

# REVISIONARY NOTES ON THE GENERA *IRANODUS* DLABOLA, 1980 AND *CAVATORIUM* DLABOLA, 1980 (HEMIPTERA: AUCHENORRHYNCHA: ISSIDAE), WITH DESCRIPTION OF A NEW GENUS

VLADIMIR M. GNEZDILOV

*Zoological Institute, Russian Academy of Sciences, Saint Petersburg, Russia*  
*e-mails: vmgnezdilov@mail.ru, vgnezdilov@zin.ru*

**Citation:** Gnezdilov, V. M. 2021. Revisionary notes on the genera *Iranodus* Dlabola, 1980 and *Cavatorium* Dlabola, 1980 (Hemiptera: Auchenorrhyncha: Issidae), with description of a new genus. *Annales Zoologici*, 71: 251–266. doi: 10.3161/00034541ANZ2021.71.2.005

**Received:** 1 February 2021 **Accepted:** 10 April 2021 **Printed:** 30 June 2021



**Abstract.**— Two issid genera, *Iranodus* Dlabola, 1980 and *Cavatorium* Dlabola, 1980, are redefined based on external morphological characters including male genitalia structure. A new genus, *Irabola* **gen. nov.**, is erected to accommodate *Hysteropterum repandum* Dlabola, 1981 (type species), *Iranodus amygdalinus* Dlabola, 1980, and *Cavatorium sarbaz* Dlabola, 1980. As a result, following combinations are introduced: *Irabola repanda* (Dlabola, 1981), **comb. nov.**, *I. amygdalina* (Dlabola, 1980), **comb. nov.**, and *I. sarbaz* (Dlabola, 1980), **comb. nov.** *Hysteropterum dumetorum* Dlabola, 1981 is transferred to the genus *Cavatorium*, with a new combination proposed – *Cavatorium dumetorum* (Dlabola, 1981), **comb. nov.** Illustrations of habitus and male genitalia are given for *Cavatorium ardakanum* Dlabola, 1980, *Irabola repanda* (Dlabola, 1981), *I. amygdalina* (Dlabola, 1980), *Iranodus khatunus* (Dlabola, 1981), and *I. transversalis* Dlabola, 1980.



**Key words.**— Hysteropterinae, Iran, morphology, new combination, new genus, taxonomy

## INTRODUCTION

The planthopper family Issidae Spinola is world-wide distributed group, divided into two subfamilies with 15 tribes and subtribes of the subfamily Issinae (Gnezdilov 2020; Gnezdilov *et al.* 2020). Western Palaearctic fauna of Issidae is very rich and comprises around 60 genera with more than 400 species, described so far in the subfamily Hysteropterinae without tribal assessment, but with several groups of

genera recognized (Gnezdilov 2016a, b; Gnezdilov *et al.* 2014, 2020). The genera *Iranodus* and *Cavatorium* were described in the family by Dlabola (1980) to accommodate ten Iranian endemics. Since the original description, not a single study focused on these taxa except the checklists (Mozaffarian and Wilson 2011, Gnezdilov *et al.* 2014). The examination of the newly obtained specimens collected during a field trip to southern Iran in June 2019 and the other materials from the National Museum in Prague (Czech Republic)

and the National Museum of Wales (UK) allowed detailed morphological studies of the species included in these genera. This resulted in changes in diagnostic features and composition of *Iranodus* and *Cavatorium* and erecting of a new genus well distinguished by the structure of hind wing and male genitalia.

## MATERIALS AND METHODS

Morphological terminology follows Gnezdilov *et al.* (2014). Photographs were taken using Canon EOS 5D Mark IV camera with the lens Canon-MP-E-65 mm f/2,8 1-5× Macro and the flash Canon Macro Twin-Lite MT-26EX-RT. Images were produced using Helicon Focus v. 7.6.4 and Adobe Photoshop CC 2019 software. The genital segments of male specimens examined were macerated in 10% KOH and figured in glycerine jelly (Brunel Micro Ltd, UK) using Leica MZ9.5 stereomicroscope with a camera lucida. Metope, hind wing, and female terminalia were figured from dry specimens using the same microscope.

The specimens listed below are from the collections of the:

- ZIN – Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia;
- NMPC – National Museum in Prague, Czech Republic;
- NMW – National Museum of Wales, Cardiff, United Kingdom.

Dlabola's label information is quoted, with '/' indicating a new line and '/' indicating the next label.

## TAXONOMY

Family Issidae Spinola, 1839

Subfamily Hysteropterinae Melichar, 1906

*Iranodus* Dlabola, 1980

*Iranodus* Dlabola, 1980: 203.

**Type species.** *Iranodus transversalis* Dlabola, 1980.

**Diagnosis.** Metope wide, with distinct median and sublateral carinae and concave upper margin (Figs 7–10). Coryphe transverse, 3 times as wide as long medially. Forewings with wide precostal area, pressed to thorax in its basal halves, without hypocostal plate. Forewing vein sequence: R 2 M 3 CuA 1. Hind wings rudimentary. Hind tibia with two lateral spines subapically. First metatarsomere with two latero-apical and six intermediate spines. Arolium with convex hind margin, not reaching claw apices (in dorsal view). Abdominal sternites IV–VI each with two sensory pits medially in imago. Pygofer elongate vertically, with

straight or weakly convex hind margins. Male anal tube elongate, nearly romb-shaped – narrowing basally and apically. Phallobase massive, wide, slightly curved or not curved (in lateral view), without keel dorsally, but with its dorso-apical part flattened laterally (Fig. 21). Phallobase with pair of large latero-apical lobes dentate marginally (Fig. 24, *lal*). Ventral phallobase lobe short and wide, enlarged apically. Apical aedeagal processes long and narrow, not visible above upper phallobase margins. Aedeagus with a pair of long ventral hooks, with acute apices, arose medially and directed downwards. Style with short neck or without neck and with a distinct hump on its dorsal margin behind capitulum. Capitulum of style with wide lateral tooth and distinct apical tooth, narrowing apically – hastate (in dorsal view).

Female anal tube long and narrow, sharply narrowing in its apical half (Fig. 33). Anal column (paraproct) short. Female sternite VII with concave or notched hind margin (Figs 26, 34). Gonoplaes without carinae. Gonocoxa VIII with distinctly lobe-shaped hind margin, however, not protruding near the base of anterior connective lamina of gonapophyse VIII (ACL).

**Composition.** The genus comprises two species – *Iranodus transversalis* Dlabola, 1980 and *I. khatunus* (Dlabola, 1981). *Iranodus nishabur* Dlabola, 1982 does not belong to this genus as this species according to Dlabola's illustrations and description (1982, figs 56, 58, 61) has aedeagal hooks arose in apical part of aedeagus and the style without hump on its dorsal margin. It is treated here as species incertae sedis until the type specimens of this species will be reexamined.

### Key to species of *Iranodus*

1. Male upper margin of metope weakly trapezoidally concave (Fig. 7). Latero-apical lobes of phallobase enlarged apically (Fig. 24). Female sternite VII with widely concave hind margin (Fig. 26) . . . . .  
 . . . . . *I. transversalis* Dlabola, 1980
- . Male upper margin of metope deeply obtusely angulately concave (Fig. 9). Latero-apical lobes of phallobase narrowing apically (Fig. 31). Female sternite VII with deeply notched hind margin (Fig. 34) . . . . .  
 . . . . . *I. khatunus* (Dlabola, 1981)

*Iranodus transversalis* Dlabola, 1980  
(Figs 1–4, 7, 8, 19–26)

*Iranodus transversalis* Dlabola, 1980: 204.

**Diagnosis.** Latero-apical lobes of phallobase enlarged apically (Fig. 24). Female sternite VII with

widely concave hind margin (Fig. 26). Total length males – 3.0–3.5 mm, females – 4.0–4.2 mm. Dlabola (1980) mentioned 3.7–4.25 mm for males and 4.3–5.0 mm for females.

**Supplementary description.** Structure as mentioned for the genus.

**Coloration. Male** (Fig. 1). General coloration light yellow whitish. Metope light yellow, with dark brown upper angles, with two wide dark brown bands of spots below its upper margin and above metopoclypeal suture between sublateral carinae, and with dark brown traces of larval sensory pits. Postclypeus apically and whole anteclypeus black. Rostrum with black apical segment. Pedicel black greenish. Preocular fields and genae with brown to black stripes.

Forewings with brown cells and 1–3 whitish bands of spots, precostal area yellow whitish. Fore and middle femora with dark brown bands. Fore and middle tibiae sometimes with dark brown stripes. Apices of leg spines and claws black. Melanistic specimens with dark brown to black forewing cells, coryphe, pro- and mesonotum with black lateral stripes, paradiscal fields of pronotum black and hind femora with dark brown bands.

