

RESEARCH PAPER

Contribution to the knowledge of selected genera of the tribe Opsiini (Hemiptera: Cicadellidae: Deltocephalinae) from the Kingdom of Saudi Arabia

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Accepted:
2nd July 2018

Published online:
1st August 2018

Abstract. The redescrptions of two genera of Opsiini (Hemiptera: Cicadellidae), *Concavifer* Dlabola, 1960 and *Phlepsopsius* Dlabola, 1979, are given based on specimens collected recently in the Kingdom of Saudi Arabia. *Concavifer nativus* Zhuravlev, 1991 syn. nov., and *C. sagittatus* Emeljanov, 1972 syn. nov. are proposed as new subjective junior synonyms of *C. marmoratus* Dlabola, 1960. *Phlepsopsius africanus* Abdul-Nour, 2007, syn. nov., is proposed as a new subjective junior synonym of *P. arabicus* Dlabola, 1979. The genus *Hishimonus* Ishihara, 1953 is newly reported for the Kingdom of Saudi Arabia, represented by the species *H. phycitis* (Distant, 1908). A key is provided to distinguish the species of *Concavifer*.

Key words. Hemiptera, Auchenorrhyncha, Cicadellidae, leafhoppers, taxonomy, new synonymy, distribution, Arabian Peninsula, Palaearctic Region

ZooBank: <http://zoobank.org/urn:lsid:zoobank.org:pub:832A060E-85F5-49B3-B2A4-5FE358A53DAA>

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Introduction

The Deltocephalinae is considered one of the most important groups of leafhoppers (Hemiptera: Cicadellidae) due to the number of species and genera, their abundance and ability to transmit plant diseases (NIELSON & KNIGHT 2000, ZAHNISR & DIETRICH 2008). Among the deltocephaline tribes the Opsiini, with more than 300 species, contains a large number of vector species. It is divided into four subtribes, two of which are represented in Saudi Arabia: Circuliferina and Opsiina (DMITRIEV 2002, ZAHNISR & DIETRICH 2013). Although Opsiina is widespread mainly in the tropical regions of the Old World, some genera are also present in the Palaearctic Region, such as *Opsius* Fieber, 1866 and *Hishimonus* Ishihara, 1953. The subtribe Circuliferina is commonly represented in the Palaearctic Region, and the genus *Concavifer* Dlabola, 1960 appears endemic in this region (EMELJANOV 1962, ZAHNISR & DIETRICH 2013).

Despite studies of the Cicadellidae in the Kingdom of Saudi Arabia (KSA) by DLABOLA (1979, 1980, 1987), and recently, the taxonomic papers of EL-SONBATI et al. (2015, 2016, 2017), it is now apparent that the leafhopper fauna is much more diverse in the country than previously considered. Recent fieldwork has found many more genera and species new to the Arabian fauna. Prior to this study, Opsiini from KSA were represented by seven genera: *Concavifer*, *Neoaliturus* Distant, 1918, *Opsius*, *Oshaibahus* El-Sonbati & Wilson, 2017, *Paraorosius* El-Sonbati & Wilson, 2016, *Orosius* Distant, 1918 and *Phlepsopsius* Dlabola, 1979. Some poorly known species of these genera require additional studies. Two of the above known genera, *Concavifer* and *Phlepsopsius* are treated herein, and *Hishimonus* is recorded here as another Opsiini genus for the first time for KSA.

The genus *Concavifer* was erected by DLABOLA (1960), with *Concavifer marmoratus* Dlabola, 1960 designated



as the type species. Originally found at several localities in Iran (DLABOLA 1960), it was later listed also from KSA (DLABOLA 1979). Later other *Concavifer* species have been described: *C. sagittatus* Emeljanov, 1972 from Mongolia (EMELJANOV 1972); *C. balkarensis* Kartal, 1982 from Turkey (KARTAL 1982); and *C. nativus* Zhuravlev, 1991 from Kazakhstan (ZHURAVLEV 1991). In the present study, the genus is redescribed and *C. sagittatus* and *C. nativus* are both proposed as junior subjective synonyms of *C. marmoratus*.

Phlepsopsius was described from KSA based on *P. arabicus* Dlabola, 1979 as the type species (DLABOLA 1979). Later, *P. africanus* Abdul-Nour, 2007 from Libya was accommodated in the genus (ABDUL-NOUR 2007). In this paper, *Phlepsopsius* is redescribed based on the type species, *P. arabicus*. *Phlepsopsius africanus* is proposed as a junior subjective synonym of *P. arabicus*.

Hishimonus currently includes more than 50 species known from the Oriental, Palaearctic, Afrotropical and Australasian Regions (ZAHNISR 2018, FLETCHER & DAI 2018). *Hishimonus phycitis* (Distant, 1908) has been reported as a vector of the Witches' broom disease of lime (WBDL) (ZREIK et al. 1995, SHABANI et al. 2011). WBDL is associated with 'Candidatus Phytoplasma aurantifolia', considered one of the most lethal plant pathogens (MARDI et al. 2011, SHABANI et al. 2013). WBDL is widely distributed in the Arabian Peninsula and especially Oman (with 98% loss of lime trees) and the United Arab Emirates. But it was also found in India and Iran (30% of Mexican lime trees over half a million trees/7000 hectares) (ZREIK et al. 1995, PARRELLA et al. 2008, MARDI et al. 2011, AL-SALEH & AMER 2014). Interestingly WBDL has been reported from KSA but with *Empoasca decipiens* Paoli, 1930 (Cicadellidae: Typhlocybinae: Empoascini) as a vector responsible for major losses, estimated at 25% loss of lime trees (ALHUDAIB et al. 2009).

Material and methods

Voucher specimens of each species are deposited in the following collections:

KSMA	King Saud University Museum of Arthropods, College of Food and Agriculture Sciences, King Saud University, Riyadh, KSA;
NMWC	National Museum of Wales, Cardiff, UK;
NHMO	Natural History Museum of Oman;
NAWRC	National Agriculture and Water Research Centre, Riyadh, KSA;
MNHN	Muséum national d'Histoire naturelle, Paris, France.

Morphological terminology follows DIETRICH (2005). Measurements are in millimeters (mm). All specimens were examined with a Leica LABOPHOT-2 stereomicroscope. Illustrations of the male genitalia were prepared using a NIKON microscope with a drawing tube attachment. Images were taken with a Canon 70D DSLR attached to a Leica Z6 microscope. Individual source images were then stacked using Helicon Focus v. 6.22 software, with calibrated scale bars added using Syncrosopy Automontage v. 5.4. The maps in Figs 51–52 were created using the ArcGIS 10.3 software.

Results

Concavifer Dlabola 1960

Concavifer Dlabola, 1960: 14. Type species: *C. marmoratus* Dlabola, 1960, by original designation.

Diagnosis. *Concavifer* can be recognized by the following combination of characters: crown sharply angled to face; pygofer with well-developed appendages; style bent, small, finger-like, curved preapically, the curve in dorsal view rounded at the apex; aedeagus with two branches, forming a semi-circle in ventral view.

Redescription. Measurements. Body length: male 3.9–4.1 mm; female 4.0–4.5 mm.

