0	2	0	1	0	1	2	0	1	2	0	0	1	0	1	1	0	1
Phasgonophora baiocchii	1	0	0	0	1	0	1	0	1	2	1	0	1	0	0	1	1	0	0	2	1	0	0	1	2	0	1	2	0	0	1	0	1	0	0	0
Phasgonophora magnanii	1	0	0	0	1	0	1	0	1	2	1	1	1	1	0	1	1	1	0	2	0	0	0	1	2	0	1	2	0	0	1	0	1	0	0	1
Phasgonophora granulis	1	0	0	0	1	0	2	0	2	2	2	1	1	1	0	1	1	0	1	2	1	1	1	1	2	0	1	2	0	0	1	0	1	1	0	1
Trigonura rubens	1	1	0	0	1	0	2	0	0	2	2	1	1	1	0	1	1	0	0	?	1	1	1	1	2	0	1	2	0	0	1	0	1	1	0	1
Trigonura crassicauda	?	?	0	0	1	0	2	0	1	2	2	1	?	1	0	1	1	1	?	2	1	?	1	1	2	0	1	2	0	0	?	?	?	1	0	?
Trigonura ruficaudis	1	0	0	0	1	0	2	0	1	2	2	1	1	1	0	1	1	1	1	2	0	1	1	1	2	0	1	2	0	0	1	0	1	1	0	1
Phasgonophora sulcata	1	0	0	0	1	0	2	0	1	2	1	1	1	1	0	1	1	0	0	2	0	1	1	1	2	1	1	2	0	1	-	?	1	1	0	1
Phasgonophora nr sulcata	1	0	0	0	1	0	2	0	1	2	1	1	1	1	0	1	1	1	?	2	0	1	1	1	2	1	1	2	0	1	-	?	1	1	0	1

Abbreviations

F1–F3 = first to third funicular segments; Gt = gastral tergite; MGV = marginal vein of fore wing; OOL = distance between lateral ocelli and inner eye margin; PMV = postmarginal vein; POL = distance between lateral ocelli; Rs = radial sector; r-m = radio-medial cross vein; SMV = submarginal vein of fore wing; STV = stigmal vein.

Results

Phylogeny of Phasgonophorini

The initial analysis provided 33 equally parsimonious trees with a length of 88 steps, and values of 0.489, 0.831 and 0.406 respectively for the consistency (CI), reten-

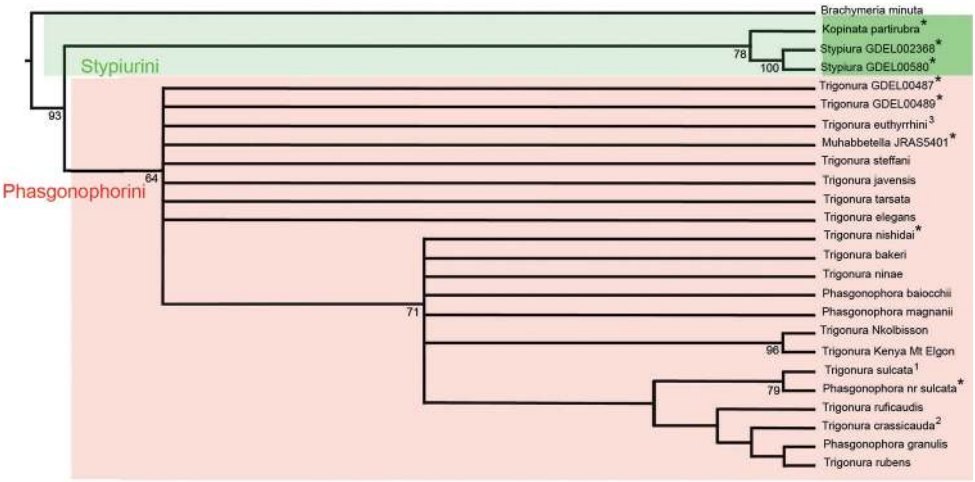

Figure 1. Strict consensus tree of the Phasgonophorini achieved from phylogenetic inference using parsimony. Bootstrap support below nodes. A, B, C denote the supported clades; * denote specimens used for the phylogenetic study using the Ultra Conserved Elements (Cruaud et al. 2020); 1, type species of *Phasgonophora* Westwood; 2, type species of *Trigonura* Sichel; 3, type species of *Chalcidellia* Girault.

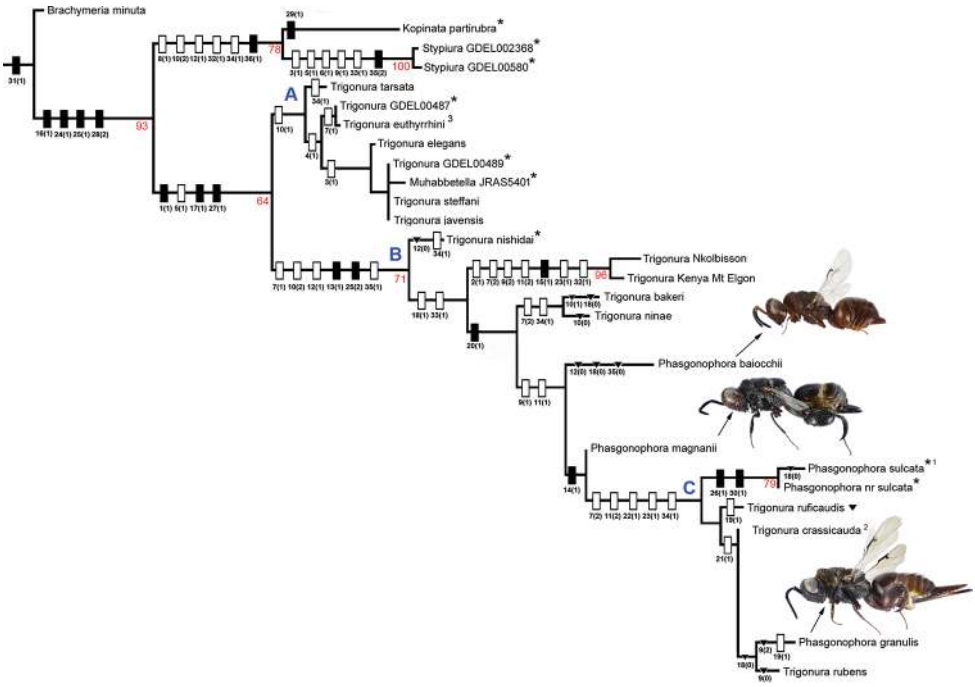

Figure 2. Preferred tree of the Phasgonophorini from phylogenetic inference using parsimony after successive weighting. Legend identical with Fig. 1. Black rectangles denote synapomorphies, white rectangles homoplastic derived states and dark triangles putative reversals.

tion (RI), and rescaled consistency (RC) indices. Stypiurini and Phasgonophorini are retrieved monophyletic with moderately strong supports (respectively 78, 64 for the bootstrap values) in the strict consensus tree (CST) (Fig. 1). Regarding Phasgonophorini, the tree shows a basal polytomy, including seven species, identified as *Trigonura* and one as *Muhabbetella* when using the traditional classification. The tree then shows a basal clade (Fig. 2, clade B), itself with a polytomy including seven species. Two of the newly described species from Saudi Arabia are retrieved here; all species in clade B would be assigned to *Trigonura* with the available keys (Bouček 1988; Narendran 1989). Finally, a second, terminal clade (Fig. 2, clade C) especially includes *P. sulcata* and *T. crassicauda* – the type species of *Phasgonophora* and *Trigonura* – together with *P. granulis*, one of the new described species from Saudi Arabia. This clade would otherwise comprise most of the species presently identified as *Trigonura*.

The successive weighing procedure provided three trees with length of 34.232, CI, RI, and RC, respectively of 0.665, 0.933 and 0.658. Ordering *versus* non-ordering characters do not change the topology. The preferred tree is presented as the Fig. 2. It is entirely congruent, for the appropriate species, with the tree achieved when using the UCE (Cruaud et al. 2020). Here the polytomies observed in the CST are solved, but the corresponding nodes do not have any support as they are sustained by a few derived, mostly homoplastic character states. Again *P. granulis* appears as sister to *T. rubens*, while *P. magnanii* as sister to clade C, a relationship sustained by the presence of a median depression on the pronotum. *P. baiocchii* merges on a node just basal to *P. magnanii*, but its position varies when the characters are equally weighted. Thus, it is sometimes sister to *P. magnanii*, sister to *T. nishidai* Narendran, 1989 or even merges on a basal node within the clade C, hence sister to the other species of the clade B taken together.

Phasgonophora **Westwood, 1832**

Phasgonophora Westwood, 1832: 432 (fig. 77). Type species: *Phasgonophora sulcata* Westwood, 1832, by monotypy.

= *Phasganophora* [sic] subg. *Trigonura* Sichel, 1866: 358–376. Type species: *Phasganophora* (*Trigonura*) *crassicauda* Sichel, 1866, by monotypy, syn. nov.

= *Trigonura* Kirby, 1883: 54, 59–60 (raised to genus level), syn. nov.

= *Bactrochalcis* Kieffer, 1912: 463. Type species: *Bactrochalcis reticulata* Kieffer, by monotypy. Synonymized with *Trigonura* by Steffan, 1951: 147, syn. nov.

= *Centrochalcis* Cameron, 1913: 92. Type species: *Centrochalcis ruficaudis* Cameron, by monotypy. Synonymized with *Trigonura* by Waterston, 1922: 10, syn. nov.

= *Centrochalcidea* Gahan & Fagan, 1923. Replacement name for *Centrochalcis* Cameron, 1913, nec Cameron, 1905, syn. nov.

= *Chalcidellia* Girault, 1924: 3. Type species: *Chalcis euthyrrhini* Dodd, 1921, by original designation. Synonymized with *Trigonura* by Bouček, 1988: 63–64, syn. nov.

= *Urochalcis* Nikol'skaya, 1952: 91. Type species: *Urochalcis ninae* Nikol'skaya, 1952, by original designation. Synonymized with *Trigonura* by Nikol'skaya, 1960: 90, syn. nov.
= *Trigonurella* Bouček, 1988: 64. Type species: *Trigonurella elegans* Bouček, 1988, by original designation, syn. nov.
= *Muhabbetella* Koçak & Kemal, 2008: 3. Replacement name for *Trigonurella* Bouček, 1988 nec *Trigonurella* Maa, 1963, syn. nov.

The above synonymies are just the taxonomic implications resulting from phylogenetic inference using UCE (Cruaud et al. 2020) and the present study from morphological data. In these two studies, *Trigonura* appears paraphyletic relative to *Phasgonophora* and *Muhebbetella.* In addition, the type species of *Phasgonophora* and *Trigonura* are included in supported clade B (values of the bootstrap 100 and 71 respectively for the UCE and the morphology tree) (Figs 1, 2). Thus, *Trigonura* cannot be sustained anymore and the species belonging to the clade B must be classified in *Phasgonophora* which may just be considered as a derived form of *Trigonura*. It would have been possible to classify the species belonging to the clade A in another genus and *Chalcidellia* Girault is available for that. Bouček (1988) was confronted to the same dilemma and wrote the following: "For some time I thought that *Chalcidellia* could be retained as a subgenus of *Trigonura*, because its type species [*Chalcis euthyrrhini* Dodd] differs from the typical *Trigonura* in having a distinct flat and punctured interantennal space and in the female the epipygium [syntergum] is short, with cercal tubercles placed right at the beginning of the sculptured part. The antennae are relatively short and very slightly thickened apically. On the contrary, the type species of *Trigonura* and many other tropical species have the interantennal space narrow, the female epipygium is prolonged with cercal tubercles removed distinctly from base, and the antennae long and filiform or even tapering apically. However, more recently I found species combining these features in varying degrees, which makes me regard *Chalcidellia* as only a species group of *Trigonura*". The distribution of character states within the morphological matrix just confirm Bouček's observations (Tables 2, 3). His opinion is shared here and is reinforced by the fact that the clade A is not at all supported and forms a polytomy in the strict consensus tree (Fig. 1).