**Coloration. Female** (Figs 2–4). Metope light yellow whitish, with two wide black bands of spots. Anteclypeus and almost whole postclypeus black. Rostrum and pedicel black. Preocular fields and genae with black stripes. Coryphe, pro-, and mesonotum with wide black lateral stripes besides of median line. Paradiscal



Figures 1–6. *Iranodus* spp.; external view. (1–4) *I. transversalis* Dlabola, 1980 (north of Jiroft); (5, 6) *I. khatunus* (Dlabola, 1981) (Banue-Charehar). (1, 5) Male, lateral view; (2, 3, 6) female, lateral view; (4) female, dorsal view. Scale bar – 1 mm.

fields of pronotum and upper angles of mesonotum black. Paranotal lobes of pronotum black, except light margins. Forewings strongly darkened, with black veins and some cells, except light precostal area and three light bands of spots. Fore and middle femora and tibiae with black longitudinal stripes or completely black. Hind femora and tibiae with brown to dark brown longitudinal stripes. Apices of leg spines black. Abdominal tergites dark brown to black except yellow margins. Gonopods black except light lateral parts. Anal tube light yellow, with brown greenish to dark brown or black median stripe and apex.

**Male terminalia** (Figs 19–25). Pygofer narrow, with almost straight or weakly convex hind margins and nearly right or weakly obtuse upper angles (in lateral view) (Fig. 19). Anal tube nearly romb-shaped, with rounded apex and lowered lateral margins (Figs 19, 20). Anal column (paraproct) 0.25 as long as anal tube. Phallobase wide, not curved, with enlarged apically latero-apical lobes, bearing teeth on inner margins (Fig. 24). Dorso-apical part of phallobase flattened laterally (Fig. 21). Ventral margins of dorso-lateral phallobase lobes with angular projections above the aedeagal hooks (Fig. 25, *anp*). Ventral phallobase lobe short and wide, enlarged apically, with weak median concavity. Aedeagus with a pair of long ventral hooks with acute apices, arose above its middle and directed downwards. Apical aedeagal processes long and narrow, narrowing apically, not visible above upper phallobase margins (Fig. 25, *aep*). Style without neck,

hind margin with a gentle hump behind capitulum, caudo-dorsal angle obtuse (Fig. 22). Capitulum of style with wide lateral tooth and distinct apical tooth, narrowing apically – hastate in dorsal view (Fig. 23).

**Material examined.** Iran, Kerman Province: 1♀, 1 larva, ca. 20 km NNE Baft, vic. of Korin, 2900–3200 m, N 29°24' E 56°42', 7.VI.2010, A. V. Timokhov leg. (ZIN); 2♂♂, 1♀, 1 larva, ca. 13 km N Darb-Behesht, vic. of Goruh, 2900 m, N 29°21' E 57°19', 24.V.2011, A. V. Timokhov leg. (ZIN); 23♂♂, 14♀♀, 50–65 km N Jiroft, 2628–2894 m, N29°05.660' E57°32.737' – N29°10.112' E57°26.885', 20.VI.2019, V. M. Gnezdilov leg. (ZIN).

**Ecological notes.** The specimens listed above from Jiroft were collected mostly from *Artemisia* sp., perhaps, also from *Astragalus* sp. in woodlands of *Juniperus* sp. and in open areas.

### *Iranodus khatunus* (Dlabola, 1981)

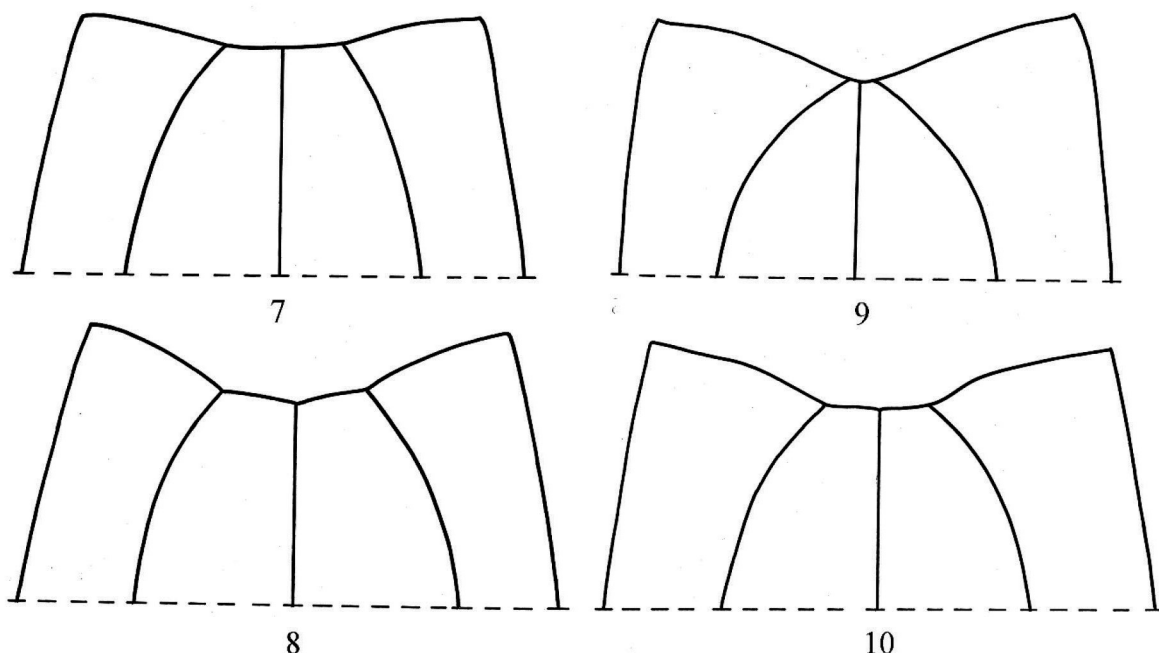
(Figs 5, 6, 9, 10, 27–34)

*Hysteropterum khatunum* Dlabola, 1981: 187.

*Iranodus khatunus*: Mozaffarian and Wilson 2011: 30.

**Diagnosis.** Latero-apical lobes of phallobase narrowing apically (Fig. 31). Female sternite VII with deeply notched hind margin (Fig. 34). Total length males – 3.0 mm, females – 3.5 mm. Dlabola (1981) mentioned 3.4 mm for the male holotype.

**Supplementary description.** Structure as mentioned for the genus.



Figures 7–10. *Iranodus* spp.; metope. (7, 8) *I. transversalis* Dlabola, 1980; (9, 10) *I. khatunus* (Dlabola, 1981). (7, 9) male; (8, 10) female.

**Coloration. Male** (Fig. 5). Metope light yellow, with two wide brown bands below its upper margin and above metopoclypeal suture and with brown traces of larval sensory pits. Postclypeus light yellow, with brown stripes. Anteclypeus dark brown to black. Preocular fields brown yellowish. Pedicel brown. Rostrum dark brown, with black apical segment. Coryphe light yellow, with two wide brown lateral stripes. Pronotum and mesonotum light yellow, with brown dots. Paranotal lobes of pronotum light yellow, with brown spots and dots. Upper angles of mesonotum brown. Forewings brown, with yellow whitish precostal area and three bands. Legs light yellow. Claws dark brown to black. Dorso-lateral plates of arolium dark brown. Apices of leg spines black. Abdominal sternites and genital block light yellow. Abdominal tergites dark brown, with yellow margins.

**Coloration. Female** (Fig. 6). Metope light yellow, with two wide dark brown to black bands below its upper margin and above metopoclypeal suture and dark brown to black traces of larval sensory pits. Preocular fields and genae with dark brown to black stripes. Coryphe light yellow, with two wide dark brown to black lateral stripes. Pronotum light yellow, with two dark brown stripes besides of median line and with brown traces of larval sensory pits. Mesonotum light yellow, with two dark brown stripes besides of median line and black apical angles. Forewings dark brown, except yellow whitish precostal area and three bands. Fore and middle femora light yellow, with two dark brown bands. Fore and middle tibiae light yellow, with dark brown stripes. Hind legs light yellow whitish. Apices of leg spines black. Claws dark brown to black. Dorso-lateral plates of arolium dark brown. Abdominal tergites dark brown to black, with yellow margins. Abdominal sternites light yellow whitish. Anal tube light yellow. Gonoplaes light yellow, with dark brown areas in its lower halves. Hind margin of gonocoxa VIII light yellow.

**Male terminalia** (Figs 27–32). Pygofer narrow, with weakly convex hind margins and obtuse upper angles (in lateral view) (Fig. 27). Anal tube rhomb-shaped, with rounded apex and lowered lateral margins (Figs. 27, 28). Anal column (paraproct) 0.3 as long as anal tube. Phallobase wide, weakly curved, with narrowing apically latero-apical lobes, bearing teeth on its inner margins (Fig. 31). Dorso-apical part of phallobase flattened laterally. Ventral margins of dorso-lateral phallobase lobes with rounded projections above the aedeagal hooks. Ventral phallobase lobe short and wide, enlarged apically, with weak median concavity (Fig. 32). Aedeagus with a pair of long and wide ventral hooks with acute apices, arose near its middle and directed downwards. Apical aedeagal processes long and narrow, narrowing apically. Connective with large wide cup (Fig. 31). Style with short neck, hind margin

with a strong hump behind capitulum, caudo-dorsal angle nearly acute (Fig. 29). Capitulum of style with wide la-teral tooth and distinct apical tooth, narrowing apically – hastate (in dorsal view) (Fig. 30).