Coloration (Figs 1–2, 7–8). Generally yellowish, with brownish spots. Pronotum and forewings with a brown streaked pattern. Pronotum yellowish brown with pale midline. Forewings with brown spots, larger spots only at the inner edge. Face yellow. Vertex with two oblique V-shaped brown spots, with or without distinctive oval brown spots. Scutellum orange, brown spotted at lateral angles. Legs yellow and mottled with brown, with brown setal areolae.

Structure. Head (Figs 1–2, 7–8) as wide as pronotum. Crown twice wider than each compound eye, elongate medially, concave, sharply angled to face. Gena slightly incised with single fine erect seta near lateral frontal suture. Lateral frontal suture reaching ocellus and directed mesad of ocelli. Frontoclypeus longer than wide. Clypeal suture straight and complete. Clypellus narrower than lorum at base, slightly expanding towards apex in basal two thirds, greatly produced beyond gena with apical margin straight. Lorum apex widely distant from gena margin. Antenna inserted near posteroventral corner of eye, mesal margin of eye notched.

Thorax. Pronotum with anterior margin convex and posterior margin slightly concave, wider than long. Combined length of mesoscutum and scutellum equal to their width. Macropterous, forewing veins not carinate, appendix restricted to anal margin, with three antepical cells, without reflexed costal veins, A1-A2 crossvein absent, r-m1 crossvein present. Hindwing submarginal vein complete.

Legs. Profemur row AM with AM1, one intercalary row with more than five fine setae gradually reduced apically, two dorsoapical setae. Protibia AD row with four duplicate macrosetae, AV row with numerous macrosetae gradually increasing in size apically. Mesofemur AV row with stout and short setae, two apical setae. Mesotibia AD and AV rows each with four macrosetae. Metafemur setal formula 2+2+1, second pair with shorter setae. Metatibia PD row with long and short macrosetae, AD row with macrosetae and three smaller intercalary setae between each pair; AV row with numerous macrosetae extending nearly to base, gradually increasing in size apically. Metatarsomere I as long as tarsomeres II plus III combined.

Male genitalia (Figs 13–26). Pygofer with well-developed appendages arising caudoventrally and extending dorsally but not exceeding pygofer margin, with well-de-

veloped macrosetae medially, ventral margin long, curved inside (Figs 25–26). Genital valve free and with pointed articulation to the pygofer (Fig. 19). Subgenital plate with one row of macrosetae near margin and some additional scattered hairs short to as long as macrosetae, apical part finger-like, apical part sinuate at lateral side (Fig. 18). Style bent, small, finger-like, curved preapically, the curve in dorsal view rounded at apex, with well-developed preapical lobe and subapical tooth (Figs 20–24). Connective Y-shaped, branches as long as half of connective total length (Fig. 17). Aedeagal shaft with two branches, each curved anteriorly, forming a semi-circle in ventral view, each branch with outer side bearing a small membranous appendage preapically, inner side sinuate medially, and apex pointed (Figs 13–16).

Female genitalia (Figs 27–29). Pygofer with numerous macrosetae. Sternite 7 as broad at base as long medially, posterior margin slightly sinuate, with elongated lobe, posterolateral angles acutely rounded (Fig. 27). First valvula convex medially. Second valvula gradually tapered apically with variable serrations on dorsal surface (Figs 28–29).

Remarks. *Concavifer* is closely related to *Neolaliturus*: both genera share the aedeagus with two branches forming a semi-circle which is considered here a putative synapomorphy. When describing *Concavifer*, DLABOLA (1960) compared his new genus with *Platymetopius* Burmeister, 1838 (currently placed in the tribe Athysanini: ZAHNISR & DIETRICH 2013) and *Distomotettix* Ribaut, 1938 (synonymised under *Neolaliturus* by LINNAVUORI 1962). *Concavifer* was originally diagnosed by the following characters: postclypeus narrow and long, twice longer than distance between ocelli; antenna long; stylus short; genital plate long; and, particularly from *Distomotettix*, by the male pygofer without an appendage. However, our examination of the type species of the genus, *C. marmoratus*, showed that the male pygofer in fact possesses an appendage, which was probably overlooked by DLABOLA (1960). EMELJANOV (1999) separated *Concavifer* and *Neolaliturus* based on the structure of the head without mentioning the main characters of the genus as given in the diagnosis above. LINNAVUORI (1962) postulated that *Concavifer* may be a subgenus of *Neolaliturus* regardless of the differences in external characters. Our redescription is based on direct examination of *C. marmoratus*, the type species of the genus. We also made attempts to borrow and examine the type material of *C. bolkarensis* Kartal, 1982, but without success. It cannot be confirmed that this species possesses a pygofer appendage. Additional studies are needed to clarify the relationship between *Concavifer* and the species currently included in *Neolaliturus*.

Distribution. Palaearctic Region (OMAN et al. 1990), from Turkey in the west to Mongolia in the east (Fig. 51).

Key to species of *Concavifer*

- 1 Vertex without distinctive 12 oval brown spots. Branches of aedeagus not sinuate laterally, with appendages on outer side preapically and inner side

with a tooth medially. Subgenital plate with few scattered hair-like setae.
 *C. marmoratus* Dlabola, 1960
 – Vertex with distinctive 12 oval brown spots. Branches of aedeagus sinuate laterally, with a small projection dorsally and inner side without a tooth medially. Subgenital plate with numerous hair-like setae.
 *C. bolkarensis* Kartal, 1982

Concavifer marmoratus Dlabola, 1960

(Figs 1–2, 7–8, 13–29)

Concavifer marmoratus Dlabola, 1960: 14.