Taxonomic study of Saudi Arabian species

Key to the species of *Phasgonophora* Westwood from the Arabian Peninsula (based on females)

1 Gaster shortly acute (Figs 5A, 12A). Syntergum short, about 1.1–1.4× as long as wide when seen from dorsal view (Fig. 5A) **2**
– Gaster lanceolate (Figs 15C, 16A, B). Syntergum evidently longer, 2.5–4.0× as long as wide when seen from dorsal view (Figs 9A, 15C, 16B) **3**

2 Body entirely red (Figs 3A–C, E, 5A). Fore wing with setae white, sparse and short (Fig. 4C). Propodeum without spiracular teeth (Fig. 4A). Pronotal collar without median depression, regularly convex (Fig. 4B). Mesoscutellum truncate anteriorly (Fig. 3E). Pedicel about 1.8 × as long as wide (Fig. 3D). Anellus hardly transverse, about 0.8× as long as wide (Fig. 3D) .... ***P. baiocchii*** **Soliman & Gul, sp. nov.**

– Meso- and metasoma mostly black (Figs 10E, 11A, 12A). Fore wing with dark setae (Fig. 11B). Propodeum with sharp spiracular teeth (Fig. 10E, F). Pronotal collar with evident median depression (Fig. 10E). Mesoscutellum bluntly angulate anteriorly (Fig. 10E). Pedicel as long as wide (Fig. 10D). Anellus quite transverse, about 0.45× as long as wide (Fig. 10D) .... ***P. magnanii*** **Gadallah & Gul, sp. nov.**

3 Propodeum without spiracular teeth (Fig. 16B). Pronotum sloping from posterior margin mesally, uniformly convex (Fig. 16B, C). Mesoscutellum convex, and bluntly angulate anteriorly as axillar grooves are joining to each other on transscutal line (Fig. 16B) ..... ***P. ninae*** **(Nikol'skaya)**

– Propodeum with sharp spiracular teeth (Fig. 7E). Pronotum with collar separated by evident angulation from collum (Figs 7E, 8A, 14A) **4**

4 Body 7.0–9.6 mm in length. Gena sparsely punctured (Fig. 14A, B). Pronotum with shallow median depression (Fig. 14D). Pronotal collar and mesonotum clearly cristate (transverse crests) (Fig. 14A), not at all punctured. Setation of axilla not especially dense, not masking integument beneath (Fig. 14D). Propodeum strongly sloping posteriorly, almost vertical. Epicnemial carina moderately raised ventrally. Fore wing without pigmented tracks of Rs and r-m (Fig. 15B). Gt_1 with curved carinulae dorsally, sparsely setose laterally (Fig. 15C).... ..... ***P. rubens*** **(Klug)**

– Body 9.5–13.6 mm in length. Gena densely punctured (Figs 7D, 8A). Pronotal collar with evident median depression (Fig. 7E). Pronotal collar and mesonotum cristate-punctured, the anterior wall of punctures raised (Fig. 8A). Axillae densely setose, setation masking integument beneath (Fig. 7E). Propodeum less strongly sloping than in alternate. Epicnemial carina strongly raised ventrally, forming sharp tooth mesally (Fig. 8A). Fore wing with evident pigmented tracks of Rs and r-m (Fig. 8D); Gt_1 with superficial, irregular wrinkles, densely setose laterally (Fig. 9A)..... ***P. granulis*** **Delvare, sp. nov.**

Review of *Phasgonophora* species from Saudi Arabia

Table 4 represents the absolute measurements of the female holotypes and male paratypes. Selected ratios are quoted in Tables 5–7. They are not repeated in the following descriptions.

Table 4. Measurements of the types of the described species of *Phasgonophora* (in µm).

Character	*Phasgonophora baiocchii* holotype ♀	*Phasgonophora granulis* holotype ♀	*Phasgonophora magnanii* holotype ♀	*Phasgonophora baiocchi* paratype ♂	*Phasgonophora magnanii* paratype ♂
head width	1537	1705	1897	1276	1821
head maximal length	784	989	1038	691	1054
head length on median line	511	608	654	447	717
eye length	532	648	737	455	690
temple length	121	182	64	138	163
frontovertex width	774	926	1026	740	989
distance between lateral ocelli	263	455	353	289	370
ocular – lateral ocellus distance	137	74	186	122	168
diameter of lateral ocellus	158	182	167	122	152
distance between median and lateral ocelli	95	142	109	102	98
head height	1058	1269	1477	1079	1284
eye height	571	744	781	584	798
distance lower edge antennal torulus – ventral margin of clypeus (ATC)	314	481	500	317	–
distance lower edge antennal torulus – lower edge of median ocellus (ATOM)	538	603	719	455	–
length of malar space	455	513	781	396	–
width of oral fossa	551	679	781	505	–
scape length	570	730	815	444	–
pedicel length	127	131	109	98	110
pedicel width	80	108	125	76	106
anellus length	59	59	62	33	37
anellus width	75	98	125	79	102
2nd flagellomere (= F1) length	159	280	308	139	301
2nd flagellomere width	102	127	161	133	163
8th flagellomere (= F7) length	110	172	232	136	272
8th flagellomere width	112	105	151	133	159
clava length	310	292	446	234	472

Phasgonophora baiocchii **Soliman & Gul, sp. nov.**

http://zoobank.org/75C97023-EFBA-437E-A031-23A13760231B

Figs 3A–E, 4A–E, 5A–D, 6A–C

Type material. ***Holotype*** ♀: Kingdom of Saudi Arabia, Riyadh, Ad Diriyah, Al Uyaynah, Wadi Al Hesiyah (40 NW of Riyadh) [24°55'22.44"N, 46°12'15.13"E, Alt. 790 m], 8.IV.2017, reared from *Anthaxia* sp. (Buprestidae), e.l. *Acacia*, leg. D. Baiocchi [KSMA]; ***Paratype*** 1♂, same data as for holotype [KSMA].

Diagnosis. Body mostly red; fore wing hyaline with white setation (Fig. 4C); setation on body and wings sparse and short (Figs 3A–C, E, 4C); flagellomeres moder-

Table 5. Calculated ratios for the females of *Phasgonophora* from measurements of Table 4.

Ratio	*Phasgonophora baiochii* holotype ♀	*Phasgonophora granulis* holotype ♀	*Phasgonophora magnanii* holotype ♀
head width : head maximal length	1.960	1.724	1.827
head width : head length on median line	3.010	2.804	2.902
head width : head height	1.453	1.343	1.285
fronto-vertex width : eye height	1.356	1.245	1.313
ocular – lateral ocellus distance : diameter of lateral ocellus	0.520	0.406	1.115
distance between median and lateral ocelli : diameter of lateral ocellus	0.600	0.781	0.654
ATC : ATOM	0.583	0.798	0.696
length of malar space : eye height	0.798	0.690	1.000
length of malar space : width of oral fossa	0.826	0.755	1.000
scape length : eye height	1.000	0.981	1.043
pedicel length : pedicel width	1.585	1.218	0.873
anellus length : anellus width	0.789	0.600	0.492
F1 length : F1 width	1.558	2.200	1.914
F7 length : F7 width	0.982	1.638	1.539
mesosoma length : mesosoma (= mesoscutum) width	1.600	1.640	1.612
mesosoma length : mesosoma height	1.538	2.335	2.265
pronotum width : pronotum maximal length	1.707	1.714	1.849
pronotum width : pronotum length on median line	3.559	2.754	2.688
pronotum width : mesoscutum width	1.077	0.977	1.042
mesoscutum length : pronotum length on median line	1.729	1.475	1.375
mesoscutellum length : mesoscutellum width	0.898	0.810	0.978
fore wing length : fore wing width	2.858	2.690	2.263
marginal vein length : costal cell length	0.348	0.269	0.284
marginal vein length : stigmal vein length	3.512	3.016	3.643
marginal vein length : postmarginal vein length	4.800	2.603	4.857
metacoxa length : metacoxa width	2.153	1.747	2.000
metafemur length : metafemur width	1.764	1.774	1.684
syntergum length : mesotibia length	0.276	1.226	0.546

ately long (Fig. 3D); clava 1-segmented in both sexes (Figs 3D, 6B); mesoscutellum moderately convex, truncate anteriorly ((Fig. 4A); propodeal spiracular tooth absent (Figs 4A, 6C); fore wing setation sparse and very short, distributed on both sides without line of setae on Rs (Fig. 4C); Gt_1 dorsally smooth (Fig. 5A); syntergum 0.276× as long as mesotibia (Fig. 5A, B).

Etymology. This species is dedicated to Daniele Baiocchi, who reared this species from *Anthaxia* spp. (Buprestidae) infesting *Acacia* sp. (Fabaceae).

Condition of holotype. Specimen glued on rectangular card, metasoma glued separately. Head and mesosoma partly covered with a thin artifactual layer in bottom of areoles, appearing artificially dull rather than glossy by places; second to fifth terga with sides wide apart from each other, probably resulting from immersion in some medium.

Description of holotype ♀: Body length 5.0 mm. ***Colour***. Body reddish brown; antennal scape and pedicel, anellus and basal half of F1 reddish (Fig. 3D), the rest of flagellum dark brown, almost black (Fig. 3D); mandibular teeth black (Fig. 3B); palpi brown; mesoscutellum apically and metanotum dark (Fig. 3E); wings hyaline (Fig. 4C), SMV testaceous, MGV, STV and PMV dark brown (Fig. 4C); tegula brownish; all legs

Table 6. Calculated ratios for the males of *Phasgonophora* from measurements of Table 4.

Ratio	*Phasgonophora baiocchii* paratype ♂	*Phasgonophora magnanii* paratype ♂
head width : head maximal length	1.847	1.727
head width : head length on median line	2.855	2.538
head width : head height	1.183	1.418
fronto–vertex width : eye height	1.267	1.240
ocular – lateral ocellus distance : diameter of lateral ocellus	1.000	1.107
distance between median and lateral ocelli : diameter of lateral ocellus	0.833	0.643
ATC : ATOM	0.696	–
length of malar space : eye height	0.678	–
length of malar space : width of oral fossa	0.784	–
scape length : eye height	0.759	–
pedicel length : pedicel width	1.286	1.038
anellus length : anellus width	0.414	–
F1 length : F1 width	1.041	1.850
F7 length : F7 width	1.020	1.718
mesosoma length : mesosoma (= mesoscutum) width	1.671	1.781
mesosoma length : mesosoma height	1.521	1.605
pronotum width : pronotum maximal length	3.296	4.064
pronotum width : pronotum length on median line	1.047	1.130
pronotum width : mesoscutum width	1.556	2.574
mesoscutum length : pronotum length on median line	0.878	1.000
mesoscutellum length : mesoscutellum width	2.650	2.892
fore wing length : fore wing width	0.307	0.367
marginal vein length : costal cell length	2.629	3.143
marginal vein length : stigmal vein length	4.182	2.973
marginal vein length : postmarginal vein length	2.154	1.901
metacoxa length : metacoxa width	1.875	1.784

reddish, but tarsi testaceous; metafemur with black teeth on ventral margin (Fig. 4E); metasoma reddish brown (Fig. 5A, B), tip of ovipositor sheaths black (Fig. 5B).

Head (Fig. 3A–C). Slightly wider than maximal width of mesosoma; with sparse, short and thin setae; vertex and frons densely punctured (Fig. 3A, B), lower face and especially gena sparsely punctured, with interspaces as large as punctures on its mesal surface; lower face and frons strongly convex, without preorbital ridges (Fig. 3B); both mandibles 3-toothed, teeth of same length, somewhat blunt at apex (Fig. 3B); clypeus roundly protruding at free margin (Fig. 3B); tentorial pits well visible (Fig. 3B); genal carina strongly raised (Fig. 3C); scrobal cavity completely transversely strigose, reaching median ocellus (Fig. 3B); lateral margins of depression slightly converging dorsally; interantennal projection as wide as diameter of antennal torulus, subtriangular, and with punctulate front surface, with sharp carina above it, 0.33× as long as scape (Fig. 3B); occiput vertically strigulose behind ocellar triangle, punctured laterally (Fig. 3A).

Antenna (Fig. 3D). Apex of scape reaching level of median ocellus; pedicel 1.58× as long as wide, without basal bottle neck; anellus hardly transverse, tapering basally; flagellomeres pubescent, bearing numerous, not raised, multiporous plate sensilla in several intricate rows; F1 somewhat tapering basally, 1.59× as long as wide, slightly longer than each of F2 and F3; clava 1-segmented, conical, not much longer than F7 and very narrowly truncate at apex.

Table 7. Comparison between the sexes of *P. baiocchii* sp. nov. and *P. magnanii* through ratios calculated from measurements of Table 4.