**Material examined.** Iran: 2♂♂, 2♀♀, “E Iran, 1800–2000 m / Banue-Charehar / 8.5 1973” // “Loc. No. 191 / Exp. Nat. Mus. / Praha” (NMPC).

**Note.** The species was previously known only from the holotype collected at Deh-bid Pass of Kuh-e Khatun Mts. (Dlabola 1981).

### *Cavatorium* Dlabola, 1980

*Cavatorium* Dlabola, 1980: 208.

**Type species.** *Cavatorium bispinatum* Dlabola, 1980.

**Diagnosis.** Metope slightly longer than wide medially, with distinct median and weak sublateral carinae joint at its upper margin. Metopoclypeal suture distinct, wedge-shaped. Coryphe transverse. Pedicel barrel-shaped. Rostrum reaching hind coxae, with 2<sup>nd</sup> and 3<sup>rd</sup> segments equal in length and 3<sup>rd</sup> one distinctly narrowing apically. Pronotum with strongly convex anterior margin. Paradiscal fields of pronotum rather wide. Forewings with wide precostal area, pressed to thorax in its basal halves, without hypocostal plate. Forewing vein sequence: R 2 M 3 CuA 1. Hind wings rudimentary. Hind tibia with a single lateral spine subapically and 5–7 apical spines. First metatarsomere with two latero-apical and 5–8 intermediate spines. Abdominal sternites IV–VI each with two sensory pits medially in imago. Phallobase massive, dorso-lateral lobes with spiny processes. Apical aedeagal processes enlarged apically, well visible above phallobase margins. Aedeagus with a pair of ventral hooks with acute apices, arose near or below its middle and directed downwards. Style often without neck, with a hump dorsally behind the capitulum.

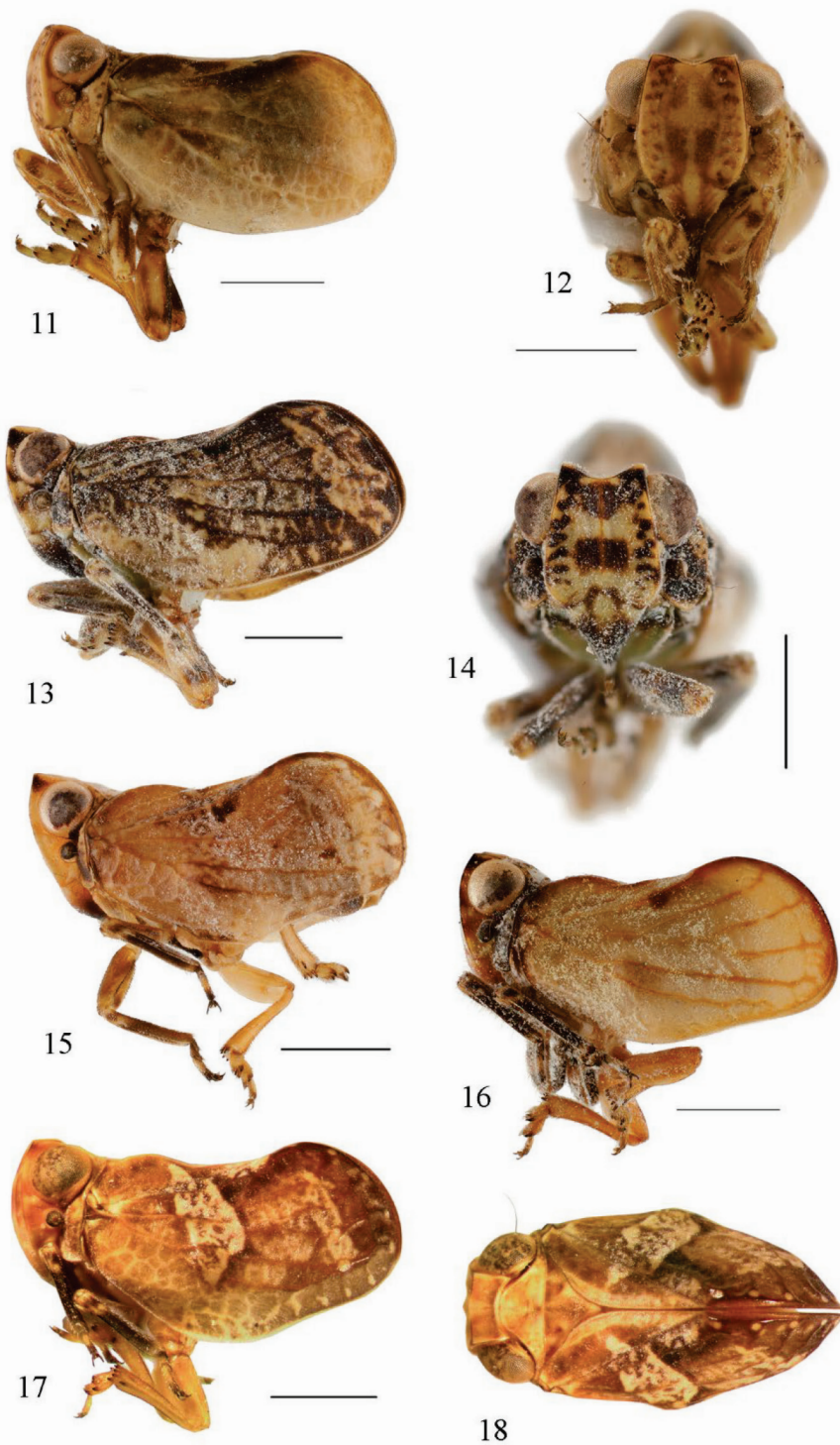
**Composition.** *Cavatorium bispinatum* Dlabola, 1980, *C. quadrispinatum* Dlabola, 1980 (Gnezdilov *et al.* 2014, fig. 23d–f), *C. ardakanum* Dlabola, 1980, *C. dumetorum* (Dlabola, 1981) **comb. nov.**

**Note.** The compilation of the identification key is impossible without the reexamination of the type specimens as the published drawings of male genitalia for most of the above listed species are not detailed.

### *Cavatorium ardakanum* Dlabola, 1980 (Figs 11, 12, 35–41)

*Cavatorium ardakanum* Dlabola, 1980: 210.

**Diagnosis.** Phallobase with deep lateral incisions, dorsal phallobase lobe with a big horn-shaped process



Figures 11–18. Issidae; external view. (11, 12) *Cavatorium ardakanum* Dlabola, 1980, male (near Kavár); (13, 14) *Irabola repanda* (Dlabola, 1981), female (near Kavár); (15) *Irabola repanda* (Dlabola, 1981), male (near Kavár); (16–18) *I. amygdalina* (Dlabola, 1980), male (17, 18) paratype, after Gnezdilov *et al.* 2014; (16) (east of Kazerun). (11, 13, 15–17) lateral view; (12, 14) frontal view; (18) dorsal view. Scale bar – 1 mm.

(Fig. 35, *lin*, *hsh*). Total length males – 4.0 mm, females – 4.2–4.7 mm. Dlabola (1980) mentioned 3.8–3.9 mm for males and 4.3–4.7 mm for females.

**Supplementary description.** Median carina of metope running throughout postclypeus. Upper margin of metope obtusely angulately concave. Coryphe transverse, three times as wide as long medially; anterior margin weakly convex; posterior margin strongly concave. Pronotum with median carina or without it. Paranotal lobes of pronotum nearly rectangular, with bent lower margins. Mesonotum without carinae. Forewings wide, with caudo-dorsal angle obtuse. Forewing vein sequence: R 2, furcating in basal fourth of the wing before knee bulge; M 3, firstly furcating just after wing middle and M<sub>1</sub> furcating in apical third of the wing; CuA 1. Hind tibia with 6–7 apical spines. First metatarsomere with a row of 6–7 intermediate spines. Arolium of pretarsus shorter than claws (in dorsal view), with pair of long and narrow well sclerotized dorso-lateral plates. Each claw with three long setae.

**Coloration. Male** (Figs 11, 12). General coloration light brown yellow greenish. Metope with two wide brown bands between sublateral carinae and brown traces of larval sensory pits. Upper angles of metope dark brown to black. Pedicel brown to dark brown. Postclypeus with brown stripes. Anteclypeus dark brown to black. Rostrum black. Coryphe with two wide brown lateral stripes besides of median line. Pronotum with brown traces of larval sensory pits. Mesonotum with two brown stripes and dark brown upper angles. Forewings with large dark brown to black areas on corium and clavus or with dark longitudinal veins. Rudiments of hind wings light yellow. Legs with brown stripes and spots. In well pigmented specimens hind femora dark brown to black from behind. Abdominal sternites and genital block light yellow, with dark brown spots at setal basements. Abdominal tergites dark brown to black. Claws and dorso-lateral plates of arolium brown. Apices of leg spines black.