Concavifer sagittatus Emeljanov, 1972: 233, **syn. nov.**

Concavifer nativus Zhuravlev, 1991: 85, **syn. nov.**

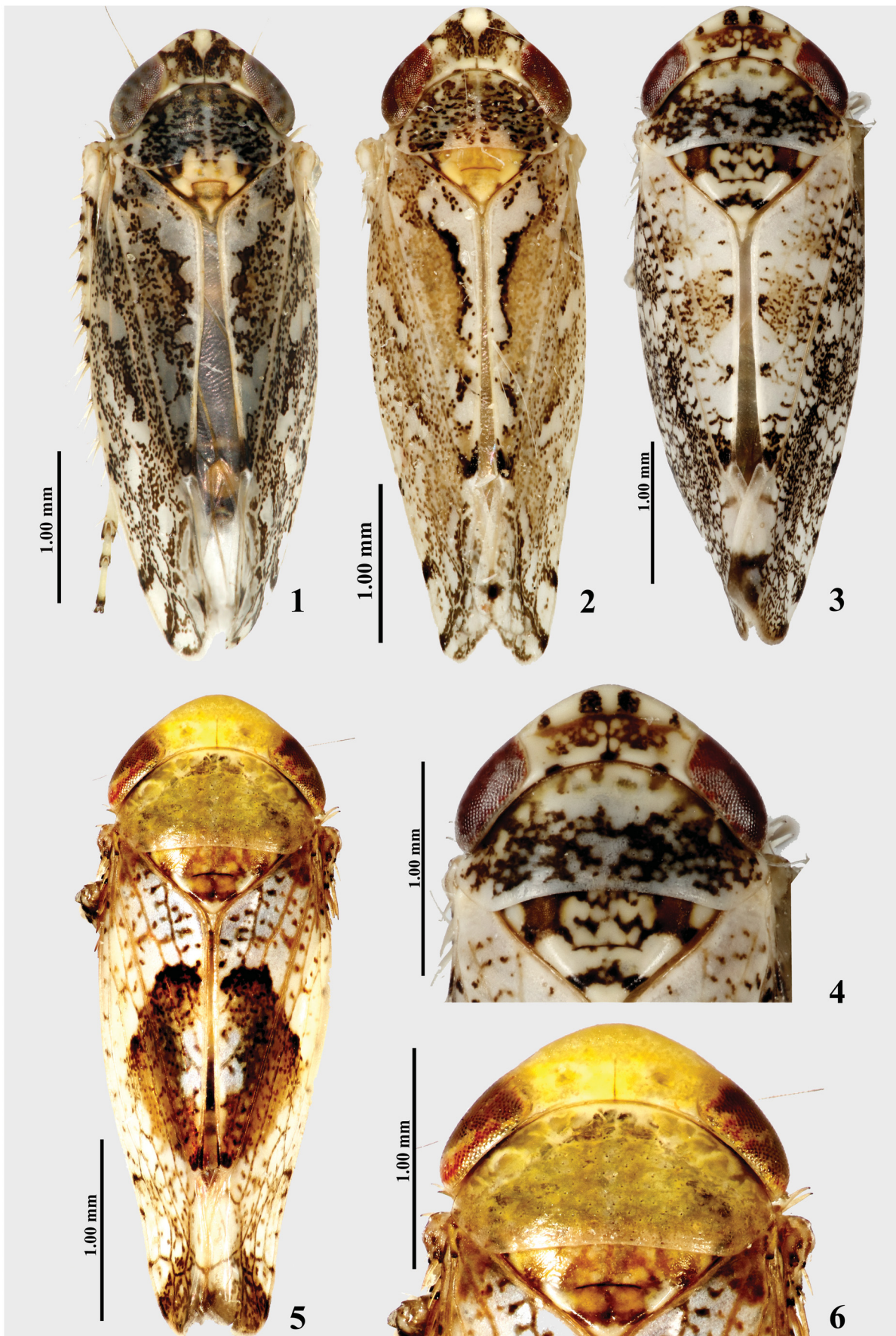
Type material examined. *C. marmoratus*: PARATYPES: 2 ♂♂, IRAN: Djiroft, Anbar-Abad, 21–30.iv.1956, W. Richter leg. (NMWC).

Additional material examined. KINGDOM OF SAUDI ARABIA:

