Revision of *Dvivarnus* (Scelionidae, Teleasinae)

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Abstract

Two new species, *Dvivarnus elektrolythron* Talamas & Mikó, sp. n. and *D. mikuki* Talamas & Mikó, sp. n. are described. The genus is redescribed and a key is provided to separate *Dvivarnus* from other groups in Teleasinae with mesoscutellar spines.

Keywords

Teleasinae, *Dvivarnus*, *Trimorus*, *Gryonoides*, mesoscutellum

Introduction

The subfamily Teleasinae is well defined morphologically by wing venation (elongate marginal vein, short stigmal and postmarginal veins), the anterior pronotal process and, in most cases, a compact ocellar triangle. Generic classification within the subfamily is another matter and a thorough phylogenetic analysis is needed. The vast majority of species are found in *Trimorus* Förster, a genus whose limits are poorly defined with respect to many of the smaller genera. *Dvivarnus* Rajmohana & Veenakumari is a well defined teleasine genus that morphologically falls well outside of *Trimorus* and until now was monotypic.
We here expand knowledge about the species-level diversity in *Dvivarnus* with the addition of two new species. We also provide additional characters to those of Veenakumari et al. (2011) for its diagnosis relative to two lineages in Teleasinae that also have mesoscutellar spines, *Gryonoides* Dodd and the *Trimorus carus* Nixon species group. The analysis of *Gryonoides* follows the examination of 12 species conducted as part of an active revision of this genus by the second author. Our treatment of the *Trimorus carus* species group is based on examination of the holotype of *T. carus* Nixon and two undescribed species from the Central African Republic that share the presence of a distally bifurcating metascutellar spine.

**Materials and methods**

The numbers prefixed with “USNMENT” or “OSUC ” are unique identifiers for the individual specimens (note the blank space after some acronyms). Details on the data associated with these specimens may be accessed at the following link: purl.oclc.org/NET/hymenoptera/ hol, and entering the identifier in the form. Persistent URIs for each taxonomic concept were minted by xBio:D in accordance with best practices recommended by Hagedorn et al. (2013). Morphological terms were matched to concepts in the Hymenoptera Anatomy Ontology (Yoder et al. 2010) using the text analyzer function. A table of morphological terms and URI links is provided in Suppl. material 1.

We represent natural language phenotypes in an Entity:Quality (EQ) format: Entity attribute: value. Semantic statements of natural language phenotypes (Suppl. material 2.) were composed in Protégé 5.0 (http://protege.stanford.edu/) using the OWL Manchester syntax (http://www.w3.org/TR/owl2-manchester-syntax/) following Balhoff et al. (2013) and Mikó et al. (2014). The full data set, represented in OWL (Web Ontology Language; http://www.w3.org/TR/owl2-overview/ last accessed February 4, 2014), was deposited as a Resource Description Framework (RDF)-XML file (http://www.w3.org/TR/REC-rdf-syntax/ in Figshare (https://dx.doi.org/10.6084/m9.figshare.2008203).

The taxonomic synopses and matrix-based descriptions were generated from the Hymenoptera Online Database (hol.osu.edu) and the online program vSysLab (vsyslab.osu.edu) (matrix title: Revision of *Dvivarnus*) in the format of character: state. Multiple states for a character are separated by a semicolon. Characters shared among the three species of *Dvivarnus* were exported as the generic description (OTU for generic characters: *Dvivarnus*), those that were not shared among all species were exported as species descriptions.

Photographs were captured with a Z16 Leica lens with a JVC KY-F75U digital camera using Cartograph software. Single montage images were produced from image stacks with the program CombineZP. In some cases, multiple montage images were stitched together in Photoshop to produce larger images at high resolution and magnification. Full resolution images are archived at the image database at The Ohio State University (http://purl.oclc.org/NET/hymenoptera/specimage).
Scanning electron micrographs were produced with a Hitachi TM300 Tabletop Microscope. The specimen was disarticulated with a minuten probe and forceps and mounted to 12 mm slotted aluminum mounting stub (EMS Cat. #75220) using carbon adhesive tabs (EMS Cat. #77825-12) by means of a fine paint brush and sputter coated with approximately 70 nm of gold/palladium.