**Coloration. Female.** Generally darker than males. Postclypeus apically and whole anteclypeus black. Preocular fields dark brown to black. Mesonotum with black upper angles. Anal tube light brown yellow greenish. Abdominal tergites black, with brown yellowish median line. Gonoplares dark brown to black, with yellow lateral parts.

**Male terminalia** (Figs 35–39). Pygofer elongate vertically, narrow in lateral view, with slightly convex hind margins and obtuse upper angles (Fig. 35). Anal tube twice as long as wide medially, slightly narrowing apically, with an apical notch (in dorsal view) (Fig. 37) and lowered lateral margins. Anal column short, 0.25 as long as anal tube. Phallobase curved in lateral view, with deep lateral incisions (Fig. 35, *lin*). Latero-apical phallobase lobes with spiny processes. Dorsal phallobase lobe with a big hook-shaped process and a small

finger-shaped process (Fig. 35, *hsh*). Ventral phallobase lobe massive, long, narrowing apically (Fig. 36). Aedeagus with a pair of short ventral hooks, with acute apices and directed downwards. Apical aedeagal processes long, enlarged subapically and hook-shaped, far exceeding upper phallobase margins (Fig. 35, *aep*). Connective with large and wide cup (Fig. 35, *cc*). Style massive, without neck, with convex hind margin and a hump behind capitulum, with rounded, not identified caudo-dorsal angle (Fig. 38). Capitulum of style wide, not narrowing apically (in dorsal view) (Fig. 39).

**Female terminalia** (Figs 40, 41). Sternite VII with widely and deeply concave hind margin (Fig. 41). Anal tube more than twice as long as wide basally, gradually narrowing apically (Fig. 40). Anal column (paraproct) short. Gonoplares without carinae.

**Material examined.** Iran, Fars Province: 1♂, 4♀♀, 20 km SE Ardakan, vic. of Abnow, ca. 2450 m, N30°11' E52°08', 29.V.2011, A. V. Timokhov leg. (ZIN); 4♂♂, 2♀♀, 35–40 km W Shiraz, N29°41.286' E52°03.217', 2007–2073 m, 13.VI.2019, V. M. Gnezdilov leg. (ZIN); 5♂♂, 1♀, near Kavavar, N29°11.890' E52°37.591', 1698 m, 17.VI.2019, V. M. Gnezdilov leg. (ZIN).

***Cavatorium dumetorum*** (Dlabola, 1981), comb. nov.

*Hysteropterum dumetorum* Dlabola, 1981: 185.

*Iranodus dumetorus*: Mozaffarian and Wilson 2011: 30.

**Note.** The species is transferred to the genus based on the structure of phallobase and aedeagus (Dlabola 1981, figs 88, 89).

***Irabola* gen. nov.**

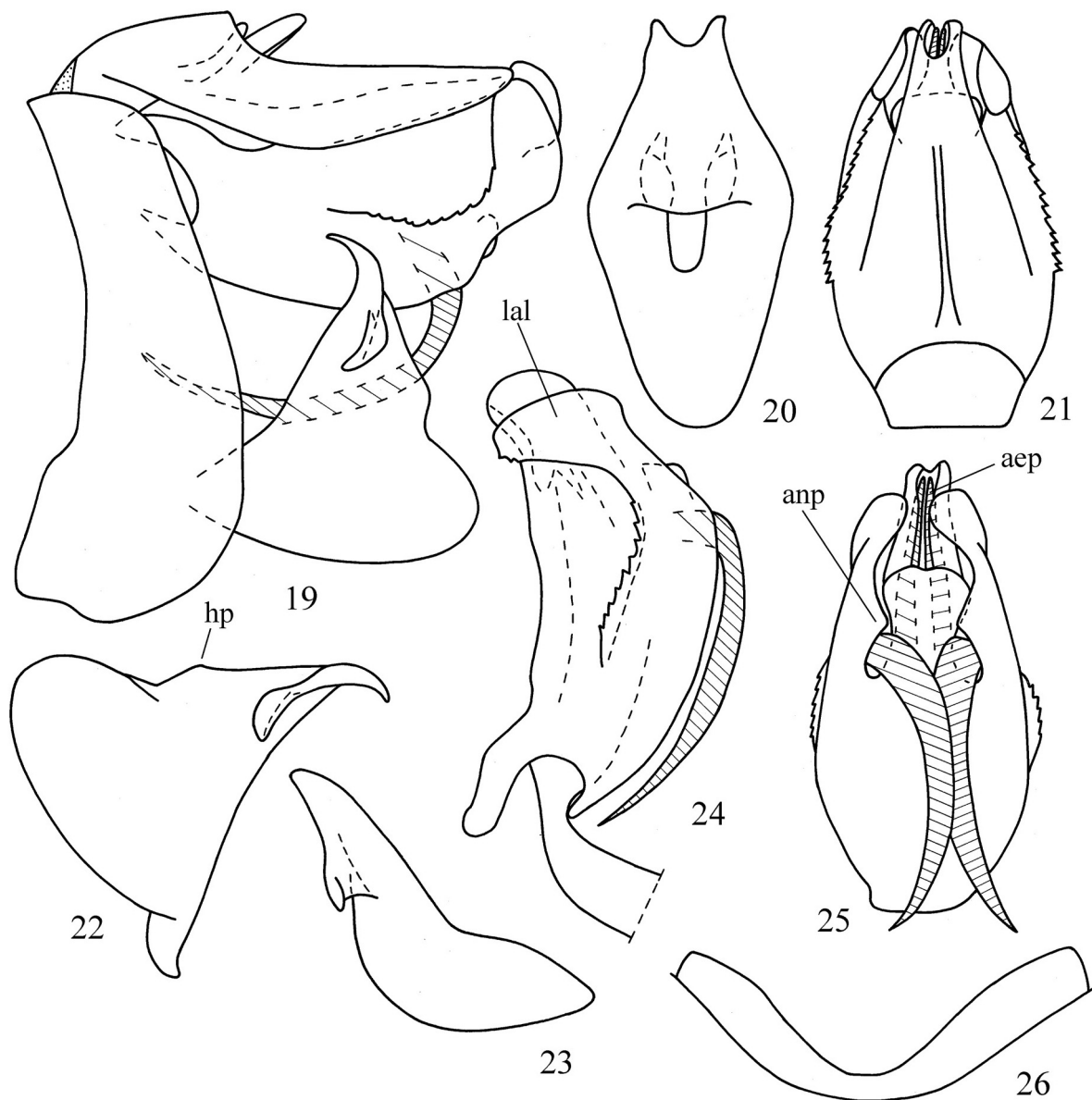
**Type species.** *Hysteropterum repandum* Dlabola, 1981, here designated.

**Etymology.** Generic name is derived from the combination of words – Iran and the name J. Dlabola (1922–2016) who contributed to the discovery of the Iranian issid fauna with numerous publications. The gender is feminine.

**Diagnosis.** Metope elongate or rather wide, with distinct median and sublateral carinae, joint at its upper obtusely angulately concave margin. Intermediate carinae of metope not reaching metopoclypeal suture which is strongly convex. Second and third segments of rostrum are equal in length, 3<sup>rd</sup> one narrowing apically. Coryphe transverse, 1.5–2.5 times as wide as long medially; anterior margin straight, posterior margin concave. Pronotum without carinae. Mesonotum sometimes with lateral carinae. Forewings without hypocostal plate, with wide precostal area, pressed to thorax in its basal halves, each with strong knee bulge. Forewing vein sequence: R 2, furcating at wing basal

third; M 3, firstly furcating just after radius and M<sub>1</sub> furcating after wing middle; CuA 1. Hind wings oval, reaching genital segments, with simple longitudinal veins (Fig. 49). Hind tibia with a single lateral subapical spine and 7–8 apical spines. First metatarsomere with a row of 5–6 intermediate spines. Each claw with three long setae. Hind margin of arolium not reaching claw apices, weakly convex (in dorsal view). Abdominal sternites IV–VI each with pair of sensory

pits medially in imago (Fig. 50). Phallobase dorsally keel-shaped, with large latero-apical lobes dentate marginally (Fig. 42, *dk*). Ventral phallobase lobe long, narrowing apically (Fig. 43, *vl*). Aedeagus with a pair of long ventral hooks with acute apices, arose medially and directed downwards. Style with long neck and distinctly convex hind margin; apical tooth distinct, lateral tooth wide. Female sternite VII with widely and strongly concave medially hind margin (Fig. 48).