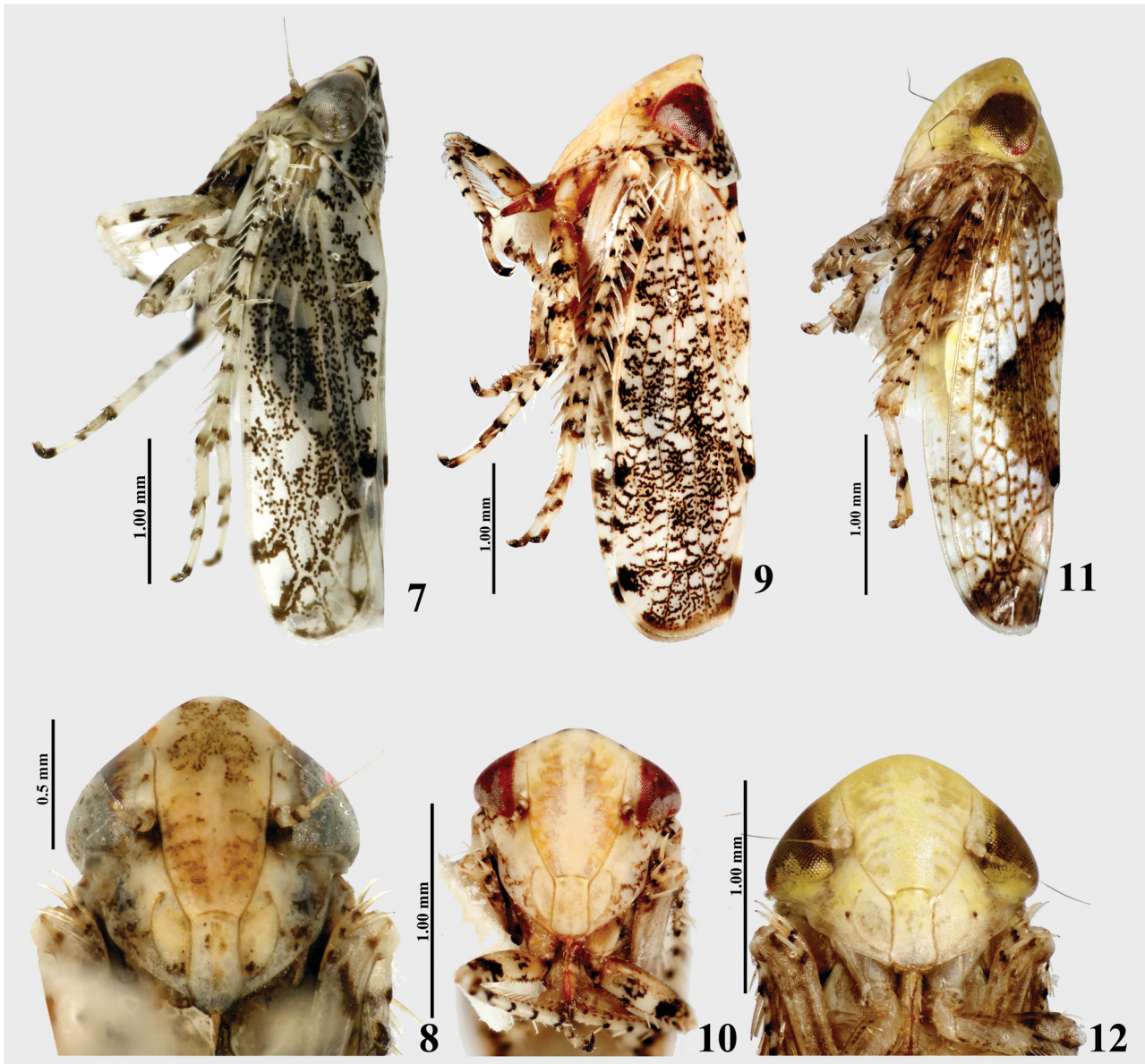
Riyadh: 2 ♂♂ 1 ♀, 20.ix.1979, A. Talhouk, S. Tilkan, R. Abousouheyrah, K. Kltaher & A. Klmsdi leg.; 1 ♀, same but 16.v.1977 (det. J. Dlabola, 1982; NAWRC); 1 ♀, Rhodet Khorim (A), 16.x.2011, 25°22.986'N, 47°16.712'E, 559 m, H. Al Dhafer & S. El-Sonbati leg.; 1 ♀, same but 24.xii.2011; 1 ♀, same but 5.ii.2012; 2 ♂♂ 1 ♀, same but 18.ii.2012; 1 ♂, same but 5.iii.2012; 1 ♀, same but 6.iii.2012; 1 ♂, same but 31.iii.2012; 3 ♂♂ 3 ♀♀, same but 14.iv.2012; 1 ♂ 11 ♀♀, same but 28.iv.2012; 1 ♂ 4 ♀♀, same but 14.v.2012; 2 ♀♀, same but 15.v.2012; 2 ♀♀, same but 18.v.2012; 5 ♂♂ 4 ♀♀, same but 26.v.2012; 1 ♀, same but 27.v.2012; 8 ♂♂ 1 ♀, same but 9.vi.2012; 9 ♂♂ 4 ♀♀, same but 10.vi.2012; 3 ♀♀, same, 23.vi.2012; 3 ♂♂ 5 ♀♀, same but 30.vi.2012; 1 ♀, same but 28.vii.2012; 1 ♀, same but 14.x.2012; 1 ♂, same but 9.iii.2013; 1 ♀, same but 20.iii.2013; 1 ♂, same but 15.vi.2013; 1 ♂, Rhodet Khorim (B), 25.i.2010, 25°25.943'N, 47°13.863'E, 572 m, H. Al Dhafer & S. El-Sonbati leg.; 3 ♂♂, same but 25.xii.2011; 1 ♂, same but 14.i.2012; 1 ♂, same but 5.ii.2012; 2 ♂♂, same but 18.ii.2012; 1 ♀, same but 5.iii.2012; 2 ♂♂ 1 ♀, same but 17.iii.2012; 14 ♂♂ 16 ♀♀, same but 14.iv.2012; 2 ♂♂ same but 28.iv.2012; 9 ♂♂ 11 ♀♀, same but 29.iv.2012; 1 ♂ 1 ♀, same but 14.v.2012; 3 ♂♂ 2 ♀♀, same but 15.v.2012; 1 ♀, same but 26.v.2012; 2 ♂♂ 1 ♀, same but 27.v.2012; 1 ♀, same but 9.vi.2012; 2 ♂♂ 3 ♀♀, same but 10.vi.2012; 3 ♂♂ 1 ♀, same but 24.vi.2012; 1 ♂, same but 30.vi.2012; 2 ♂♂ 5 ♀♀, same but 28.vii.2012; 5 ♀♀, same but 28.viii.2012; 4 ♂♂, same but 14.x.2012; 1 ♂, same but 20.iv.2013; 1 ♂ 1 ♀, same but 11.v.2013; 1 ♂ 1 ♀, same but 20.vi.2013; 1 ♂, Muzahimiyah, Al Khararah, 14.xi.2011, 24°24.59'N, 46°14.74'E, Y. Al Drayhim, H. Al Dhafer, A. El-Gharbawy & M. El Motairy leg.; 4 ♂♂, same but 17.iv.2012, H. Al Dhafer, H. Fadl, M. Abdel-Dayem, A. El Torkey & A. Al-Ansi leg.; 1 ♂ 1 ♀, Az Zulfi, Rhodet Al Sabalah, 19.v.2015, 26°21.624'N, 44°59.010'E, 669 m, H. Al Dhafer, M. Abdel-Dayem, A. El Torkey, A. El-Gharbawy & A. Soliman leg.; 1 ♂, Tumair, 19.v.2013, 25°42.36'N, 45°52.11'E, H. Al Dhafer & F. El Hussein leg.; 2 ♂♂, Al Aflaj, Al Naifiyah, Farshet Sheal, 10.iv.2015, 22°24.935'N, 46°35.287'E, 599 m, H. Al Dhafer, M. Abdel-Dayem, A. El Torkey, A. El-Gharbawy & A. Soliman leg.; 1 ♀, Wadi Namar, 29.ii.2012, 24°34.222'N 46°40.672'E, A. Al-Ansi, M. Al-Harbi & A. Al-Othman leg.; 8 ♂♂ 6 ♀♀, Ibex Reserve National Park, Wadi Hutet Beni Tamem, 180 km S of Riyadh, 7.v.2012, 23°27.133'N, 46°41.281'E, 676 m, H. Al Dhafer, M. Abdel-Dayem, A. El Torkey & A. Al-Ansi leg. (all KSMA, NMWC). **OMAN:** **SCHAMAL ASCH-SCHARQIYYA:** 1 ♀, Al Mudaibi, Samad, Ashan, Aswareeg, 22°49.5'N 58°09.117'E, 9–10.viii.2017, A. Al Jahdhami leg.; 1 ♂, same but 7–10.vii.2017; 1 ♂, same but 1–10.x.2017 (all KSMA, NHMO).

Diagnosis. Based on the published description of *C. bolkarensis* (KARTAL 1982), *C. marmoratus* can be distinguished from *C. bolkarensis* by the characters given in the key above.

Redescription. Measurements. Body length: male 3.9–4.1 mm; female 4.0–4.5 mm. Crown twice wider than eye width, 0.5 mm long medially and 0.4 mm broad between



Figs 1–6. 1–2 – *Concavifer marmoratus* Dlabola, 1960: 1 – dorsal view of male; 2 – dorsal view of female. 3–4 – *Phlepsopsius arabicus* Dlabola, 1979: 3 – dorsal view; 4 – head and thorax. 5–6 – *Hishimonus phycitis* (Distant, 1908): 5 – dorsal view; 6 – head and thorax.



Figs 7–12. 7–8 – *Concavifer marmoratus* Dlabola, 1960: 7 – lateral view; 8 – face. 9–10 – *Phlepsopsius arabicus* Dlabola, 1979: 9 – lateral view; 10 – face. 11–12 – *Hishimonus phycitis* (Distant, 1908): 11 – lateral view; 12 – face.