Ratio	*Phasgonophora baiocchii* holotype ♀	*Phasgonophora baiocchii* paratype ♂	*Phasgonophora magnanii* holotype ♀	*Phasgonophora magnanii* paratype ♂
head width : head maximal length	1.960	1.847	1.827	1.727
head width : head length on median line	3.010	2.855	2.902	2.538
head width : head height	1.453	1.183	1.285	1.418
fronto–vertex width : eye height	1.356	1.267	1.313	1.240
ocular – lateral ocellus distance : diameter of lateral ocellus	0.520	1.000	1.115	1.107
distance between median and lateral ocelli : diameter of lateral ocellus	0.600	0.833	0.654	0.643
ATC : ATOM	0.583	0.696	0.696	–
length of malar space : eye height	0.798	0.678	1.000	–
length of malar space : width of oral fossa	0.826	0.784	1.000	–
scape length : eye height	1.000	0.759	1.043	–
pedicel length : pedicel width	1.585	1.286	0.873	1.038
anellus length : anellus width	0.789	0.414	0.492	0.360
F1 length : F1 width	1.558	1.041	1.914	1.850
F7 length : F7 width	0.982	1.020	1.539	1.718
mesosoma length : mesosoma (= mesoscutum) width	1.600	1.671	1.612	1.781
mesosoma length : mesosoma height	1.538	1.521	2.265	–
pronotum width : pronotum maximal length	1.707	3.296	1.849	1.605
pronotum width : pronotum length on median line	3.559	1.047	2.688	4.064
pronotum width : mesoscutum width	1.077	1.556	1.042	1.130
mesoscutum length : pronotum length on median line	1.729	0.878	1.375	2.574
mesoscutellum length : mesoscutellum width	0.898	2.650	0.978	1.000
fore wing length : fore wing width	2.858	0.307	2.263	2.892
marginal vein length : costal cell length	0.348	2.629	0.284	0.367
marginal vein length : stigmal vein length	3.512	4.182	3.643	3.143
marginal vein length : postmarginal vein length	4.800	2.154	4.857	2.973
metacoxa length : metacoxa width	2.153	1.875	2.000	1.901
metafemur length : metafemur width	1.764	–	1.684	1.784
syntergum length : mesotibia length	0.276	–	0.546	–

Mesosoma (Figs 3E, 4A, B). Slightly convex in lateral view (Fig. 4B), pronotum and mesonotum bearing short thin setae, adpressed on pronotum and suberect on mesonotum (Fig. 3E); pronotum entirely punctured, its dorsal outline regularly convex, without median depression (Fig. 3E); lateral panel with oblique crenulae ventrally; mesonotum cristate-punctured, the transverse crests moderately raised (Fig. 4B); notauli not much impressed (Fig. 3E); tegula bearing three very short setae basally; mesoscutellum short, convex in lateral view (Fig. 4B), truncate anteriorly as the axillae are widely separated, broadly rounded at apex, with fine longitudinal carinae; postscutellum as trapezoidal areola with secondary sculpture (Fig. 3E); propodeum not much sloping, without anterolateral spiracular tooth (Figs 3E, 4A), with irregular costula and poorly delimited median areola; mesepisternum with mesodiscrimen as faint carina dorsally, bifurcate ventrally delimiting a shallow fovea (Fig. 4A); epicnemial carina strongly raised at mid-height, moderately raised ventrally (Fig. 4B); ventral shelf virtu-

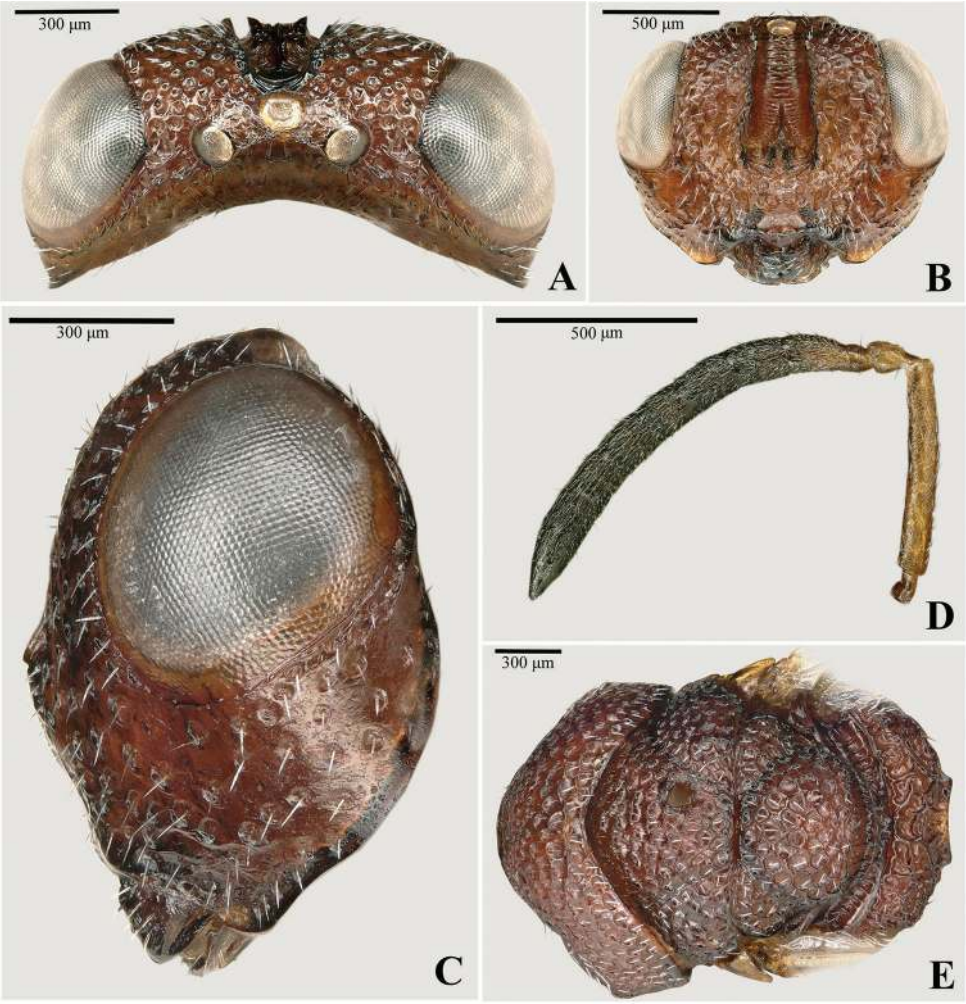

Figure 3. A–E *Phasgonophora baiocchii* Soliman & Gul, sp. nov., female (holotype) **A** head (dorsal view) **B** head (frontal view) **C** head (lateral view) **D** antenna **E** mesosoma (dorsal view).

ally smooth; adscrobal area of mesepisternum, entire mesepimeron and metepimeron with dense setiferous punctures, the setae are short and adpressed as on pronotum (Fig. 4B); femoral scrobe of mesopleuron entirely strigose (Fig. 4B).

Wings (Fig. 4C). Fore wing lacking marginal fringe, with microtrichiae on both sides, MGV 0.35× as long as SMV, PMV 0.20× as long as MGV, STV slightly longer than PMV; hind wing with three similar closely set hamuli.

Legs (Fig. 4D, E). Procoxa deeply depressed anteriorly, the depression delimited laterodorsally by strongly raised carina (Fig. 4D). Protibia with thin apicodorsal socketed spine (Fig. 4D). Mesotibia without dorsal pegs. Hind leg bearing sparse, thin and suberect setae on ventral side of coxa, femur and tibia (Fig. 4E); metafemur sparsely

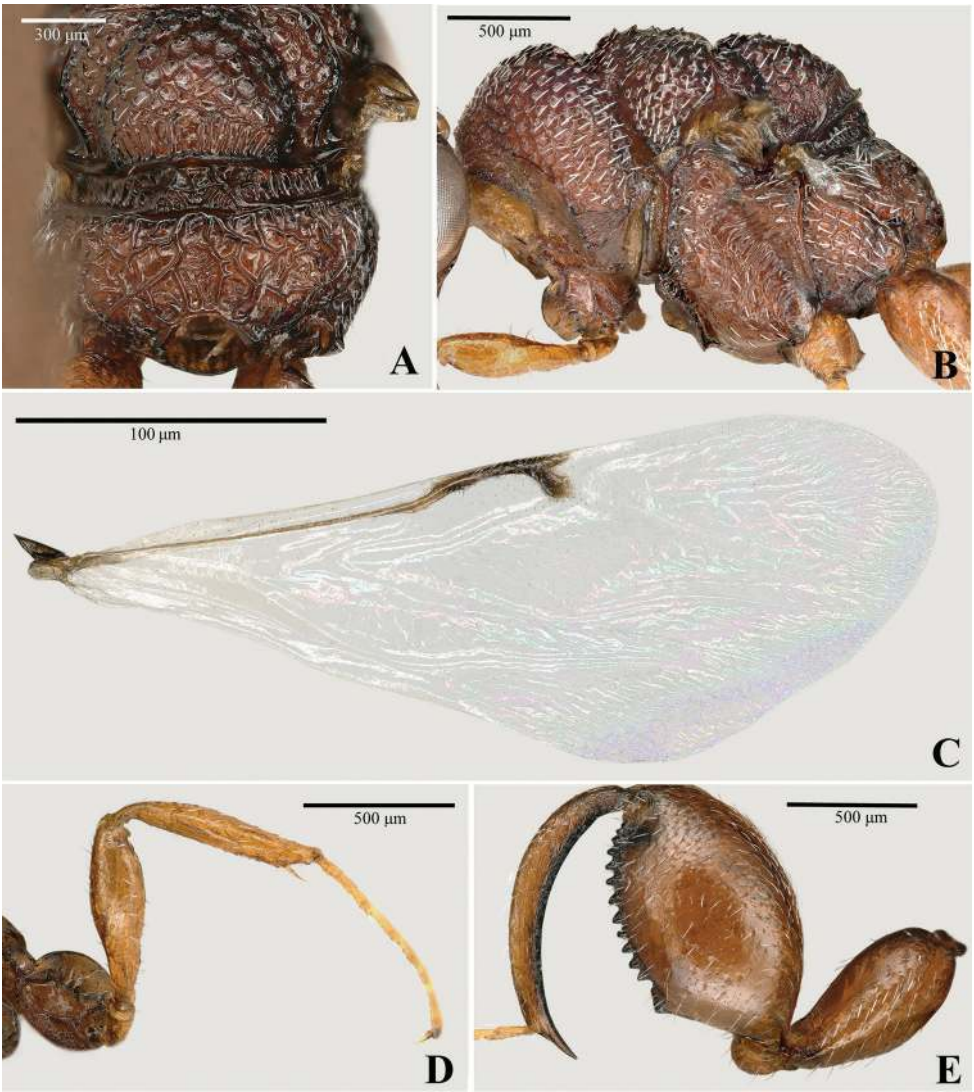

Figure 4. A–E *Phasgonophora baiocchii* Soliman & Gul, sp. nov., female (holotype) **A** mesosoma (part, dorsal view) **B** mesosoma (lateral view) **C** fore wing **D** proleg **E** hind leg.

punctulate on outer side, its ventral margin with a row of 11 regularly distributed equal teeth, basal tooth not prominent, no basal inner tooth (Fig. 4E). All tarsi thin, bearing slender claws.

Metasoma (Fig. 5A, B). Petiole quite transverse in dorsal view, ventral surface virtually smooth. Gaster short, only slightly longer than mesosoma; Gt_1 2.6× as wide as long, as long as Gt_2 and Gt_3 combined, smooth on disc, solely with a row of three thin and short setae on either side (Fig. 5A); $Gt_{2–5}$ smooth, except for the setiferous punctures in front of their posterior margin, laterally with a complete row of setae and a partial row in front of it (Fig. 5A); penultimate tergite entirely densely and deeply

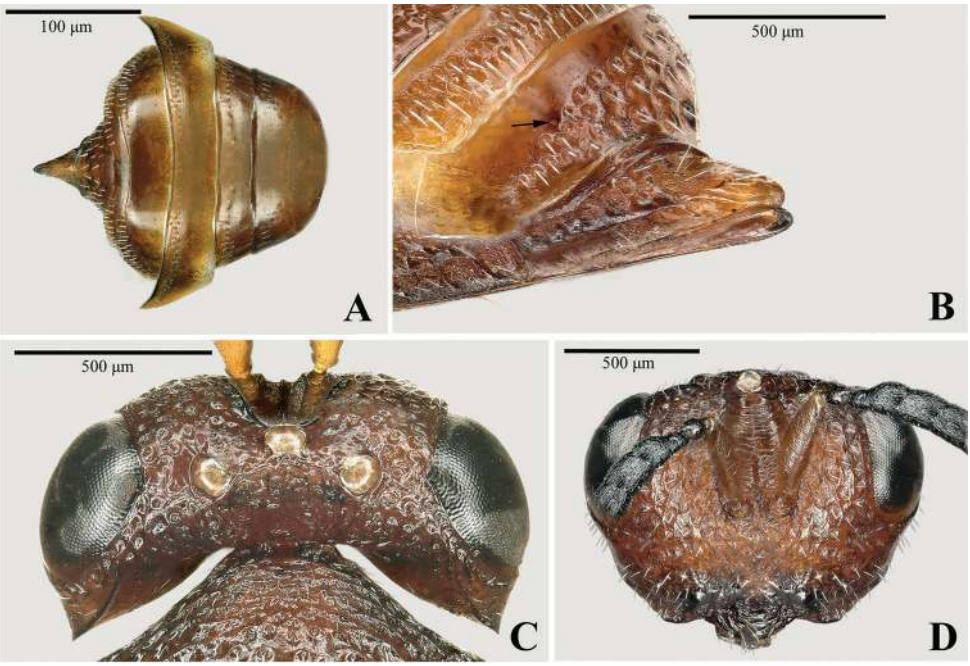

Figure 5. A–D *Phasgonophora baiocchii* Soliman & Gul, sp. nov. **A, B** female (holotype): **A** metasoma (dorsal view) **B** syntergum (lateral view) **C, D** male (paratype): **C** head (dorsal view) **D** head (frontal view).

punctured, with three rows of setiferous punctures, spaces between punctures smooth and shiny; spiracle very small, hardly visible at lateral edge of punctured surface as its peritreme is not raised; syntergum very short, only 0.276× as long as mesotibia, its basal part, in front of cercal plates (Fig. 5B); extremely short, median ridge present; tergum coarsely punctured laterally; sternites smooth and bare; tip of hypopygium at about half length of gaster.