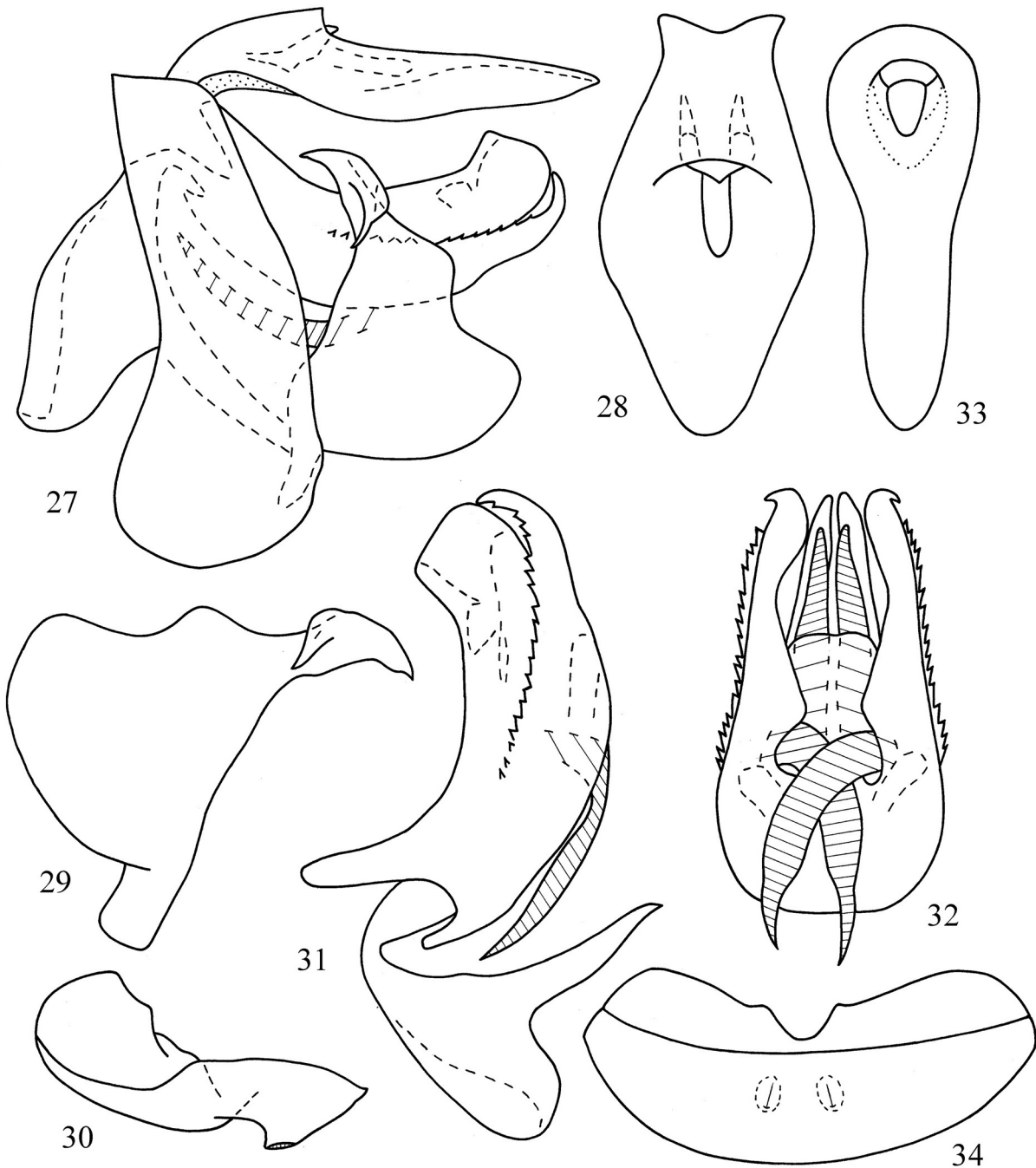


Figures 19–26. *Iranodus transversalis* Dlabola, 1980; male and female genitalia. (19) Male genital block, lateral view; (20) male anal tube, dorsal view; (21) penis, dorsal view; (22) style, lateral view; (23) style, dorsal view; (24) penis and basal part of connective, lateral view; (25) penis, ventral view; (26) female sternite VII, ventral view. Abbreviations: aep – apical aedeagal processes; anp – angular projections above aedeagal hooks; hp – hump behind capitulum of style; lal – latero-apical phallobase lobes.



Female anal tube long and narrow, sharply narrowing in its apical half (in dorsal view) similarly to *Iranodus* (Fig. 33). Hind margin of gonocoxa VIII with a large elongate lobe near to ACL (Fig. 48, shaded).

**Composition.** *Irabola repanda* (Dlabola, 1981), comb. nov., *I. amygdalina* (Dlabola 1980), comb. nov., *I. sarbaz* (Dlabola, 1980), comb. nov.



Figures 27–34. *Iranodus khatunus* (Dlabola, 1981); male and female genitalia. (27) Male genital block, lateral view; (28) male anal tube, dorsal view; (29) style, lateral view; (30) style, dorsal view; (31) penis and connective, lateral view; (32) penis, ventral view; (33) female anal tube, dorsal view; (34) female VI–VII sternites, ventral view.

## Key to species of *Irabola*

1. Male anal tube enlarged apically (in dorsal view) (Dlabola 1980, fig. 161) . . . . *I. sarbaz* (Dlabola, 1981)
- . Male anal tube narrowing apically (Figs 47, 55) . . . . 2
2. Coryphe strongly transverse, 2.5–3.0 times as wide as long medially. Male anal tube with lateral margins deeply excavated (Fig. 51). Phallobase slightly curved . . . . . *I. amygdalina* (Dlabola 1980)
- . Coryphe slightly transverse, 1.5–2.0 times as wide as long medially. Male anal tube with lateral margins not excavated (Fig. 42). Phallobase strongly curved, horse-shoe-shaped . . . . . *I. repanda* (Dlabola, 1981)

*Irabola repanda* (Dlabola, 1981), comb. nov.  
(Figs 13–15, 42–48)

*Hysteropterum repandum* Dlabola, 1981: 183.

*Iranodus repandus*: Mozaffarian and Wilson 2011: 30.

**Diagnosis.** Coryphe slightly transverse, 1.5–2.0 times as wide as long medially. Male anal tube with lateral margins not excavated (Fig. 42). Phallobase strongly curved, horse-shoe-shaped. Total length males – 3.0–3.5 mm, females – 4.0 mm. Dlabola (1981) mentioned 3.4–3.75 mm for males and 4.0–4.5 mm for females.

**Supplementary description.** Structure as mentioned for the genus.

**Coloration. Male** (Fig. 15). Metope and postclypeus basally light yellow. Upper angles of metope and postclypeus apically brown. Anteclypeus black. Upper angles of preocular fields black. Pedicel and rostrum black. Coryphe, pro-, and mesonotum light yellow. Paranotal lobes of pronotum brown to dark brown medially. Upper angles of mesonotum black. Forewings light yellow, with brown lateral margins and dark brown to black stripes and spots along CuA and on clavus and with sparse dark brown spots on corium. Fore and middle femora light yellow, with two wide light or dark brown bands. Fore and middle tibiae brown to dark brown, with light yellow basal and apical parts. Hind legs light yellow. Apices of leg spines black. Abdominal sternites and genital block light yellow, with brown to dark brown spots at setal basements. Claws and dorso-lateral plates of arolium dark brown to black.

**Coloration. Female** (Figs 13, 14). Metope light yellow greenish, with two wide dark brown to black bands and dark brown traces of larval sensory pits. Postclypeus black, except light yellow greenish basally. Anteclypeus and rostrum black. Preocular fields and pedicel black. Coryphe, pro-, and mesonotum light yellow greenish, with two wide black lateral stripes besides of median line. Paranotal lobes of pronotum black, except yellow greenish margins. Pro- and mesonotum light yellow greenish, with dark brown to

black spots. Upper angles of mesonotum black. Forewings dark brown to black, with light yellow pre-costal area and band apically. Fore and middle femora light yellow greenish, with two wide dark brown to black bands. Fore and middle tibiae dark brown to black, except light yellow greenish basal and apical parts. Hind femora light yellow greenish, each with dark brown spot apically. Claws and dorso-lateral plates of arolium dark brown to black. Apices of leg spines black. Abdominal sternites light yellow greenish, with dark brown to black spots at setal basements. Anal tube light yellow greenish, with black apex. Gonopods black, each with light yellow greenish spot laterally. Gonocoxa VIII with light yellow greenish hind margin. Abdominal tergites dark brown to black, with light brown median line.

**Male terminalia** (Figs 42–47). Pygofer elongate vertically, narrow in lateral view, with weakly convex hind margins in its basal halves and right upper angles (Fig. 42). Anal tube nearly romb-shaped, with rounded apex and lowered lateral margins (Figs 42, 47). Anal column (paraproct) long, half as long as anal tube. Phallobase strongly curved, horse-shoe-shaped (in lateral view), with large latero-apical lobes dentate marginally. Ventral phallobase lobe long and narrowing apically (Fig. 43). Aedeagus with a pair of long ventral hooks, with acute apices, arose medially and directed downwards. Apical aedeagal processes long and narrow, slightly narrowing apically, curved, visible above upper phallobase margins (Figs 42, *aep*, 45, 46). Connective with large elongate cup. Style with long neck, apical tooth distinct, lateral tooth wide (Fig. 42). Capitulum of style wide, not narrowing apically (in dorsal view) (Fig. 44).