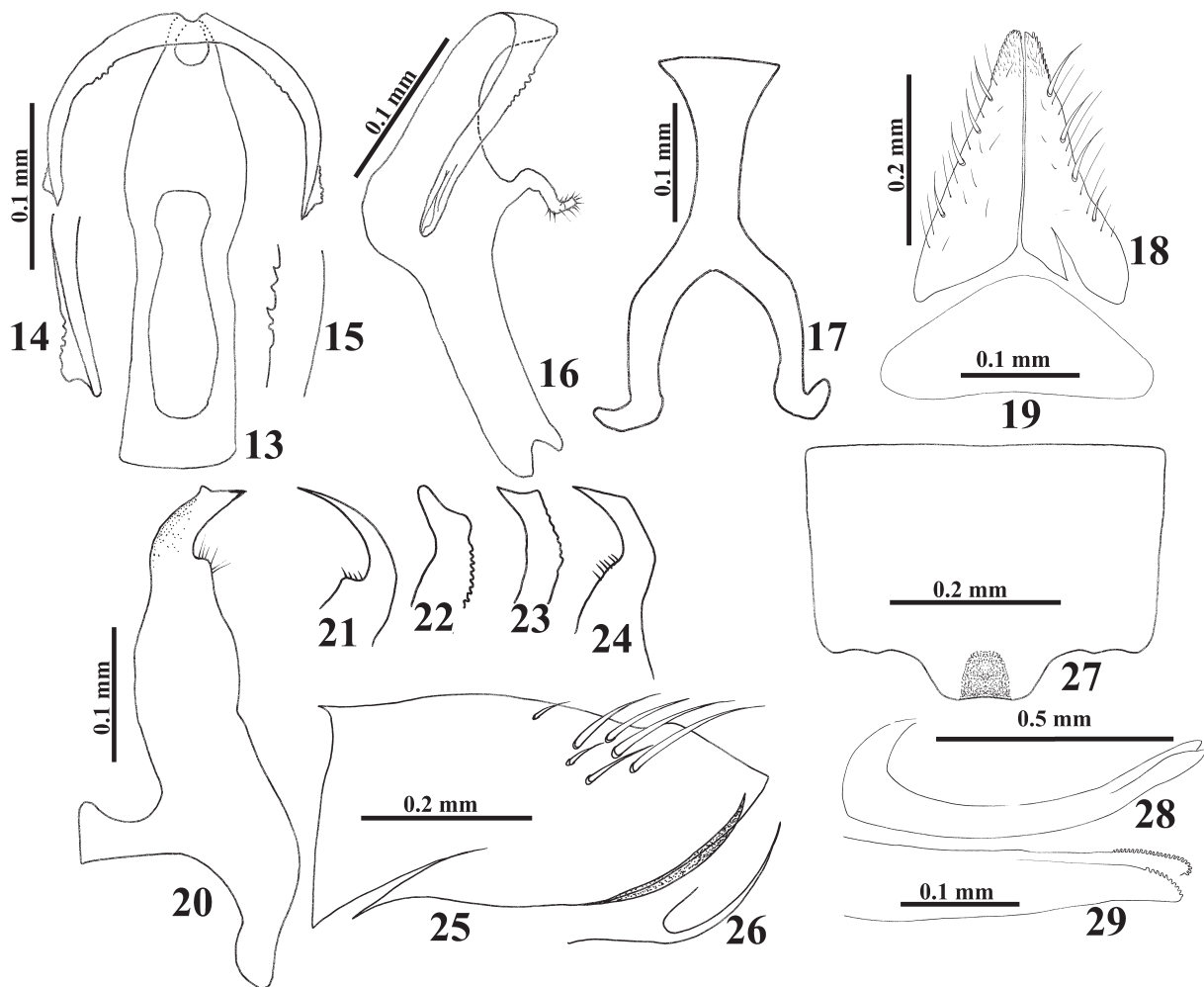
eyes. Pronotum wider (0.7 mm) than long (0.5 mm). Combined length of mesoscutum and scutellum 0.4 mm (as wide as long). Forewing length 3.1 mm.

Coloration and structure. See the generic redescription.

Ecology and biology. This species was commonly found in the Rawdhat Khorim (= Rhodet Khorim) National Park situated in the Central KSA (Fig. 53), which has a diverse flora of 153 plant species within 32 families (ALFARHAN 2001). *Concavifer marmoratus* was collected there on *Lycium shawii* Roem. & Schult. (Solanaceae) but there were many other plant species in the surroundings, e.g. *Acacia gerrardii* Benth. (Fabaceae) and *Rhazya stricta* Decne. (Apocynaceae). No further biological information is available and no assessment of any economic importance of *Concavifer* has been reported yet.

Distribution (Figs 51–52). Iran (DLABOLA 1960), Kingdom of Saudi Arabia (DLABOLA 1979, this paper), Mongolia (EMELJANOV 1972), Kazakhstan (ZHURAVLEV 1991), Palestine (LINNAVUORI 1962).

Remarks. *Concavifer nativus* Zhuravlev, 1991 and *C. sagittatus* Emeljanov, 1972 are treated herein as new subjective junior synonyms of *C. marmoratus*. EMELJANOV (1972) and ZHURAVLEV (1991) distinguished their newly described species from *C. marmoratus* based only on Dlabola's original illustrations of the stylus. However, DLABOLA (1960) did not illustrate the stylus structure correctly, which is demonstrated here by a study of paratypes from Iran and additional specimens from KSA originally identified by Dlabola. These specimens, as well as numerous additional specimens from KSA, Iran and



Figs 13–29. *Concavifer marmoratus* Dlabola, 1960. 13 – aedeagus, dorsal view; 14 – aedeagus, detail of apex of lateral branch, dorsal view; 15 – aedeagus, detail of median part of lateral branch, dorsal view; 16 – aedeagus, lateral view; 17 – connective; 18 – subgenital plate; 19 – valve; 20 – style; 21–24 – different views of style; 25 – pygofer; 26 – pygofer appendage; 27 – female 7th sternite; 28 – ovipositor, lateral view; 29 – detail of ovipositor apex.

Oman fully agree with characters specified in the original descriptions of *C. nativus* and *C. sagittatus*.

Phlepsopsius Dlabola, 1979

Phlepsopsius Dlabola, 1979: 132. Type species: *Phlepsopsius arabicus* Dlabola, 1979, by original designation.

Diagnosis. *Phlepsopsius* can be recognized by the following combination of characters: general colour greyish white with tinge of yellow, with some extremely dense brown mottling, particularly on forewings behind base; crown sharply angled to face; aedeagus with shaft bifurcate, each branch as long as two thirds of the total aedeagus length, curved dorsad in lateral view; aedeagus basally with long bifurcate process, pointed at apex, curved dorsad in lateral view and curved mesiad apically in dorsal view.

Redescription. Measurements. Body length: male 4.2–4.6 mm; female 4.3–4.8 mm. Crown width 1.6 mm, crown length 0.6 mm. Pronotum width 1.6 mm, pronotum length 0.6 mm. Scutellum width 0.8 mm, scutellum length 0.5 mm. Forewing length 3.5 mm.

Coloration (Figs 3–4, 9–10). Ground colour greyish white with tinge of yellow, with some extremely dense

brown mottling, particularly on forewings behind base. Face yellow. Vertex with two oblique V-shaped brown spots and two small spots laterally, posterior margin with three small spots. Pronotum yellowish brown, with pale area beyond vertex and incomplete rows of spots forming a net-like pattern. Forewings with brown spots in incomplete rows forming a net-like pattern. Legs yellow and mottled with brown, all spines arising from brown base. Legs with brown setal areolae.

Structure. Head (Figs 3–4, 9–10). Head slightly narrower than pronotum; crown twice wider than distance between eyes, slightly produced medially, sharply angled to face. Gena slightly incised with single fine erect seta near to lateral frontal suture. Lateral frontal suture reaching ocellus and directed mesad of ocelli. Frontoclypeus longer than wide. Clypeal suture arcuate and complete. Clypellus narrower than lorum at base, not produced beyond gena, apical margin straight. Lorum apex widely distant from gena margin, inner margin bordering post-clypeus for more than one third of its length. Antenna short, inserted near posteroventral corner of eye, mesal margin of eye entire.