Male (Figs 5C, D, 6A–C). Length 4.2 mm; similar to female except for the following characters: black parts better expanded especially on occiput, pronotum and mesonotum; scape bright reddish brown (Fig. 6B); head less transverse in dorsal view with anterior outline of frons more convex and temples relatively longer (Fig. 5C), gena mostly smooth, with very sparse punctures (Fig. 6A); frons with faint preorbital ridges, carina above interantennal projection almost reaching dorsal margin of scrobal depression (Fig. 5D); scape fusiform, 3.4 × as long as wide, anellus transverse, strongly tapering basally (Fig. 6B).

Recognition. None of the described *Phasgonophora* from the Afrotropical region have the short syntergum exhibited by *P. baoicchii*. Considering the Oriental species, the species would run, using Narendran (1989), either to *Trigonura steffani* Narendran, or *T. javensis* Narendran, 1987. The first species (holotype examined) is quite different, especially the deeply impressed notauli and the strongly convex mesoscutellum. In the second species (holotype examined), the lower face has a differentiate median strip similar to that of *Muhattebella*, and fore wing bears dark setae among other characters.

Figure 6. A–C *Phasgonophora baiocchii* Soliman & Gul, sp. nov., male (paratype) **A** head (fronto-lateral view) **B** antenna **C** head and mesosoma (dorsal view).

From this species group, especially in *P. euthyrrhinii*, the type species of *Chalcidiella*, *P. baiocchii* differs from all species examined by the non-segmented clava, the mesodiscrimen, not raised as median crest, and the white setae of the fore wing *versus* clava 3-segmented, mesodiscrimen raised as a carina dorsally and fore wing setation dark.

Distribution. Only known from Saudi Arabia, in Riyadh Region (Fig. 17).

Host. *Anthaxia* (*Haplanthaxia*) *abdita* Bílý, 1982 and *A.* (*H.*) *kneuckeri* ssp. *zabranskyi* Bílý, 1995 (Coleoptera, Buprestidae).

Phasgonophora granulis **Delvare, sp. nov.**

http://zoobank.org/5EB72879-1E9C-4A89-BCD8-FF37534B7172

Figs 7A–E, 8A–D, 9A, B

Type material. ***Holotype*** ♀: Kingdom of Saudi Arabia, Al-Baha, Al Mikhwa (Shada Al-Ala Natural Reserve) [19°50'51"N, 41°18'06.12"E, Alt. 1358 m], 14.IV.2016,

e.l. *Acacia*, leg. D. Baiocchi [KSMA]. ***Paratypes*:** 7♀, same data as holotype [KSMA]; 2♀, same data as holotype [BMNH]; 2♀, same data as holotype [USNM]; 3♀, same data as holotype [EFC]; 2♀, same data as holotype but differing as for the coordinates [19°51'39.96"N, 41°18'15.84"E, Alt. 1248 m] and collection date, 29.III.2017 [KSMA]; 2♀, Kingdom of Saudi Arabia, Asir, Muhayil, Wadi Sabian (28 km SSE of Muhayil) [18°17'54.89"N, 42°07'41.11"E, Alt. 809 m], 05.IV.2017, e.l. *Acacia*, leg. D. Baiocchi [KSMA].

Diagnosis. Gaster longer than mesosoma and acuminate, with syntergum longer than mesotibia (1.15×) (Fig. 9A, B); gena densely and entirely punctured (Figs 7D, 8A); occiput completely strigulose (Fig. 7A); flagellum filiform, with all flagellomeres much longer than wide, F1 2.5× as long as wide (Fig. 7C); mesosomal dorsum somewhat flattened (Fig. 8A); pronotal collum and mesonotum cristate punctured (Fig. 8A); axillae densely setose, setation masking integument posteriorly (Fig. 7E); propodeum with sharp spiracular teeth (Fig. 7E); mesepisternum with epicnemial carina forming sharp tooth mesoventrally (Fig. 8A); fore wing with dense but short setation, and pigmented track of Rs and r-m (Fig. 8D); Gt_1 with weak wrinkles dorsally (Fig. 9A); Gt_6 with deep punctures and very small, hardly visible, spiracle; cerci removed from base of syntergum, situated at half of its length (Fig. 9A, B).

Etymology. The name is chosen in reference to the secondary sculpture of the areoles on the head and mesonotum, giving to them a dull, granulose appearance (see Fig. 8B).

Condition of holotype. Specimen glued on rectangular card. Head and mesosoma partly covered with a thin layer on the bottom of areoles; second to fifth tergites with sides wide apart from each other, probably resulting from immersion in some medium.

Description of female holotype. Body 8.4 mm. ***Colour***. Head and mesosoma entirely black (Fig. 7A–E), metasoma brown (Fig. 9A), with syntergum darker laterally (Fig. 9B); tegula brownish (Fig. 8A); fore and mid legs dark brown, but knees, apex of tibiae and tarsi testaceous; hind leg dark brown (Fig. 8C), ventral femoral teeth and ventral side of tibia black (Fig. 8C), tarsus lighter; antenna entirely black (Fig. 7C); wings hyaline, veins dark brown (Fig. 8D).

Head (Figs 7A, B, D, 8A). Hardly wider than mesosoma; with moderately dense setation, the setae long, thin and suberect, regularly distributed according to punctures; lower face and frons strongly convex, without preorbital ridges (Fig. 7D); vertex, frons and lower face densely punctured (Fig. 7B, D), gena more coarsely punctured (Fig. 8A); both mandibles 3-teethed (Fig. 7D), lower tooth the largest and somewhat removed from the mid one; clypeus hardly protruding at free margin (Fig. 7D); edge of oral fossa thickened (Fig. 7D); tentorial pits absent (Fig. 7B); scrobal depression entirely transversely strigose, reaching median ocellus (Fig. 7B); interantennal projection (Fig. 7B) strongly compressed laterally, narrower than antennal torulus, punctulate on front surface (one row of punctures only), narrowly produced upwards, but without flange above it; vertex with short but distinct carina behind median ocellus (Fig. 7A); POL 6× OOL (Fig. 7A); occiput entirely strigulose, except for a row of punctures behind posterior edge of eye (Fig. 7A).

Antenna (Fig. 7C). Scape linear, its apex with level of vertex; pedicel 1.2× as long as wide, with slight basal bottle neck; anellus slightly transverse, 0.8× as long as wide,

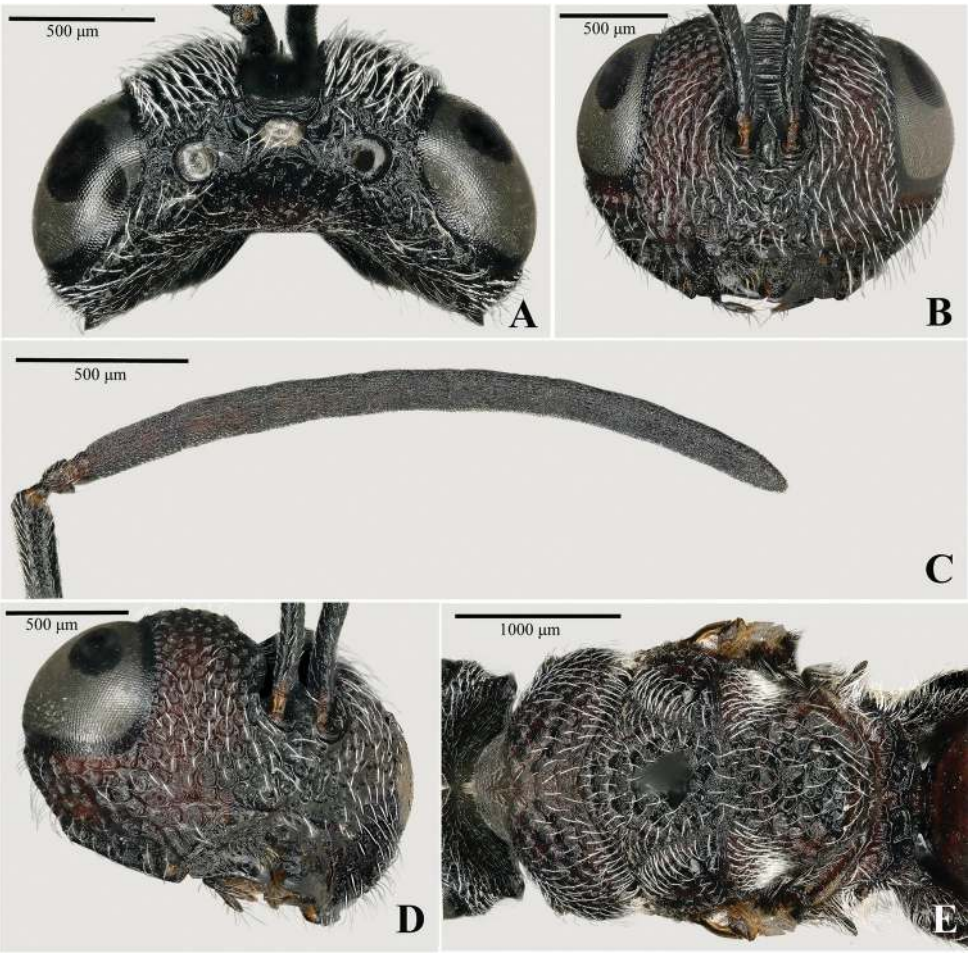

Figure 7. A–E *Phasgonophora granulis* Delvare, sp. nov., female (holotype) **A** head (dorsal view) **B** head (frontal view) **C** antenna **D** head (frontolateral view) **E** mesosoma (dorsal view).

tapering basally; funicular segments pubescent, bearing numerous, not raised multiporous plate sensilla in several intricate rows; F1 2.2× as long as wide, shorter than F2; F2 as long as F3; F7 1.64× as long as wide; clava 2-segmented (suture nevertheless hardly distinct), narrowly rounded apically.