**Material examined.** Iran: 2♂♂, “S. Iran, 15 km / NW Mian Jangal / 5.6.1973” // “Loc. No. 224 / Exp. Nat. Mus. / Praha” (NMPC); 3♂♂, 1♀, Fars Province, near Kavavar, N29°11.890' E52°37.591', 1698 m, 17.VI.2019, V. M. Gnezdilov leg. (ZIN).

*Irabola amygdalina* (Dlabola, 1980), comb. nov.  
(Figs 16–18, 49–55)

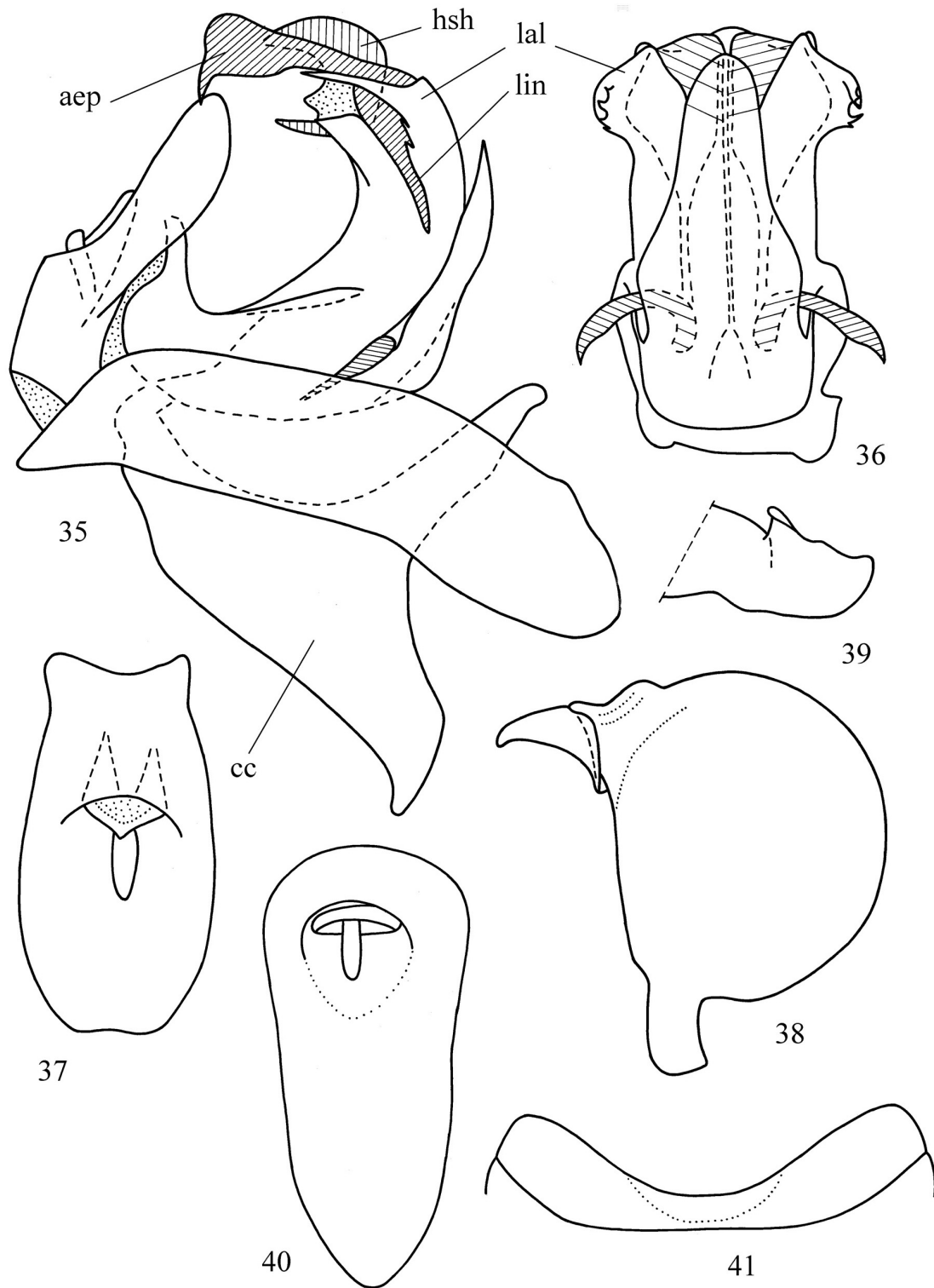
*Iranodus amygdalinus* Dlabola, 1980: 205.

*Iranodus amygdalinus*: Gnezdilov *et al.* 2014: 58, fig. 31a–c.

**Diagnosis.** Coryphe transverse, 2.5–3.0 times as wide as long medially. Male anal tube with lateral margins deeply excavated (Fig. 51). Phallobase slightly curved. Total length males – 3.5–4.0 mm, females – 4.0–4.2 mm. Dlabola (1980) mentioned 3.9–4.4 mm for males and 4.2–4.7 mm for females.

**Supplementary description.** Structure as mentioned for the genus.

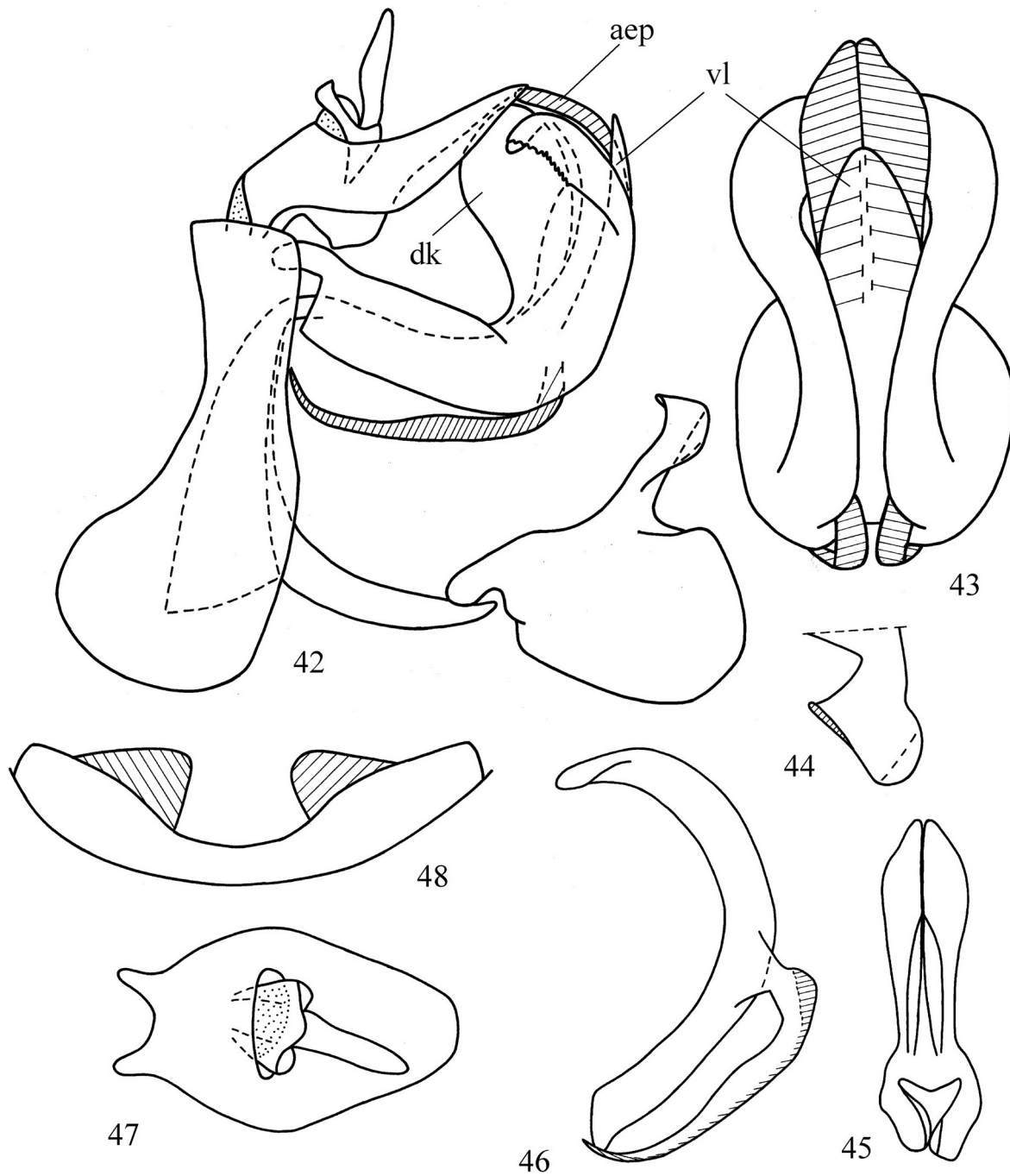
**Coloration. Male** (Figs 16–18). Metope yellow, without distinct dark bands or with two wide dark



Figures 35–41. *Cavatorium ardakanum* Dlabola, 1980; male and female genitalia. (35) Male genital block, lateral view; (36) penis, ventral view; (37) male anal tube, dorsal view; (38) style, lateral view; (39) capitulum of style, dorsal view; (40) female anal tube, dorsal view; (41) female sternite VII, ventral view. Abbreviations: aep – apical aedeagal processes; cc – connective cup; hsh – hook-shaped process of dorsal phallobase lobe; lal – latero-apical phallobase lobes; lin – lateral incision of phallobase.

brown bands between sublateral carinae and with black upper angles. Traces of larval sensory pits dark brown. Postclypeus brown yellowish. Anteclypeus and pedicel black. Rostrum black. Coryphe, pronotum and mesonotum brown yellowish. Paranotal lobes of pronotum dark brown to black, except light margins.