Character annotations

cly  clypeus (Figs 1–2)
ctk  central keel (Figs 15–16, 18)
epc  epomial carina (Fig. 25)
lpT3–T6 lateral patch on T3–T6 (Figs 21–24)
lpc  lateral propodeal carina (Figs 7, 9–10)
mc  mesopleural carina (Fig. 43)
mcsp  mesoscutellar spine (Figs 7–8)
mees  mesepimeral sulcus (Fig. 34)
mssp  median mesoscutellar spine (Fig. 43)
ms  marginal setae (Fig. 9)
mns  metanotal trough (Figs 5–6)
msct  metascutellar spine (Figs 5–8)
nc  nuchal carina (Fig. 36)
nes  netrion sulcus (Fig. 4)
net  netrion (Figs 3–4, 34)
not  notaulus (Fig. 46)
plc  plica (Figs 6, 9–10)
ppp  posterior propodeal projection (Figs 5–6)
psu  posterior scutellar sulcus (Fig. 37)
pssu  prespecular sulcus (Fig. 34)
r  radicle (Figs 1–2, 17)
trt  torular triangle (Figs 15–16, 18)
vmc  ventral mesopleural carina (Fig. 43)

Specimens

This study is based on specimens from the following collections:

**CNCI**  Canadian National Collection of Insects, Ottawa, Canada
**BPBM**  Bernice P. Bishop Museum, Honolulu, HI, USA
**ICIPE**  International Centre of Insect Physiology and Ecology, Nairobi, Kenya
**NMKE**  National Museum of Kenya, Nairobi, Kenya
Figure 1–4. 1 *Trimorus* sp., female (OSUC 186090), head, anterior view 2 *Gryonoides pulchellus* Dodd, female (USNMENT00872146), head, anterior view 3 *Trimorus* sp., female (OSUC 192417), pronotum, anterolateral view 4 *Gryonoides glabriceps* Dodd, female (USNMENT00872142), pronotum, anterolateral view. Scale bars in millimeters.

**OSUC** C.A. Triplehorn Collection, The Ohio State University, Columbus, OH, USA  
**USNM** Smithsonian National Museum of Natural History, Washington, DC, USA

**Taxonomy**

*Dvivarnus* Rajmohana & Veenakumari  
http://bioguid.osu.edu/xbiod_concepts/305672


**Diagnosis.** Per the characters presented by Veenakumari et al (2011), *Dvivarnus* can be differentiated from other teleasines by the combination of the dense punctuation found throughout T3 and S3, the presence of paired mesoscutellar spines, the absence of lateral propodeal carina and the presence of an inverted U-shaped carina dorsally.
surrounding the metasomal depression. Punctuation on T3 can be found in some species of *Trimorus* (Fig. 20), but the punctuation is surrounded by rugulae of varying intensity. In *Dvivarnus*, the punctuation is uniform throughout most of the tergite and is not accompanied by additional sculptural elements. Specimen USNMENT01109195 (Fig. 20) also has spines derived from the metapleural carina, which are not present in *Dvivarnus*. Additional characters for the identification of *Dvivarnus* are presented in the key to teleasines with mesoscutellar spines.

**Comments.** The species of *Dvivarnus* are extremely similar in most pleural characters and differ primarily by features of the head, pronotum, and metasoma. Sexual dimorphism is exhibited mostly in the pattern of setation and striation of the frons. In males, the glabrous area above the interantennal process is less distinct and the density of setation throughout the frons varies greatly. The facial striae in males extend dorsally throughout the frons whereas in females the striation is absent from the center portion of the frons.