Mesosoma (Figs 7E, 8A). With setae about twice as long puncture diameter, curved and suberect; setae regularly distributed on punctures, but pronotum in front of prepectus, axillae and propodeum laterally around the spiracle, densely setose, the setae adpressed there; dorsum of mesosoma somewhat flattened (Fig. 8A), with dorsal outline of pronotal collar and mesonotum straight; punctures with secondary, very fine, sculpture on their bottom (visible only at very high magnification: 800×) (as in Fig. 8B), thus appearing dull; pronotal collum transversely strigose (Fig. 7E); pronotal collar and mes-

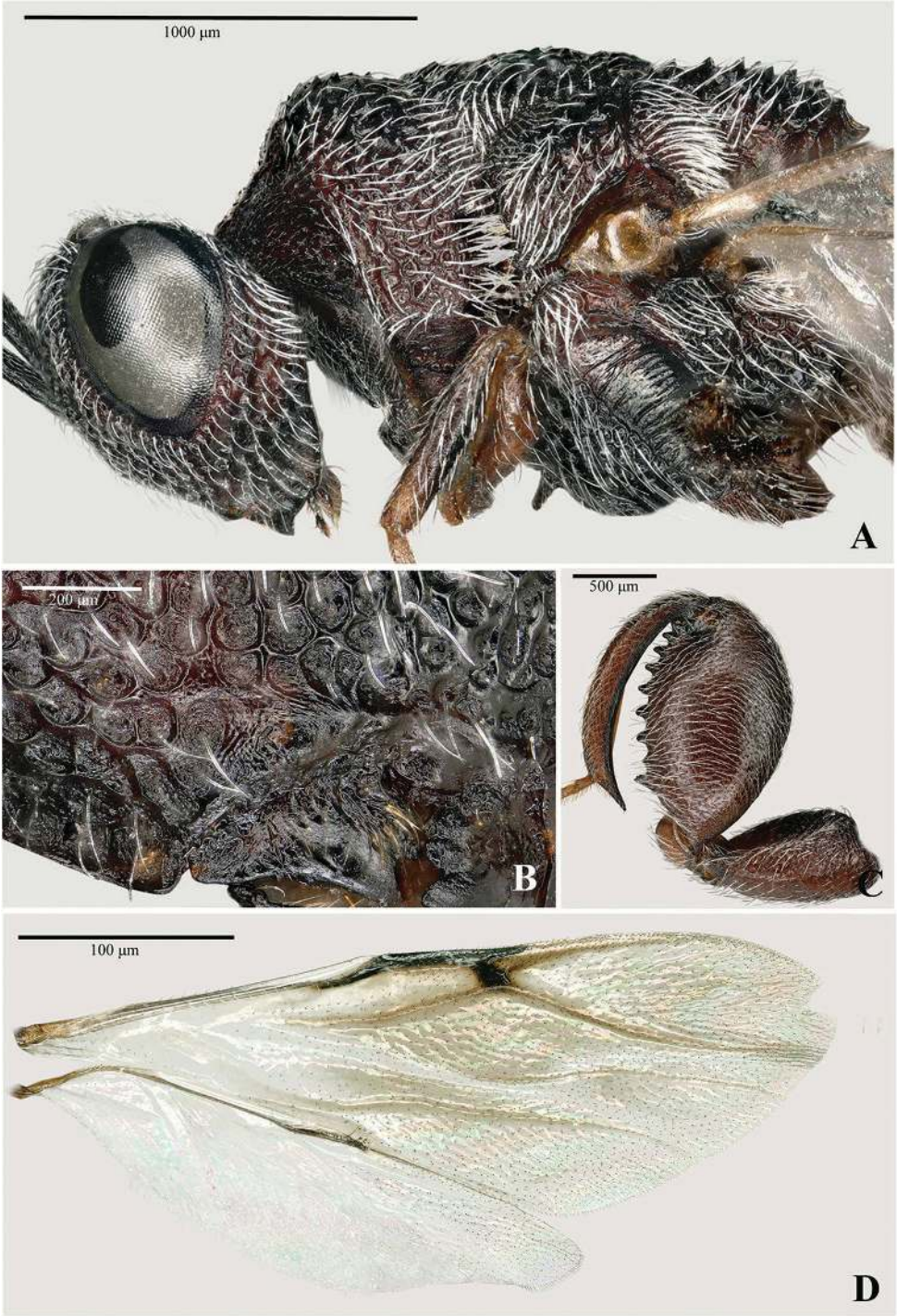

Figure 8. A–D *Phasgonophora granulis* Delvare, sp. nov., female (holotype) **A** head and mesosoma (lateral view) **B** head (part of integument, showing granulate foveae) **C** hind leg **D** fore and hind wings.

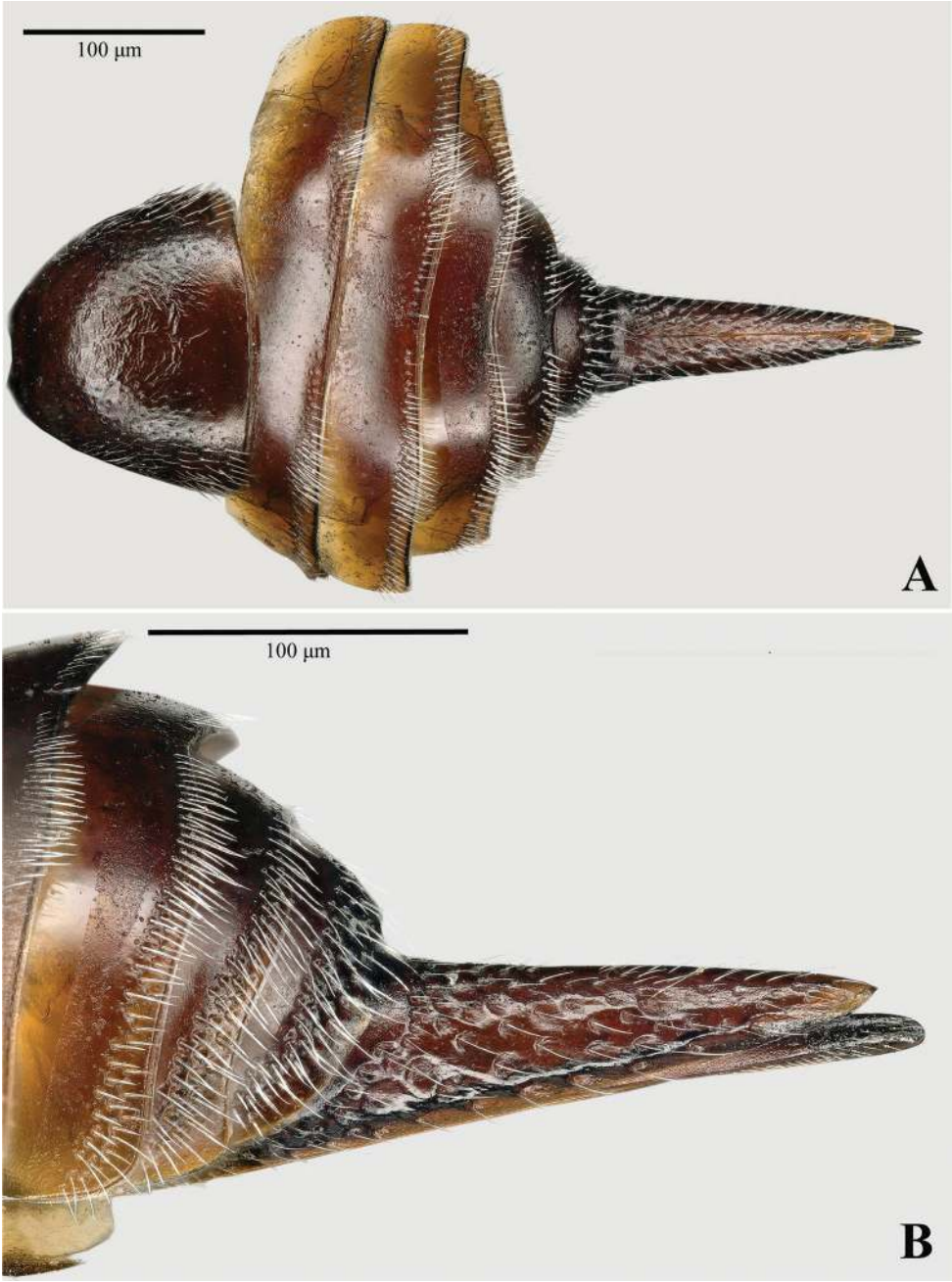

Figure 9. A, B *Phasgonophora granulis* Delvare, sp. nov., female (holotype) **A** metasoma (dorsal view) **B** syntergum (lateral view).

onotum uniformly cristate punctured, the anterior wall of punctures forming crests (Fig. 8A); pronotal collar with shallow mesal depression, its sides strongly convex (Fig. 8A); pronotal carina visible laterally, forming a tooth in dorsal view; lateral panel mostly flat,

with longitudinal carinulae dorsally and raised curved carina ventrally; notauli impressed (Fig. 7E); tegula with a tuft of about 10 setae anteriorly (Fig. 8A); mesoscutellum truncate anteriorly, rounded apically, its posterior margin raised and surpassing postscutellum (Fig. 7E); propodeum strongly sloping anteriorly, more strongly so posteriorly, with sharp spiracular tooth (Fig. 7E) and two irregular costulae; mesepisternum with mesodiscrimen as faint carina all over, without ventral fovea; epicnemial carina moderately raised laterally, strongly protruding mesoventrally, appearing as a sharp tooth in lateral view (Fig. 8A); ventral shelf in mesepisternum very weakly sculptured; adscrobal area, mesepimeron, and metepimeron coarsely areolate, the later bearing long setae; femoral depression of mesepisternum with only a few low carinae (Fig. 8A).

Wings (Fig. 8D). Fore wing densely setose but bare on basal cell, basal and cubital folds, marginal cell with a single, incomplete row of setae on the underside; setae generally very short on the disc of the wing, somewhat longer below MGV, PMV and Rs track; setae uniformly short on the underside of wing; MGV 0.27× as long as SMV; PMV 0.38× as long as MGV; STV 0.33× as long as PMV; hind wing with 4 hamuli, the basal one the largest, removed from the followings.

Legs (Fig. 8C). Procoxa with deep depression anteriorly, margined dorsolaterally with carina raised into flange. Protibia with sharp, non-socketed apical spine. Mesotibia without dorsal pegs. Metacoxa sparsely punctured ventrally, densely so on outer surface of metafemur, with dense and fine setiferous punctures, ventral edge with irregular row of unequal teeth, outer ventral margin with a row of 8–10 teeth, basal tooth not prominent but wider than other teeth; inner basal tooth absent; apical truncation of metatibia forming a curved spine. Tarsi slender.

Metasoma (Fig. 9A, B). Petiole not visible dorsally. Gaster lanceolate, longer than mesosoma; Gt_1 with weak wrinkles dorsally, setose laterally, the setae progressively longer towards the side (Fig. 9A); Gt_{2-5} smooth, with posterior rows of setiferous punctures, a tuft of sublateral setae longer (Fig. 9A); posterior margin of tergites hardly concave; penultimate tergite smooth anteriorly, with moderately coarse setiferous punctures posteriorly; spiracle hardly visible in sublateral position, its aperture much smaller than puncture diameter; syntergum elongate (Fig. 9A, B), 1.23× as long as mesotibia, densely and deeply punctured, with dorsal median ridge (Fig. 9A); cerci removed from base of syntergum, situated at half of its length.

Male. Unknown.

Distribution. Known from Saudi Arabia only in Al-Baha and Asir Regions (Fig. 17).

Host. *Anthaxia* (*Haplanthaxia*) *abdita* Bílý, 1982 and *A.* (*H.*) *kneuckeri* ssp. *zabranskyi* Bílý, 1995 (Coleoptera, Buprestidae).

Phasgonophora magnanii **Gadallah & Gul, sp. nov.**
http://zoobank.org/EFFB564A-B742-47FB-8C59-A9DEDBA2B07C
Figs 10A–F, 11A–D, 12A–D, 13A, B

Type material. ***Holotype*** ♀: Kingdom of Saudi Arabia, Asir, Abha (Garf Raydah Natural Reserve) [18°12'14.04"N, 42°24'42.84"E, Alt. 2809 m], 16.IV.2016,

e.l. *Dodonaea viscosa*, reared from *Chrysobothris* sp. (Buprestidae), leg. G. Magnani [KSMA]; ***Paratypes*:** 1♀, same data as holotype but differing as for the collection date, 11–13.IV.2019 and the collector, D. Baiocchi [KSMA]; 1♂, same data as holotype [KSMA].

Diagnosis. Body mostly black with head predominantly red (Figs 10A–F, 12A); setation of wings dark (Fig. 11B); frons strongly convex (Fig. 10C), and occiput quite concave (Fig. 10A); vertex with transverse mesal carina behind ocellar triangle (Fig. 10A); pedicel short with basal bottle neck (Fig. 10D); funicular segments elongate (Fig. 10D); clava 2-segmented (Fig. 10D); pronotum with mesal depression (Fig. 10E), notauli hardly impressed (Fig. 10E); mesoscutellum bluntly angulate anteriorly (Fig. 10E); propodeum with sharp spiracular teeth (Fig. 10E, F); surface of propodeum with long and dense setae lateral to costula (Fig. 10F); mesepisternum with mesodiscrimen as moderately raised carina, without ventral depression (Fig. 11A); epicnemial carina not raised laterally, but raised mesoventrally; forming a tooth in lateral view (Fig. 11A); gaster short with syntergum about half as long as mesotibia (Fig. 12A); vertex of male without transverse carina behind ocellar triangle (Fig. 12B); clava 1-segmented (Fig. 12D).

Etymology. The new species is dedicated to Gianluca Mangani (Roma, Italy) who reared this species from *Chrysobothris* sp. (Buprestidae) infesting *Dodonaea viscosa* (L.) Jacq. (Sapindaceae).

Condition of holotype. Specimen glued on rectangular card; head and mesosoma partly covered with a thin artifactual layer on bottom of areoles, appearing artificially dull by places; second to fifth tergites with sides widely separated from each other, probably resulting from immersion in some medium.