Tegulae brown yellowish to dark brown. Forewings brown yellowish or yellow whitish to dark brown or black, with two whitish bands composed of spots. Hind wings light yellow. Coxae and trochanters light yellow. Fore and middle legs darker than hind ones. Fore and middle femora dark brown yellowish, with pair of black



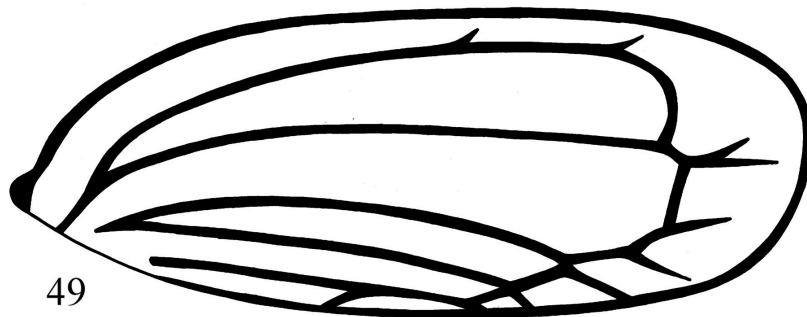
Figures 42–48. *Irabola repanda* (Dlabola, 1981); male and female genitalia. (42) Male genital block, lateral view; (43) penis, ventral view; (44) capitulum of style, dorsal view; (45) aedeagus, ventral view; (46) aedeagus, lateral view; (47) male anal tube, dorsal view; (48) female sternite VII and hind margins of gonocoxae VIII (shaded), ventral view. Abbreviations: aep – apical aedeagal processes; dk – dorsal keel of phallobase; vl – ventral phallobase lobe.

bands. Fore and middle tibiae dark brown yellowish to black. Hind femora and tibiae light yellow. Middle and hind tarsomeres light yellow greenish dorsally; sometimes fore and middle tarsomeres completely black. Apices of leg spines black. Claws dark brown. Arolium of pretarsus with dark brown to black dorso-lateral plates. Abdominal sternites light yellow, with dark brown spots at setal basements. Abdominal tergites brown reddish to dark brown, with yellow margins. Anal tube yellow. Styles with dark brown hind margins.

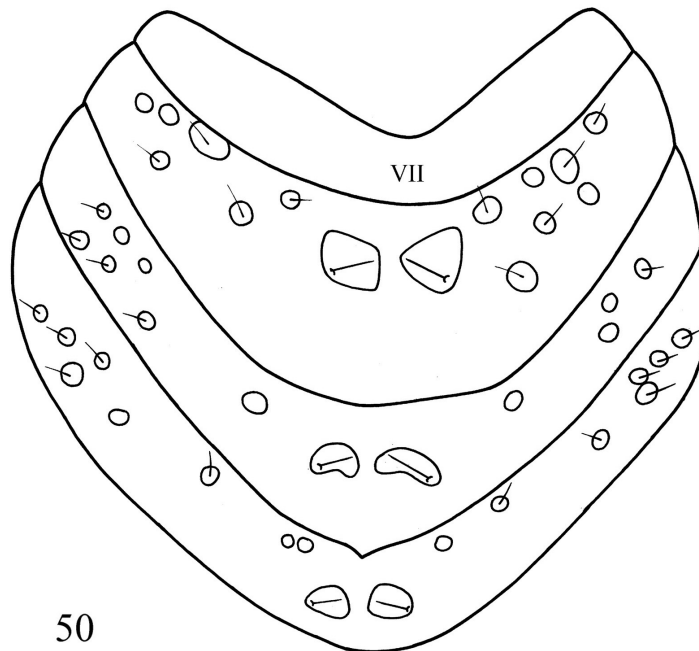
**Coloration. Female.** Metope black, except yellow stripes above clypeus, in its middle, and laterally between lateral margins and sublateral carinae. Metopoclypeal suture brown. Postclypeus dark brown, except yellow stripe below metopoclypeal suture. Anteclypeus dark brown to black. Preocular fields and pedicel black. Rudiments of ocelli and genae yellow. Coryphe, pro-, and mesonotum light yellow, with dark

brown to black spots; sometimes coryphe completely black. Paranotal lobes of pronotum black, except light yellow margins. Forewings dark brown to completely black, with two light yellow bands composed of sparse spots and dots. Fore and middle femora dark brown. Fore and middle tibiae dark brown, with yellow spot basally on its external surface. Hind legs light brown. Claws and dorso-lateral plates of arolium brown. Apices of leg spines black. Abdominal sternites light yellow medially. Anal tube dark brown to black. Gonoplaes dark brown, each with yellow spot laterally. Gonocoxa VIII with light yellow hind margin. Abdominal tergites dark brown, with light yellow median parts.

**Male terminalia** (Figs 51–55). Pygofer elongate vertically, narrow in lateral view, with nearly straight hind margins and right upper angles (Fig. 51). Anal tube nearly elongate, with rounded apex (in dorsal



49

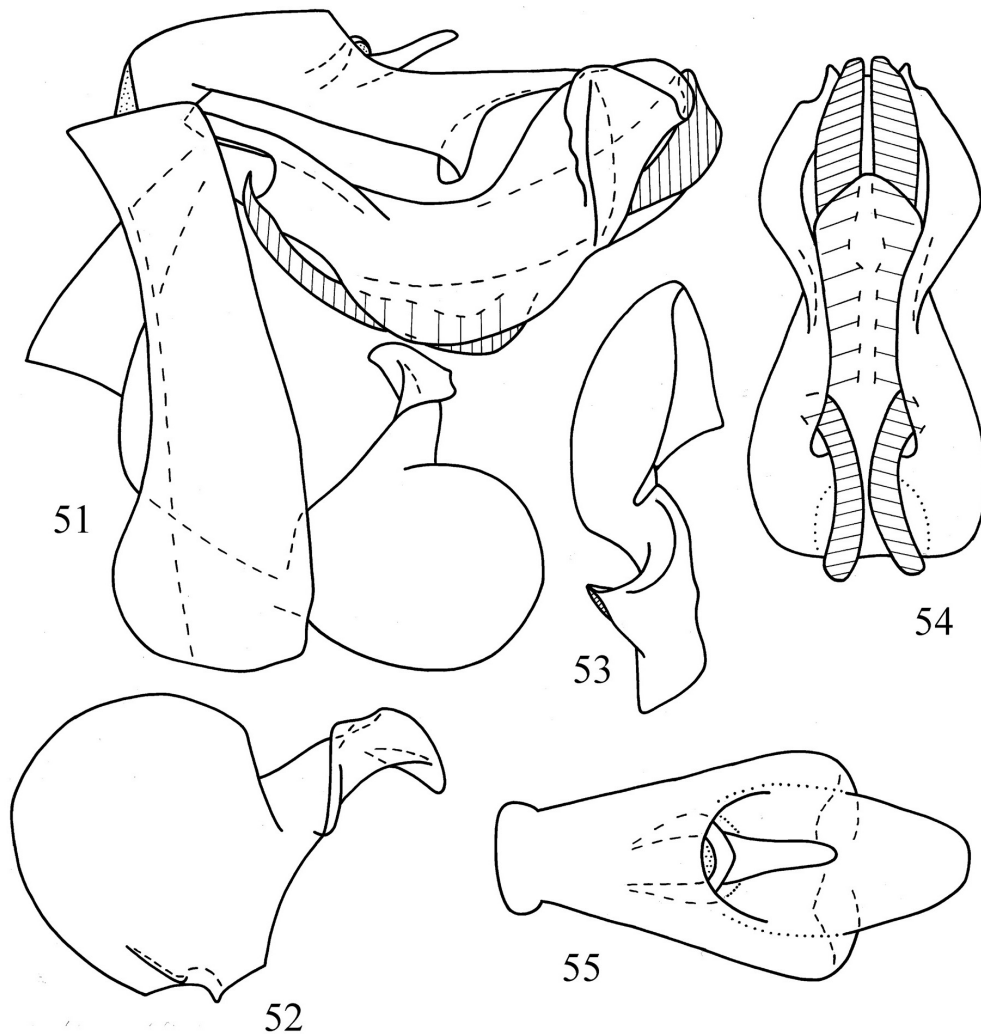


50

Figures 49–50. *Irabola amygdalina* (Dlabola, 1980). (49) hind wing; (50) female sternites IV–VII, ventral view.

view) (Fig. 55), lateral margins sharply and deeply excavated before apex (in lateral view) (Fig. 51). Anal column (paraproct) 0.25 as long as anal tube. Phallobase wide, curved (in lateral view), with large, nearly triangular latero-apical lobes dentated along its lower margins. Ventral phallobase lobe long and wide, narrowing apically, far not reaching apices of dorso-lateral lobes (Fig. 54). Aedeagus with a pair of long ventral hooks, with acute apices, arose medially and directed downwards. Apical aedeagal processes long and narrow, narrowing and curved apically, visible above the upper phallobase margins. Connective with large elongate cup. Style with long neck and round plate, apical tooth distinct, lateral tooth wide, hind margin distinctly convex, caudo-dorsal angle widely rounded (Fig. 52). Capitulum of style wide, narrowing apically (in dorsal view) (Fig. 53).