Thorax. Pronotum wider than long, anterior margin convex, posterior margin straight. Scutellum wider than long. Macropterous, forewing veins not carinate, appendix restricted to anal margin, with three antepical cells, without reflexed costal veins, with A1–A2 and r-m1 crossveins. Hindwing submarginal vein complete.

Legs. Profemur row AM with AM1, one intercalary row with more than five fine setae gradually reduced apically, two dorsoapical setae, AV with numerous short stout setae, dorsal margin rounded with fine hairs. Protibia AD and PD row each with four macrosetae, AV row with numerous macrosetae gradually increasing in size apically. Mesofemur AV row with stout and short setae, two apical setae. Mesotibia AD and PD row each with four macrosetae, AV row with numerous macrosetae. Metafemur setal formula 2+2+1. Metatibia PD and AD row with long and short macrosetae, three smaller intercalary setae between each pair; AV and PV row with numerous macrosetae extending nearly to base, gradually increasing in size apically. Metatarsomere I shorter than tarsomeres II plus III combined.

Abdomen. Sternal male apodemes parallel-sided, apically angulate, apodeme width equal to distance between each apodeme (Fig. 37).

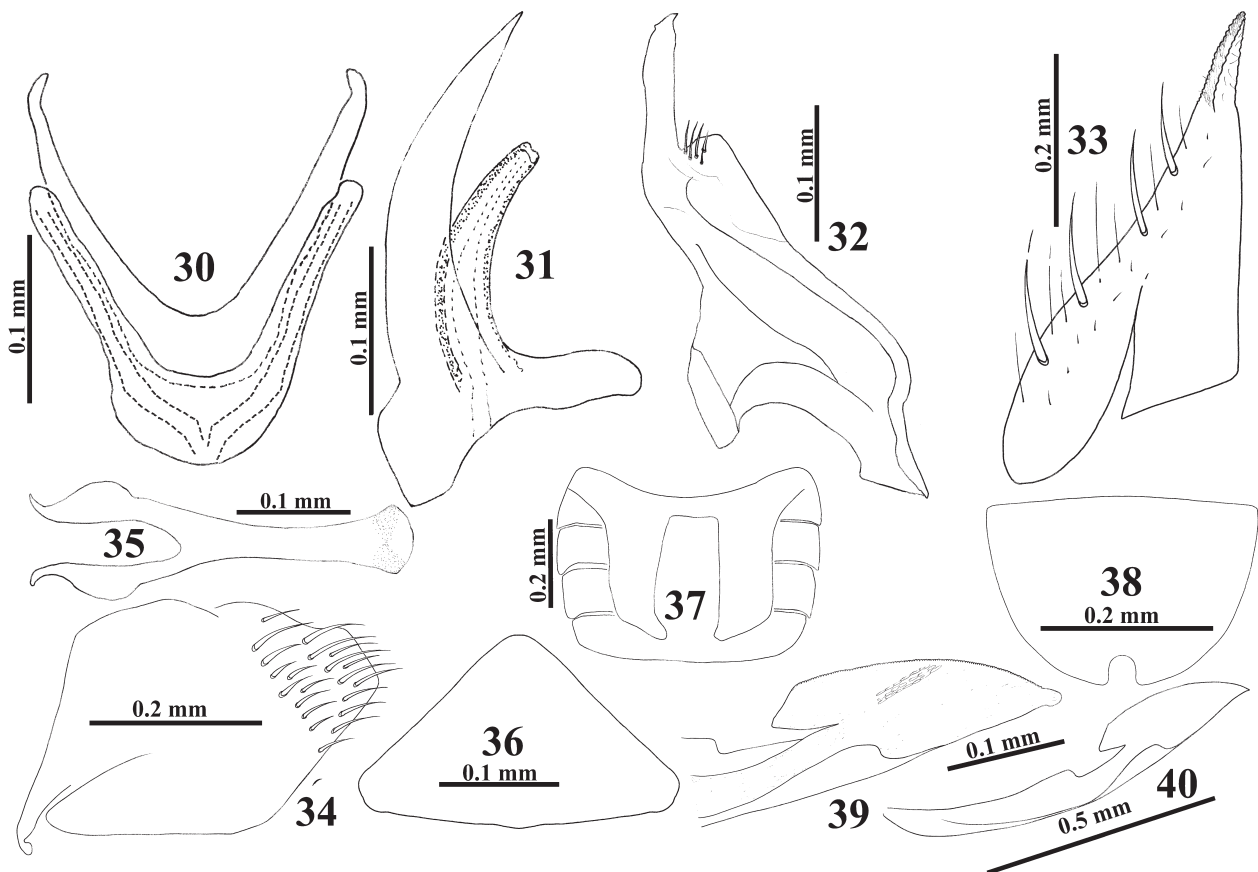
Male genitalia (Figs 30–36). Pygofer long with well-developed macrosetae, ventral margin serrate, curved inside (Fig. 34). Genital valve free and with pointed articulation to pygofer (Fig. 36). Subgenital plate with one row of macrosetae near margin and some scattered fine hairs which are

short to as long as macrosetae, apical part finger-like, sinuate (Fig. 33). Style bent, small, finger-like, curved preapically, inner side with projection, well-developed preapical lobe and subapical tooth (Fig. 32). Connective articulated with aedeagus, Y-shaped, branches shorter than half of connective total length (Fig. 35). Aedeagus with shaft bifurcate, each branch as long as 2/3 of the total aedeagus length, curved dorsad in lateral view; aedeagus basally with long bifurcate process, pointed at apex, curved dorsad in lateral view, and mesiad apically in dorsal view (Figs 30–31).

Female genitalia (Figs 38–40). Pygofer with numerous macrosetae. Sternite 7 about twice longer than wide, posterior margin curved, with median U-shaped notch in middle, posterolateral angles acutely rounded (Fig. 38). First valvula slightly convex; second valvula blade-like, abruptly broadened basad of tooth section, regularly serrated with small teeth (Figs 39–40).

Remarks. *Phlepsopsius* is similar to *Pseudophlepsius* Zachvatkin, 1924 in general habitus and *Opsius* Fieber, 1866 in the male genitalia. *Phlepsopsius* can be distinguished easily from *Pseudophlepsius* by the aedeagus shafts not robust and without a projection on the outer side, and pygofer without appendages. From *Opsius*, *Phlepsopsius* can be distinguished by the anterior margin of head carinate, transition of vertex to frons forming a distinct angle.

Distribution. North Africa and Arabian Peninsula (Figs 51–52).



Figs 30–40. *Phlepsopsius arabicus* Dlabola, 1979. 30 – aedeagus, dorsal view; 31 – aedeagus, lateral view; 32 – style; 33 – subgenital plate; 34 – pygofer; 35 – connective; 36 – valve; 37 – apodemes; 38 – female 7th sternite; 39 – detail of ovipositor apex; 40 – ovipositor, lateral view.