Description of holotype ♀: Body length 6.5 mm. ***Colour***. Head mostly red (Fig. 10A–C), ocellar triangle, occiput laterally, gena ventrally, interantennal projection and supraclypeal strip, black (Fig. 10A–C); antenna black (Fig. 10D), scape and pedicel with faint brownish tint; meso- and metasoma black (Figs 10E, 12A), pronotal collar and shoulder (Fig. 10E), mesoscutum laterally and anteromedially (Fig. 10E), mesoscutellum dorso-laterally (Fig. 10E), posterior margin of Gt_1, gaster laterally, tip of syntergum and ovipositor sheaths basally, brownish (Fig. 12A); fore wing slightly infuscate, with track of Rs pigmented, veins dark brown to black (Fig. 11B); tegula glassy yellowish brown (Fig. 10E); fore and mid legs dark brown to black, tarsi brown (Fig. 11C); hind leg black (Fig. 11D), coxa apically, femur ventrally, tibia dorsally brownish, tarsus brown.

Head (Fig. 10A–C). Subequal to maximal width of mesosoma; with moderately dense long thin and suberect setae (Fig. 10A–C), setae longer towards oral fossa; lower face and frons strongly convex, without preorbital ridges (Fig. 10C); both mandibles 3-toothed, lower tooth the largest and somewhat removed from the mid one (Fig. 10B); clypeus protruding at free margin, but projection truncate (Fig. 10B); tentorial pits present, but not well distinct from other punctures (Fig. 10B); lower face and gena densely punctured (Fig. 10B, C), interspaces 0.2× punctures diameter; gena with deep sulcus along genal carina (Fig. 10C); scrobal depression piriform, entirely transversely strigose, reaching median ocellus (Fig. 10A); interantennal projection foveolate, nearly

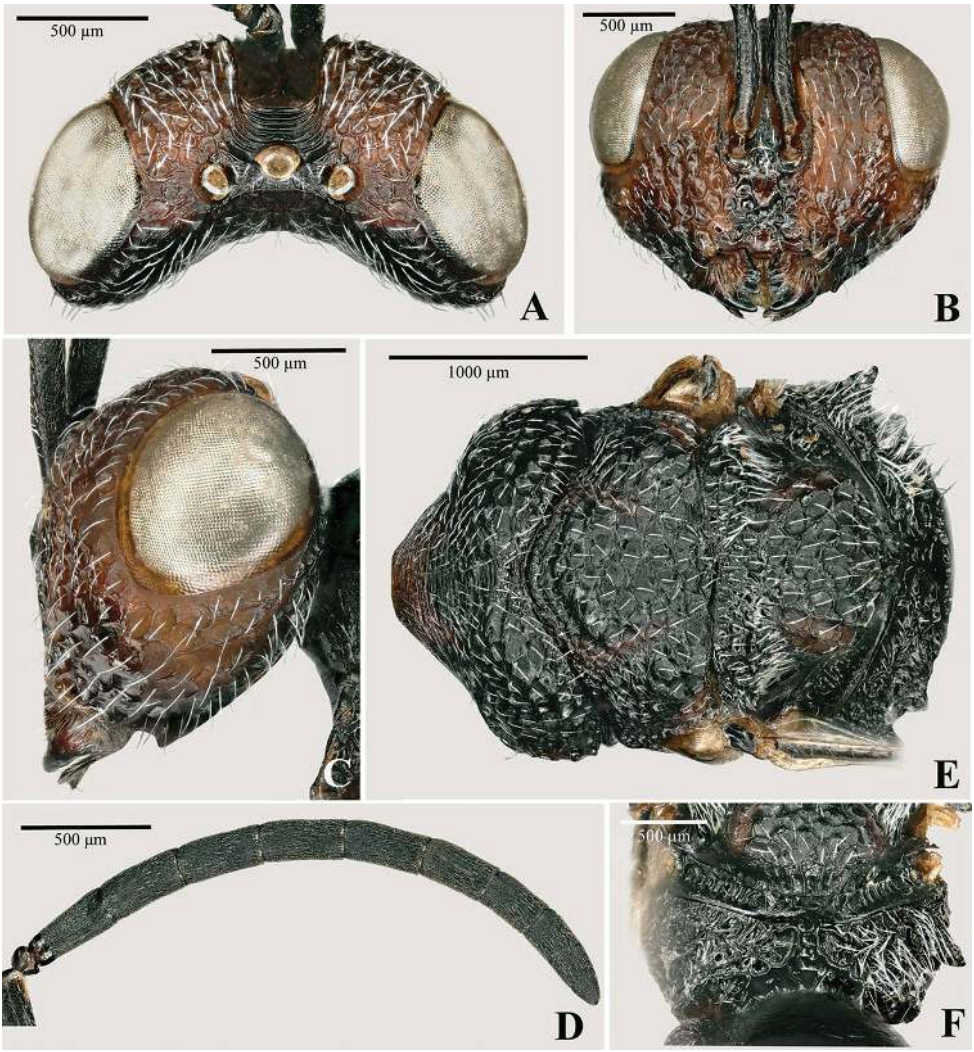

Figure 10. A–F *Phasgonophora magnanii* Gadallah & Gul, sp. nov., female (holotype) **A** head (dorsal view) **B** head (frontal view) **C** head (lateral view) **D** antenna **E** mesosoma (dorsal view) **F** propodeum (posterodorsal view, showing spiracular teeth).

as wide as diameter of antennal torulus, 0.45× as long as scape (Fig. 10B); vertex and frons densely areolate (Fig. 10B), vertex with distinct curved carina behind ocellar triangle (Fig. 10A); occiput with vertical carinulae behind ocellar triangle; punctured-strigose laterally, with oblique crests (Fig. 10A).

Antenna (Fig. 10D). Apex of scape reaching level of median ocellus; anellus strongly transverse; pedicel short, with strong basal bottle neck; flagellomeres pubescent, bearing numerous, not raised, multiporous plate sensilla in several intricate rows; F1 1.8× as long as wide, scarcely shorter than F2 or F3 (0.93×); clava 2-segmented, narrowly rounded apically.

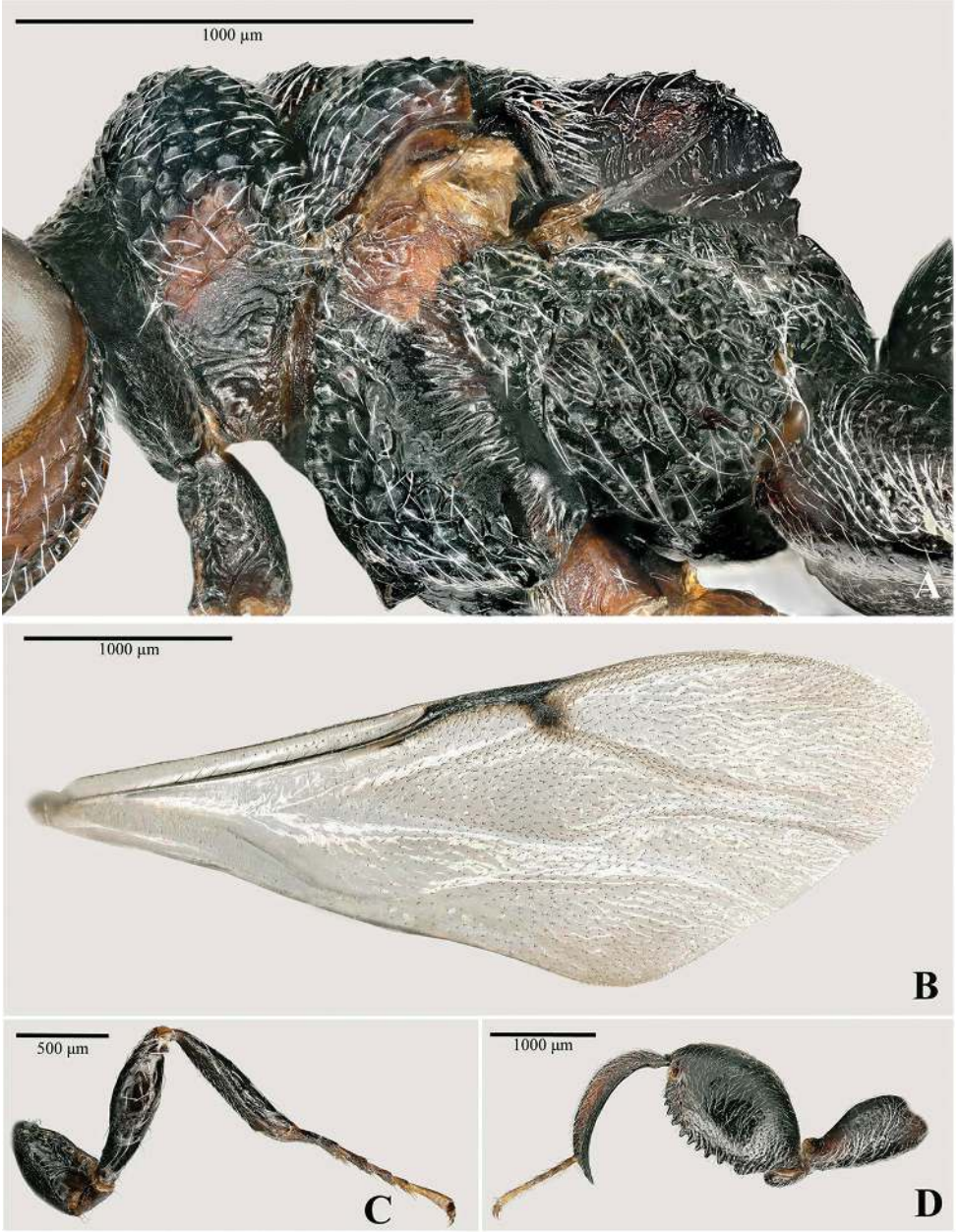

Figure 11. A–D *Phasgonophora magnanii* Gadallah & Gul, sp. nov., female (holotype) **A** mesosoma (lateral view) **B** fore wing **C** fore leg **D** hind leg.

Mesosoma (Figs 10E, F, 11A). Pronotum and mesonotum bearing short, adpressed and thin setae (Fig. 10E); pronotum with deep median depression, only angulate laterally for distinction of collar, which is densely punctured, the anterior walls of which

are raised into crests, especially on either side of the median depression (Fig. 10E); pronotal collum transversely strigose; lateral panel flat, with a single oblique carina (Fig. 11A); dorsal outline of mesonotum straight, mesoscutum and mesocutellum being flattened, crests transverse and hardly raised on mesoscutum, better raised and interrupted between each puncture on mesoscutellum (Fig. 11A); notauli hardly impressed posteriorly; tegula with a patch of about 10 setae posteriorly; mesoscutellum rhombic and angulate anteriorly as axillar grooves are joining to each other on transscutal line (Fig. 10E); frenum distinctly sloping; posterior margin of mesoscutellum rounded (Fig. 10E); propodeum moderately sloping, with sharp spiracular teeth and raised but irregular costulae (Fig. 10E, F); surface of propodeum with long and dense setae lateral to costulae (Fig. 10E); mesepisternum with mesodiscrimen appearing as moderately raised carina, without ventral depression (Fig. 11A); epicnemial carina not raised laterally, but raised mesoventrally, forming a tooth in lateral view (Fig. 11A); ventral shelf of mesepisternum punctured-strigose (Fig. 11A); adscrobal area, mesepimeron, and metepimeron coarsely areolate, bearing long, thin and erect setae (Fig. 11A).

Wings (Fig. 11B). Fore wing densely setose, but basal cell, basal and cubital folds bare; marginal cell with a single row of hairs on the underside; MGV 0.35× as long as SMV, PMV 0.2× as long as MGV, STV 1.3× as long as PMV; hind wing with three hamuli, the basal one larger and somewhat removed from the followings.

Legs (Fig. 11C, D). Procoxa depressed anteriorly, the depression delimited laterodorsally by a raised carina (Fig. 11C). Protibia with apicodorsal, not socketed spine. Mesotibia without pegs. Metacoxa densely punctured on outer ventral side, with long fine setae along its whole surface (Fig. 11D); metafemur with dense fine setiferous punctures on outer side, ventral margin with a row of 11 teeth, basal tooth not prominent but wider than other teeth, no inner basal tooth (Fig. 11D). Apical truncation of metatibia forming a curved spine (Fig. 11D).

Metasoma (Fig. 12A). Petiole not visible from above, entirely concealed within propodeal foramen. Gaster slightly longer than mesosoma; Gt_1 1.35× as wide as long, as long as $Gt_{2–5}$ combined, faintly transversely striolate mesally, broadly setose posterolaterally; $Gt_{2–5}$ with 1 row of setae in front of the slightly concave posterior margin; penultimate tergite densely and coarsely punctured on the whole dorsal surface; spiracle very small, hardly distinct; syntergum short, 0.55× as long mesotibia, without median ridge, densely coarsely punctured laterally; sternites sparsely finely punctulate; tip of hypopygium 0.60 of gaster length.