**Material examined.** Iran: 1♂, Fars Province, 15 km E Sarvestan, 15–16.VI.2003, R. and S. Linnavuori leg. (NMW); 1♂, “SW Iran / Kazerun / 5–6.7.1970” // “Loc. No. 45 / Exp. Nat. Mus. / Praha” // “Paratypus / *H. repandus* / det. Diabola 1977” (NMPC); 6♂♂, 1♀, “C. Iran, 1650 m / 30 km N Sabzewaran / 17–19.5.1977” // “Loc. No. 337 / Exped. Nat. Mus. / Praha” (NMPC); 3♂♂, “C. Iran / Ferdows-e Esfandagah / 21.5.1977” // “Loc. No. 340 / Exped. Nat. Mus. / Praha” (NMPC); 1♂, “E. Iran, 1600 m / Mohammadabad / 3–5.5.1973” // “Loc. No. 187 / Exp. Nat. Mus. / Praha” (NMPC); 1♂, “S. Iran / Env. Ghotbabad / 27.5.1973” // “Loc. No. 214 / Exp. Nat. Mus. / Praha” (NMPC); 4♂♂, Fars Province, 20 km E Kazerun, N29°33.034' E51°49.416', 1256 m, 14.VI.2019; 3♂♂, 1♀, Kerman Province, 40 km N Jiroyft, near Saqdar, N28°50.484' E57°51.622', 1711 m, 19.VI.2019; 2♂♂, Kerman Province, near Dehbakri, N29°05.263'



Figures 51–55. *Trabola amygdalina* (Diabola, 1980); male genitalia. (51) Genital block, lateral view; (52) style, lateral view; (53) style, dorsal view; (54) penis, ventral view; (55) anal tube, dorsal view.

E57°55.464', 1940 m, 19.VI.2019, all leg. V. M. Gnezdilov (ZIN).

**Note.** The male from Kazerun determined by Dlabola as the paratype of *Hysteropterum repandus* (the red label is attached to the specimen) listed above belongs to *Irabola amygdalina* on account of peculiar shape of male anal tube. Thus Dlabola apparently mixed the type series of *H. repandus* as this male was listed as the paratype in the original description of this species (Dlabola 1981).

*Irabola sarbaz* (Dlabola, 1980), comb. nov.

*Cavatorium sarbaz* Dlabola, 1980: 212.

**Note.** The species placed in the genus based on the structure of style – capitulum on neck, with distinct apical tooth (Dlabola 1980, fig. 158). The species was not redescribed as no new material was available for study.

## DISCUSSION

*Iranodus* Dlabola, *Cavatorium* Dlabola, and *Irabola* gen. nov. are forming a group of closely related genera linked by a specific structure of forewings pressed to thorax in its basal halves, with a wide precostal area and without hypocostal plate. *Iranodus* is distinguished by having two lateral spines on hind tibia, while *Irabola* gen. nov. is peculiar due to rather developed hind wings (Fig. 49). On the other hand, *Irabola* gen. nov. is close to *Iranodus* by the pattern of coloration with metope light, with two dark brown to black bands, forewings dark brown, with three light bands (Figs 1–6, 13, 14, 17, 18) and by large latero-apical lobes of phallobase with dentate margins and narrow apical aedeagal processes (Figs 24, 31, 42, 51). *Iranodus* is close to *Cavatorium* by massive style almost without neck, with a hump on its dorsal margin (Figs 22, 29, 38). Finally *Cavatorium* and *Irabola* gen. nov. are similar by having long and narrowing apically ventral phallobase lobe (Figs 36, 43).

All three genera are characterized by unique synapomorphy – presence of two sensory pits in imago on IV–VI abdominal sternites medially (Fig. 50). Same condition is known also for Northern African genus *Lethierium* Dlabola, 1980 and American genera *Kathleenium* Gnezdilov, 2002 and *Balduza* Gnezdilov et O'Brien, 2008 (Gnezdilov *et al.* 2014). However the presence of sensory pits in Palaearctic and American issid taxa is probably a result of convergent adaptation to dry habitats as recent molecular analysis placed them in different phylogenetic lineages interpreted as subfamilies (Gnezdilov *et al.* 2020).

## ACKNOWLEDGEMENTS

I am glad to thank Dr. Fariba Mozaffarian (Tehran, Iran) who provided my collecting trip to Iran, Dr. Alexandr V. Timokhov and Dr. Dmitry Yu. Tishechkin (Moscow, Russia), Dr. Petr Kment (Prague, Czech Republic), and Dr. Michael R. Wilson (Cardiff, UK) for giving me an opportunity to study the specimens, Dr. Vladimir V. Neimorovets (Saint Petersburg, Russia) for taking photos of the species discussed, and Prof. Dr. Hannelore Hoch (Berlin, Germany) for her valuable comments on the manuscript.

The study was performed based on the ZIN collection within the State Program no. AAAA-A19-119020690082-8. My trip to Iran was financially supported by the Russian Foundation for Basic Research (grant No. 18-04-00065).

## REFERENCES

- Dlabola, J. 1980. Tribus-Einteilung, neue Gattungen und Arten der Subf. Issinae in der eremischen Zone (Homoptera, Auchenorrhyncha). Acta Musei Nationalis Pragae, 36B(4): 173–248.
- Dlabola, J. 1981. Ergebnisse der Tschechoslowakisch-Iranischen entomologischen Expeditionen nach dem Iran (1970 und 1973) (Mit Angaben über einige Sammelresultate in Anatolien) Homoptera: Auchenorrhyncha (II. Teil). Acta Entomologica Musei Nationalis Pragae, 40: 127–311.
- Dlabola, J. 1982. Fortsetzung der Ergänzungen zur Issiden-Taxonomie von Anatolien, Iran und Griechenland (Homoptera, Auchenorrhyncha). Acta Musei Nationalis Pragae, 38B(3): 113–169.
- Gnezdilov, V. M. 2016a. Notes on phylogenetic relationships of planthoppers of the family Issidae (Hemiptera, Fulgoroidea) of the Western Palaearctic fauna, with description of two new genera. Entomologicheskoe Obozrenie, 95(2): 362–382. English translation published in Entomological Review, 2016, 96(3): 332–347. DOI: 10.1134/S0013873816030106.
- Gnezdilov, V. M. 2016b. Planthoppers of the family Issidae (Hemiptera, Fulgoroidea) of Western Palaearctic. Thesis of Doctoral Dissertation (Dr. Sci. habilitation). St.–Petersburg. 44 p. (In Russian).
- Gnezdilov, V. M. 2020. New tribe, new genera, and new species of the family Issidae (Hemiptera: Fulgoroidea) from Southeastern Asia and New Guinea, with notes on morphology and evolution of the family. Proceedings of the Zoological Institute RAS, 324(3): 306–345. DOI: 10.31610/trudyzin/2020.324.3.306.
- Gnezdilov, V. M., Holzinger, W. E. and M. R. Wilson. 2014. The Western Palaearctic Issidae (Hemiptera, Fulgoroidea): an illustrated checklist and key to genera and subgenera. Proceedings of the Zoological Institute RAS, 318 (Supplement 1): 1–124. [http://www.zin.ru/journals/trudyzin/doc/vol\\_318\\_s1/TZ\\_318\\_1\\_Supplement\\_Gnezdilov.pdf](http://www.zin.ru/journals/trudyzin/doc/vol_318_s1/TZ_318_1_Supplement_Gnezdilov.pdf).
- Gnezdilov, V. M., Konstantinov, F. V. and S. Y. Bodrov. 2020.

New insights into the molecular phylogeny and taxonomy of the family Issidae (Hemiptera: Auchenorrhyncha: Fulgoroidea). *Proceedings of the Zoological Institute RAS* 324(1): 146–161. DOI: 10.31610/trudyzin/2020.324.1.146.

Mozaffarian, F. and M. R. Wilson. 2011. An annotated checklist of the planthoppers of Iran (Hemiptera, Auchenorrhyncha, Fulgoromorpha) with distribution data. *ZooKeys*, 145: 1–57.