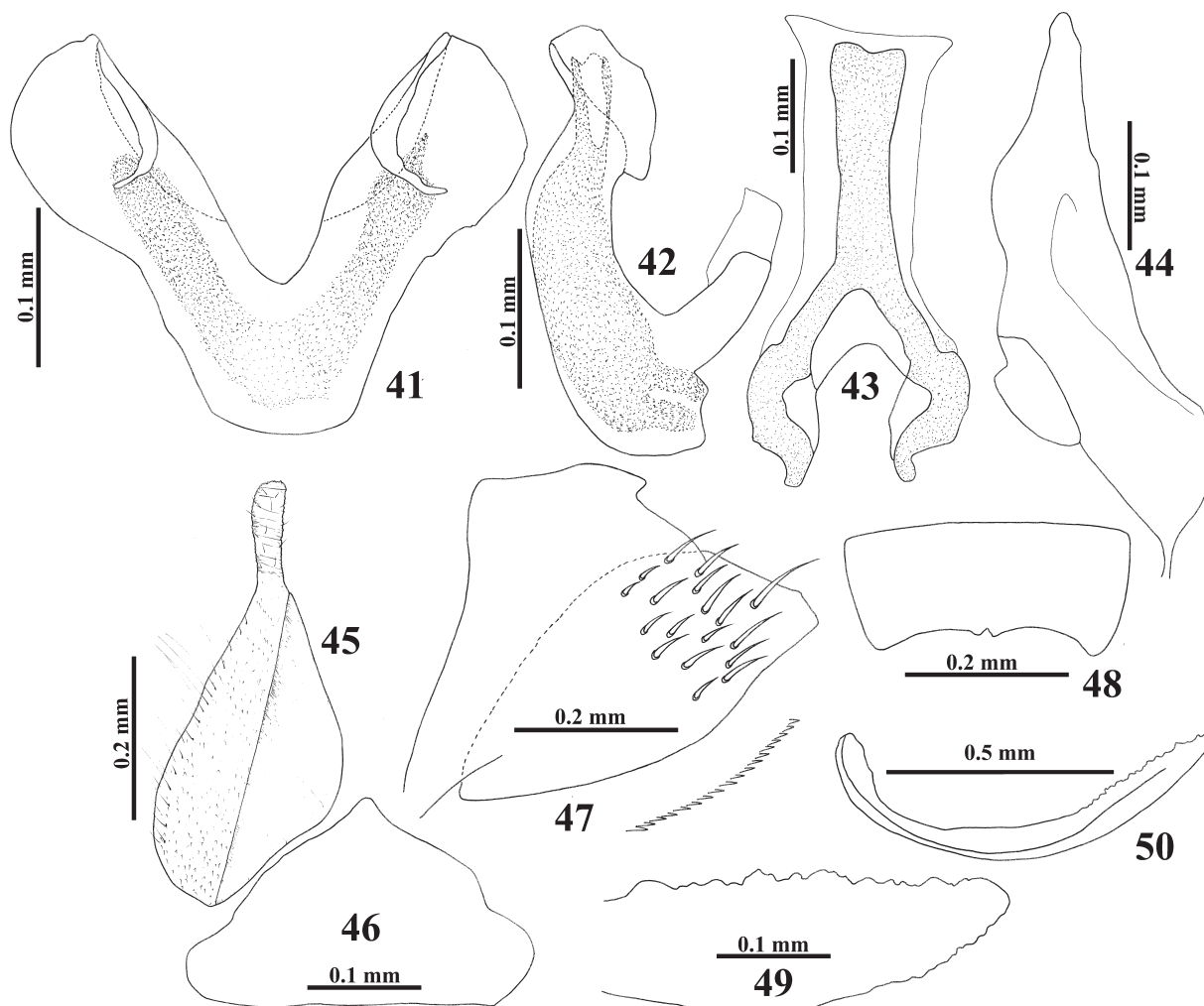
***Phlepsopsius arabicus* Dlabola, 1979**

(Figs 3–4, 9–10, 30–40)

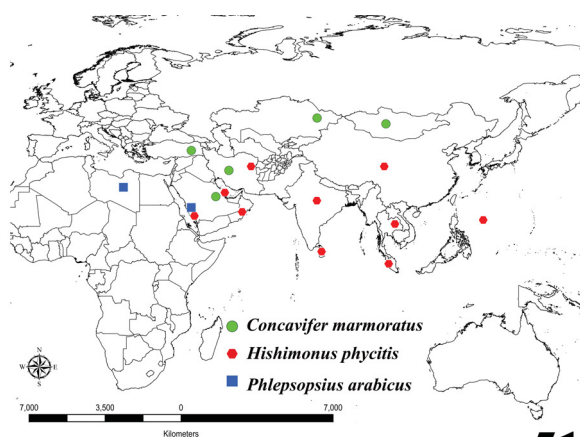
Phlepsopsius arabicus Dlabola, 1979: 132.*Phlepsopsius africanus* Abdul-Nour, 2007: 303, **syn. nov.****Type material examined.** *P. africanus*: HOLOTYPE: ♂, LIBYA: Mizdah (Tripolitania), 2.ix.2005, P. Weill leg. (MNHN).**Additional material examined. KINGDOM OF SAUDI ARABIA:**

RIYADH: 11 ♀♀ 4 ♂♂, Ibex Reserve National Park, Wadi Hutet Beni Tamem, 180 km S of Riyadh, 7.v.2012, light trap, 23°27.133'N, 46°41.281'E, 676 m, H. Al Dhafer, M. Abdel-Dayem, A. El Torky & A. Al-Ansi leg.; 1 ♂, Muzahimiyah, Al Khararah, 7.vi.2011, light trap, 24°24.59'N, 46°14.74'E, Y. Al Drayhim, H. Al Dhafer, A. El-Gharbawy & H. Setyaningrum leg.; 1 ♂, same but 5.v.2015; 1 ♂, same but 26.iv.2011; 7 ♀♀ 8 ♂♂, Al Aflag, Al Naifiyah, Farshet Sheaal, 10.iv.2015, light trap, 22°24.935'N, 46°35.287'E, 599 m, H. Al Dhafer, M. Abdel-Dayem, A. El Torky, A. Elgharabawy & A. Soliman leg. **ASIR:** 1 ♀, Wadi Targ, 14.iii.2012, light trap, 19°37.385'N, 42°18.020'E, 1317 m, H. Fadhallah & H. Setyaningrum leg.; 1 ♂, Abha, Al-Hubail, Wadi Reem, 17.x.2014, light trap, 18°06.981'N, 42°13.939'E, 451 m, Al Harbi & I. Rasool leg.; 8 ♀♀ 6 ♂♂, Al Magardah, Wadi Yabah, 11.x.2013, light trap, 19°14.911'N, 41°47.200'E, 402 m, S. El-Sonbati, I. Rasool, M. Al Harbi & S. Khan leg.; 1 ♂, Al Magardah, Wadi Tourabah, 1.v.2012, light trap, 20°14.369'N, 41°15.234'E, 1757 m, H. Al Dhafer, M. Abdel-Dayem, A. Al-Ansi & A. Al-Othman leg.; 1 ♂, Al Magardah, Wadi Talalea, 12.x.2013, light trap, 19°02.740'N, 41°46.333'E, 259 m, S. El-Sonbati leg. **BAHAH:** 1 ♂, Shada Al Ala, 24.iv.2014, light trap, 19°52.598'N, 41°18.672'E, H. Al Dhafer & S. El-Sonbati leg. **JAZAN:** 1 ♀, Fifa, Al Abasia, 1.v.2014, suction sampling, 17°15.831'N, 43°05.498'E, S. El-Sonbati leg. **MAKKAH:** 1 ♀, Taif, Sadai-

rah, 24.x.2013, baiting trap, 21°24.962'N 40°33.065'E.; 1 ♂, Mahazat As Sayd, 23.xi.2011, baiting trap, 22°14.678'N 41°50.428'E (all KSMA).