Male (Figs 12B–D, 13A, B). Length 5.8 mm. Differs from female mostly through the following characters: interantennal projection better raised and laterally compressed (Fig. 12C); gena with dense umbilicate punctures (Fig. 12C); carina behind ocellar triangle vestigial (Figs 12B, 13A); flagellomeres shorter with clava only 1-segmented (Fig. 12D); mesosoma more elongate with dorsal outline slightly convex in lateral view; $Gt_{2–5}$ with 2–3 rows of setiferous punctures posteriorly (Fig. 13B).

Recognition. None of the Afrotropical species described in *Trigonura* or *Phasgonophora* has the short syntergum exhibited by *P. magnanii*. In the key of the Oriental species provided by Narendran (1989), it would run to *T. samarensis* Narendran, 1987.

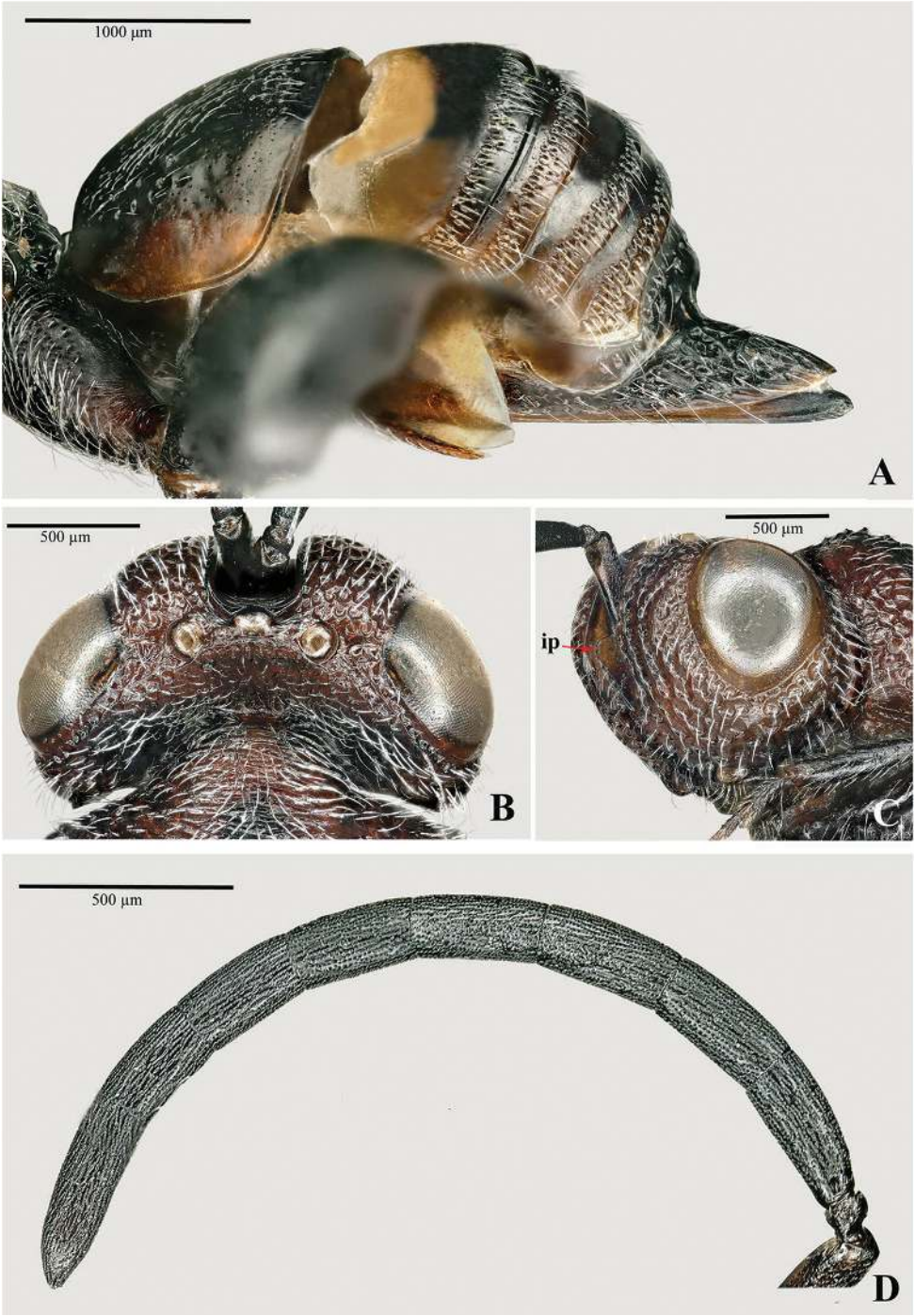

Figure 12. A–D *Phasgonophora magnanii* Gadallah & Gul, sp. nov. **A** female (holotype) metasoma (lateral view) **B, C** male (paratype): **B** head (dorsal view) **C** head (lateral view) **D** antenna.

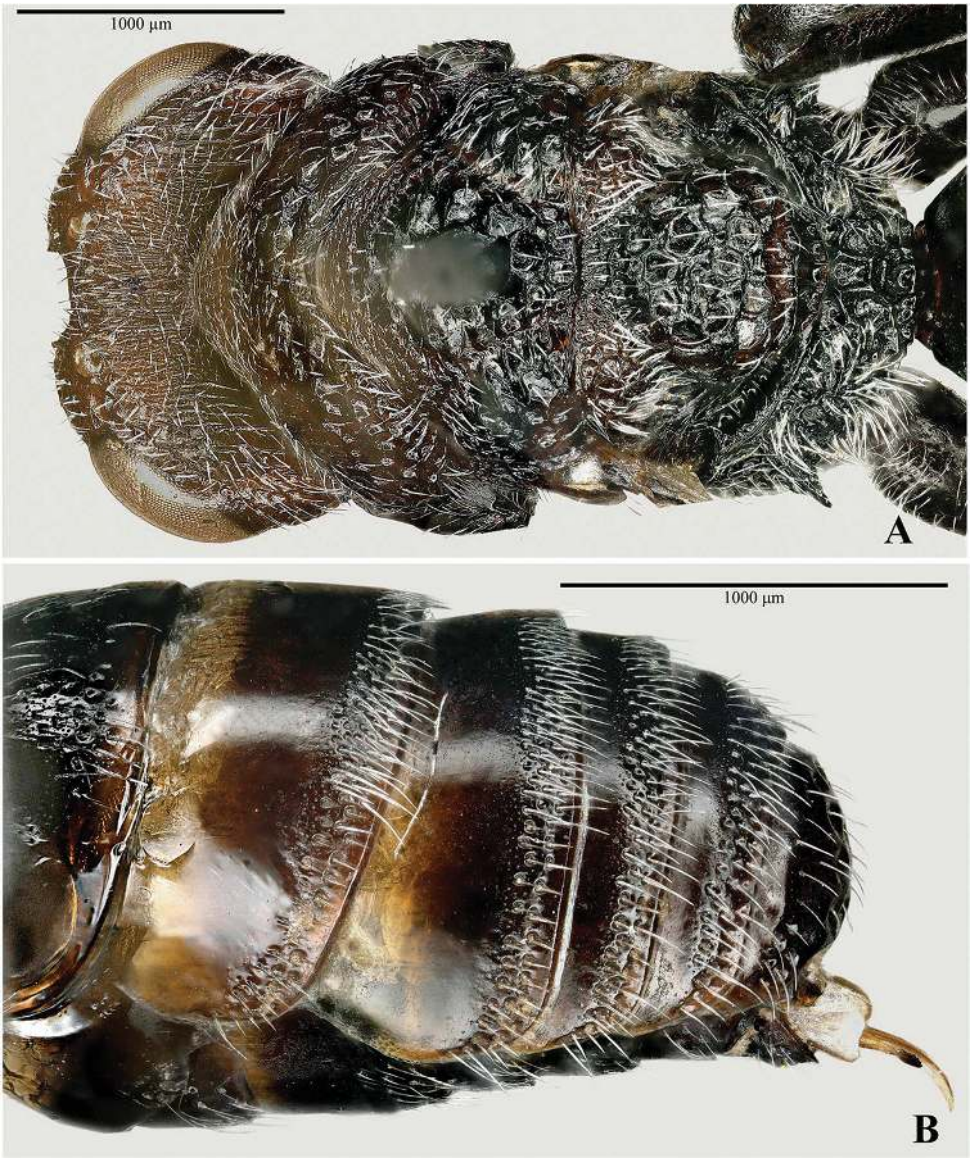

Figure 13. A, B *Phasgonophora magnanii* Gadallah & Gul, sp. nov., male (paratype) **A** head and mesosoma (dorsal view) **B** metasoma (dorsolateral view).

It differs from this species by the gaster being longer than the mesosoma *versus* shorter in *samarensis*; it also lacks the infuscate spot around the stigma, and Gt_1 is transversely striolate on the disc *versus* smooth and shiny in *T. samarensis.*

Distribution. Only known from Saudi Arabia in Asir Region (Fig. 17).

Host. *Chrysobothris* (*Abothris*) sp. (Coleoptera, Buprestidae).

***Phasgonophora rubens* (Klug, 1834)**
Figs 14A–D, 15A–C

Chalcis rubens Klug, 1834: tab. 37, fig. 7, n. 2.
Phasganophora rubens (Klug), Sichel, 1866: 368.
Urochalcis maura Nikol'skaya, 1952: 91–92.

Material examined. Type material. Two conspecific, pinned, ♀ syntypes, labelled "Abissynien /Ambukohl /Ehrbg. L' [manuscript, black ink, green label] 'rubens Kl' [manuscript, black pencil] 'type' [red label] 'GBIF-ChalcISE /ID: Chalc0656' [MNB].

Other material (all from Saudi Arabia): 1♀, 2♂, Al-Baha, 2 km E of Nawan [19°32'48"N, 41°11'34"E, Alt. 117 m], 31.III.2017, e.l. *Acacia*, leg. D. Baiocchi [KSMA]; 1♂, Asir, Abha, N of Khamis Mushait [18°25'25"N, 42°42'05"E, Alt. 1944 m], 17.IV.2016, e.l. *Acacia*, leg. D. Baiocchi [KSMA]; 2♀, 3♂, Riyadh, Ad Diriyah, Al Uyaynah, Al Bodah (30 km NW Riyadh) [24°53'33"N, 46°17'39.84"E, Alt. 761 m], 10.IV.2016, e.l. *Acacia*, leg. D. Baiocchi [KSMA]; 1♂, the same previous data but differing as for collection date (08.IV.2017) [KSMA]; 13♀, 14♂, Riyadh, Ibex Reserve Protected Area (W of Hutat Bani Tamim) [23°27'26"N, 46°33'37"E, Alt. 721 m], 11.IV.2017, e.l. *Acacia*, leg. D. Baiocchi [KSMA]; 3♀, 2♂, Riyadh, Ibex Reserve Protected Area (W of Hutat Bani Tamim) [23°21'06.62"N, 46°21'35.94"E, Alt. 709 m], 11.IV.2017, e.l. *Acacia*, leg. D. Baiocchi [KSMA]; 1♀, Riyadh, Rimah, Rawdat Khuraim (100 km NE Riyadh) [25°22'59.06"N, 47°16'42.58"E, Alt. 559 m], 18.II.2012, sweep net (A), *Calotropis procera*, leg. unknown [KSMA]; 1♂, Riyadh, Rimah, Rawdat Khuraim (100 km NE Riyadh) [25°25'56.64"N, 47°13'51.96"E, Alt. 572 m], 28.IV.2012, pitfall trap (B), leg. unknown [KSMA]; 1♀, same data but differing as for the trap (Malaise trap (B)) [KSMA]; 9♀, 7♂, Riyadh, Rimah, Rawdat Khuraim (100 km NE Riyadh) [25°23'13"N, 47°16'45"E, Alt. 550 m], 09.IV.2016, e.l. *Acacia*, leg. D. Baiocchi [KSMA]; 2♀, 1♂, Riyadh, Rimah, Rawdat Khuraim (100 km NE Riyadh) [25°22'59.06"N, 47°16'42.58"E, Alt. 559 m], 09.IV.2016, e.l. *Acacia*, leg. D. Baiocchi [EFC]; Riyadh, Rimah, Rawdat Khuraim (100 km NE Riyadh) [25°22'59.06"N, 47°16'42.58"E, Alt. 559 m], 09.IV.2017, e.l. *Acacia*, leg. D. Baiocchi [12♀, 13♂ in KSMA; 1♀, 1♂ in EFC]; 6♀, 8♂, Riyadh, Wadi Al Hesiyah (40 NW of Riyadh) [24°55'22.44"N, 46°12'15.13"E, Alt. 790 m], 08.IV.2017, e.l. *Acacia*, leg. D. Baiocchi [KSMA]; 1♀, Riyadh, Wadi Huraymila (86 km NW of Riyadh) [25°04'44.20"N, 46°03'29.80"E, Alt. 798 m], 08.IV.2017, e.l. *Acacia*, leg. D. Baiocchi [KSMA].

Diagnosis. *Female* with gena sparsely setose (Fig. 14B); flagellomeres long, F1 2× as long as wide (Fig. 14C); pronotal collar angulate with collum, with shallow median depression (Fig. 14D); mesonotum flattened dorsally, entirely cristate (Fig. 14A); propodeum with spiracular teeth (Fig. 15A), sloping posteriorly; fore wing with moderately dense setation, without pigmented track of Rs and r-m (Fig. 15B); metasoma lanceolate (Figs 14A, 15C); Gt_1 with evident curved carinae dorsally, sparsely setose laterally

Figure 14. A–D *Phasgonophora rubens* (Klug), female **A** lateral habitus **B** head (anterolateral view) **C** antenna **D** mesosoma (dorsal view).

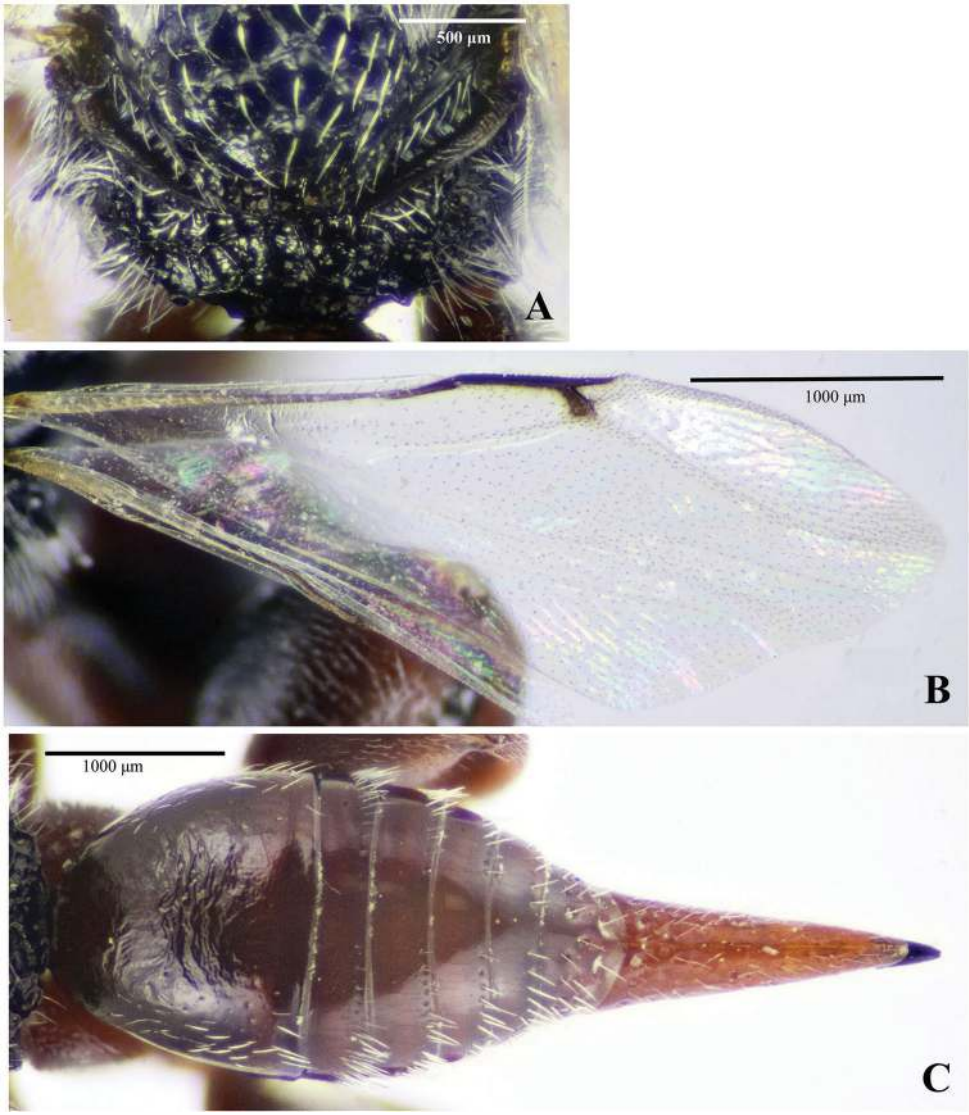

Figure 15. A–C *Phasgonophora rubens* (Klug), female **A** mesoscutellum and propodeum (dorsal view) **B** fore wing **C** metasoma (dorsal view).

(Fig. 15C); penultimate tergite densely and deeply punctured (Fig. 15C); syntergum (Fig. 14A) longer than mesotibia (1.25×), sparsely shallowly punctured (punctures dense at base), with median ridge (Fig. 15C). *Male*. Length 3.1–4.6 mm. Similar to female but antenna stouter; denser pale setae on fore wing; propodeal spiracular teeth slightly shorter; metasomal petiole narrow.

Distribution. General distribution. ALGERIA: mostly northwestern and central Sahara, less common in southern Sahara and Sahel (Mateu, 1972); EGYPT: surrounds

Figure 16. A–C *Phasgonophora ninae* (Nikol'skaya), female **A** lateral habitus **B** dorsal habitus **C** mesosoma (lateral view).

of Cairo (Masi 1931); ISRAEL: Wadi Fukra (Bouček 1956); TUNISIA: Bled Ejdla (Nikol'skaya 1952); SAUDI ARABIA (**new record**; Asir, Al-Baha and Riyadh Regions, Fig. 16); SUDAN (Klug 1834); UAE (Delvare 2017).

Biology. Hosts. *Anthaxia* [as *Cratomerus*] *angustipennis* (Klug, 1829) (Buprestidae) (Nikol'skaya 1952); *Anthaxia* spp., especially *A. angustipennis* and *A. pseudocongregata* Descarpentries & de Miré, 1963, *A. pulex* Abeille de Perrin, 1893, *Acmaeodera* spp., especially *A. adspersula* (Illiger, 1803), *A. flavipennis* (Klug, 1829), *A. convolute* (Klug, 1829) (Mateu 1972), *Anthaxia* (*Haplanthaxia*) *abdita* Bílý, 1982, *A.* (*H.*) *kneuckeri zabraskyi* Bílý, 1995, and *A.* (*H.*) *marginifera metallescens* Abeille de Perrin, 1907 (present study).

Associated plants. *Vachellia* [= *Acacia*] *farnesiana* (L.) Willd, 1806 (Masi 1931), *Acacia tortilis* (Forssk.) Hayne, 1825 [ssp. *Acacia raddiana* Savi] and *A. ehrenbergiana* Haine [= *A. flava* (Forssk.) Schwein.]; it was also reared from cages with *Tamarix pauciovulata* and *Rhus tripartitus* R. Sch. infested by *Buprestis hilaris* Klug, 1829 but with possible contamination from cultures of infested *A. tortilis* (Mateu, 1972) in the neighborhood.

Female behavior and larval development (Mateu 1972). Mating occurs only once and soon after the female looks for hosts. She oviposits preferably in cracks; the duration of oviposition is short (5–10 minutes); the stylets are not always vertical but forms an obtuse angle with the surface of the wood. A single, caudate larva develops within the host. The female apparently choses for old instar larvae. At the end of the development, the larva fully occupies the body of the pupa of the buprestid host, which is at that time mummified. The larva of the host is thus preserved until its complete development. In this respect, the mature larva of the host is able to dig the gallery that is normally used by the adult for emergence but used here by the chalcidid. The progeny emerges during late spring from eggs deposited in summer (August) of the previous year; the species is thus univoltine.

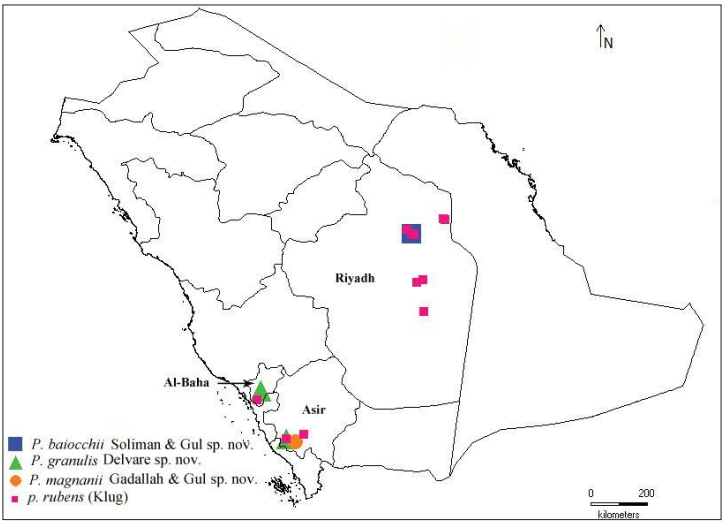

Figure 17. Distribution map of *Phasgonophora* species in Saudi Arabia.

Discussion

Systematic placement of the new species

The three new species, as well as *P. rubens*, undoubtedly belong to the genus *Phasgonophora*, sharing with its type species: 1) a laterally compressed interantennal projection (homoplastic); 2) a transverse carina behind ocellar triangle on the vertex (homoplastic); 3) a strigulose occiput behind the ocellar triangle (homoplastic); 4) a punctured strigulose or even strigulose occiput laterally (homoplastic); 5) a partial fusion of the claval segments (fusion complete in *P. baiocchii*) (a true synapomorphy within the subfamily); 6) the mesodiscrimen appearing as a low carina dorsally and as a vestigial fovea ventrally (a true synapomorphy of a part of clade B); 7) the apical projection of the protibia forming a sharp tooth (a true synapomorphy of a part of clade B); 8) a very small spiracle on the penultimate tergite with the peritreme not raised (homoplastic).

Phasgonophora granulis is retrieved as the sister species of *P. rubens* but this relationship is solely supported by a reversal on the mesoscutellum (anteriorly truncate). *Phasgonophora granulis* might otherwise have been the sister species of *P. ruficaudis* (Cameron, 1905) as the setation of the axilla in these species (and in some undescribed Afrotropical *Phasgonophora* as well) is quite dense; nevertheless, this conflicts with a derived state on the epicnemial carina (here strongly raised laterally) shared by *P. granulis* and *P. rubens*. Apparently, a radiation occurred in what appears in the tree as the sister group of *Phasgonophora sensu stricto* (*P. sulcata* and its sister species) with a high diversity of forms in the Afrotropical fauna.

Phasgonophora magnanii is retrieved as sister group of the well supported clade C (Fig. 2). This relationship is sustained by a single synapomorphy, the presence of a median depression on the pronotum. The position of *P. magnanii* within the clade B, in which most species exhibit a long syntergum, is *a priori* surprising for a species with a short syntergum; one would have positioned it within the clade A. Yet *P. magnanii* shows all derived states of this clade and, in addition, a number of those exhibited by the clade C. Such a placement on the tree finally has sense.

Phasgonophora baiocchii is a quite enigmatic species according to its amazing combination of character states that would prompt it within the clade A, as it is the case when using the available key (Narendran 1989). However, this species likewise shares the derived states sustaining the clade B and, to a less degree than for *P. magnanii*, some of those of the clade C. This suggests that it necessary merges on a node situated between the origins of these clades. Resulting from a lack of support, the topology in this part of the tree is unstable; it is therefore difficult to assess the exact placement of *P. baiocchii*. Molecular data are here requested.

Hosts and biology

Detailed biological data and hosts are available for *T. rubens*, the latter apparently restricted to Buprestidae belonging to the genera *Anthaxia* and *Acmaeodera* (Bupresti-

dae). The same host family (genus *Anthaxia)* was retrieved for *P. baiocchii* and *P. granulis*. Mateu (1972) stated that the larvae of these buprestids are able to develop within dried wood and certainly are adapted to the desert areas; *T. rubens* itself is adapted to their life-cycle and phenology. On the other hand, a strong discrepancy appears in the data from Saudi Arabia between the relatively large number of *P. rubens* reared from *Acacia* (n = 94) and the number of specimens (respectively 2 and 19) of the other species (*P. baiocchii* and *P. granulis*) reared from the same tree. In addition, *P. rubens* was collected in nine places *versus* a single site for *P. baiocchii* and two sites for *P. granulis*. This questions whether the tree species actually is their usual associated tree; in that case, they would really be quite rare. In the alternate, if the relevant *Acacia* is a marginal associate plant one would look for other trees where they would inhabit.

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