Redescription. The only species in the genus, see the generic redescription.**Distribution** (Figs 51–52). Libya (ABDUL-NOUR 2007), KSA (DLABOLA 1979). In KSA, widely distributed in the central region including several areas, e.g. Al Aflag and Muzahimiyah, Al Khararah, and in the southwestern region, e.g. Shada Al A'la protectorate in Al Bahah province and Raydah protectorate in Asir province (Fig. 54), which is considered the richest area for biodiversity in Saudi Arabia (HEGAZY et al. 1998).**Ecology and biology.** The abundance of *P. arabicus* is significantly higher in April and October. Most specimens were collected at light and no host plants can be given.**Remarks.** *Phlepsopsius africanus* Abdul-Nour, 2007 is proposed here to be a new junior subjective synonym of *P. arabicus* based on the examination of the male holotype of *P. africanus*, which has identical genitalia to numerous specimens collected in KSA.***Hishimonus* Ishihara, 1953***Hishimonus* Ishihara, 1953: 38. Type species: *Thamnotettix sellatus* Uhler, 1896: 294, by original designation.

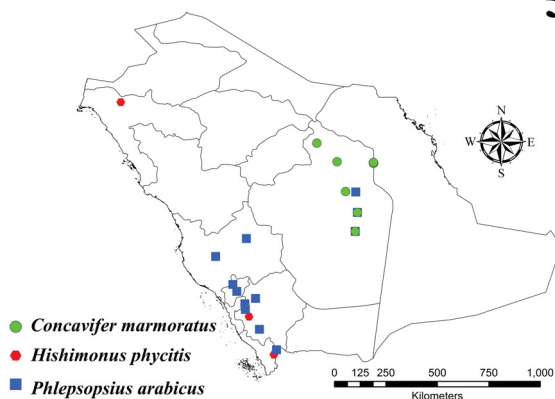
Figs 41–50. *Hishimonus phycitis* (Distant, 1908). 41 – aedeagus, dorsal view; 42 – aedeagus, lateral view; 43 – connective; 44 – style; 45 – subgenital plate; 46 – valve; 47 – pygofer; 48 – female 7th sternite; 49–50 – ovipositor, lateral view.



51



53



52



54

Figs 51–54. 51–52 – distribution of *Concavifer* spp., *Phlepsopsius arabicus* Dlabola, 1979 and *Hishimonus phycitis* (Distant, 1908) (51 – distribution at global scale; 52 – distribution in the Kingdom of Saudi Arabia). 53–54 – habitats of *Concavifer* and *Phlepsopsius* spp. 53 – locality of *Concavifer marmoratus* Dlabola, 1960 and *Phlepsopsius arabicus* in Rhodet Khorim, Ramah governorate, Saudi Arabia; 54 – locality of *Phlepsopsius arabicus* and *Hishimonus phycitis* in Raydah Protectorate, Saudi Arabia.

Diagnosis. *Hishimonus* is similar to *Naevus* Knight, 1970, *Hishimonoides* Ishihara, 1965, and *Litura* Knight, 1970. *Hishimonus* can be recognised easily from *Naevus* and *Litura* by the atrium of the aedeagus not extended ventrad beyond the shafts; and from *Hishimonoides* by the absence of a pair of well-developed ventral paraphyses on the aedeagus.

Description. Detailed generic descriptions can be found in KNIGHT (1970), DAI et al. (2013) and VIRAKTAMATH & MURTHY (2014).

Hishimonus phycitis (Distant, 1908)

(Figs 5–6, 11–12, 41–50)

Eutettix phycitis Distant, 1908: 363; METCALF (1968: 483).

Hishimonus phycitis: NIELSON (1968: 303); ISHIHARA (1969: 244).

Cestius (Hishimonus) phycitis: SINGH (1971: 571); BINDRA (1973: 18).

Eutettix phycitidis [sic!]: GHOSH & GHOSH (1994: 30).

Eutettix lugubris Distant, 1918: 60; METCALF (1968: 476). Synonymy by KNIGHT (1970: 128).

Hishimonus orientalis Emeljanov, 1969: 1102. Synonymy by KNIGHT (1970: 128).

Material examined. KINGDOM OF SAUDI ARABIA: ASIR: 1 ♀, Saloos Almanzar W of Baqrah, 4.xi.2013, light trap, 18°47.511'N, 42°01.090'E, 422 m, H. Al Dhafer, H. Fadl, M. Abdel-Dayem & A. El Torky leg. JAZAN: 2 ♂♂, Fiyfa, Al Absisa Mountains, 20.iii.2014, suction sampling, 17°15.831'N 43°06.498'E, 1770 m, S. El-Sonbati leg.; 1 ♂, same but Al Dayer, 17°20.223'N 43°07.539'E (all KSMA). TABUK: 13 ♀♀ 11 ♂♂, Tabuk City, Maksarin Sahara Hotel grounds, 28°24.566'N 36°35.716'E, 8.iv.2013, ex *Dodonaea viscosa*, M. R. Wilson leg. (NMWC).

Diagnosis. *Hishimonus phycitis* has been adequately redescribed by KNIGHT (1970), DAI et al. (2013) and VIRAKTAMATH & MURTHY (2014). Here we list only the diagnostic characters: Head as wide as pronotum, both greenish yellow, without spots; wings with large brown spot and scattered small patches; subgenital plate gradually tapered at base, with finger-like lobe; stylus with apical lobe straight, preapical lobe not well-differentiated; aedeagus shafts abruptly divergent, with apically enlarged posteromedial lobe.

Economic importance. The genus *Hishimonus* is known as a vector of Witches' broom disease of lime (WBDL) considered one of the most lethal plant pathogens and widely distributed in the Arabian Peninsula (SHABANI et al. 2011, 2013; AL-SALEH & AMER 2014).

Distribution. Iran, United Arab Emirates, Oman, India, Sri Lanka, China, Malaysia, Thailand, Australia (METCALF 1967, KNIGHT 1970, ZREIK et al. 1995, SALEHI et al. 2007, DAI et al. 2013) and KSA (new records). In KSA, the species has been recorded in low abundance from the southwestern and Tabuk regions and is considered uncommon for Saudi Arabia.

Acknowledgements

The authors are grateful to John Deeming (NMWC) for the valuable suggestions, to James Turner (NMWC) for

helping in photographing specimens, to Boris Kondratieff, Colorado State University, for reading the manuscript, and to Igor Malenovsky for his helpful editorial comments. The authors would like to extend their sincere appreciation to the Deanship of Scientific Research at King Saud University for funding their research group (no. RGP-1437-009).

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