We examined two morphospecies of males that we were unable to unambiguously associate with the female of *D. elektrolythron*. One morphospecies (USNMENT01109164, Figs 46–50) shares with *D. elektrolythron* the pattern of striation on the lateral pronotum (Fig. 45) and the longitudinal furrow on the metanotal trough (Fig. 47). However, it has distinct notauli (Fig. 46) and *D. elektrolythron* has none, and the posterior margin of the mesoscutellum between the mesoscutellar spines is concave in USNMENT01109164, and medially pointed in *D. elektrolythron*. The other morphospecies (USNMENT01109212, Figs 40–45) has the opposite arrangement of characters: it shares with *D. elektrolythron* the absence of notauli and the presence of a pointed posterior margin of the mesoscutellum (Figs 40, 43) but it has a foveolate metanotal trough (Fig. 43) and the lateral pronotum is predominantly smooth (Fig. 45). In the absence of additional specimens that would allow us to thoroughly assess intraspecific variability in males, or molecular or biological data, we consider it best to document the morphology of these males and present them as undetermined at the species-level.

**Key to teleasines with mesoscutellar spines**

1. Radicle shorter than distal width of clypeus (Figs 15–19); lateral propodeal carina absent (Figs 36, 43, 48); metasomal depression surrounded dorsally by an inverted U-shaped carina (Figs 48, 43, 36); T3 and S3 densely punctate (Figs 21–23, 25, 29); metascutellar spine longitudinally striate throughout (Figs 5–6, 31, 36–37; T3 with lateral patch (Figs 21–23) ............... *Dvivarnus*

   – Radicle as long as distal width of clypeus (Figs 1–2); lateral propodeal carina present (Figs 9–10); metasomal depression not surrounded dorsally by continuous carina (Figs 9–10); T3 and S3 not densely punctate (Figs 12, 14, 24), or punctation with interstitial rugulae (Fig. 20); metascutellar spine smooth in distal half (Figs 7–8); T3 without lateral patch (Figs 12, 14, 24) ............... 2
Revision of Dvivarnus (Scelionidae, Teleasinae)

2 Metasomal depression without marginal setae (Figs 8, 10); netrion sulcus distinct (Fig. 4); apex of metascutellar spine unbranched (Figs 8, 14) ........

– Metasomal depression with marginal setae (Figs 7, 9); netrion sulcus not visible in lateral view (Fig. 3); metascutellar spine with bifurcate apex..........

Gryonoides

Trimorus carus species group

Key to species Dvivarnus (females)

1 Frons with central keel separate from carinae of torular triangle (Fig. 15); mesoscutellum with posterior margin between mesoscutellar spines medially convex in dorsal view (Fig. 28, 31); pronotum with posterior portion transversely striate (Fig. 30); lateral patch on T4 present as a dense tuft of setae (Fig. 22); T5 with lateral patch present (Fig. 22) .........................

---------- Dvivarnus elektrolythron Talamas & Mikó, sp. n.

– Frons with central keel extending to torular triangle (Figs 16–18); mesoscutellum with posterior margin concave between mesoscutellar spines in dorsal view (Figs 26, 33, 36); pronotum with posterior portion predominantly smooth (Figs 25, 32, 34–35); lateral patch on T4 broad (Figs 39, 21, 23); T5 without lateral patch (Figs 21, 23) ........................................

2 Torular triangle setose (Figs 16–17); sulcus in metanotal trough foveolate (Fig. 5); lateral face of pronotum with epomial carina (Fig. 25) ........

---------- Dvivarnus agamades (Kozlov & Lê)

– Torular triangle without setation (Fig. 18); sulcus in metanotal trough present as an elongate furrow (Figs 6, 36–37); lateral face of pronotum without epomial carina (Fig. 34) ........ Dvivarnus mikuki Talamas & Mikó, sp. n.

Dvivarnus agamades (Kozlov & Lê)

http://bioguid.osu.edu/xbiod_concepts/343746

Figures 5, 16–17, 23, 25–26

Gryonoides agamades Kozlov & Lê, 1986: 100 (original description); Lê, 2000: 218 (description, type information).

Dvivarnus punctatus Rajmohana & Veenakumari, 2011: 44 (original description); Talamas & Buffington, 2014: 104 (junior synonym of Dvivarnus agamades (Kozlov & Lê)).


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Figure 11–12. **11** Trimorus sp., female (OSUC 186090) head, mesosoma, metasoma, lateral view. **12** Trimorus sp., male (OSUC 345677), head, mesosoma, metasoma, dorsal view. Scale bars in millimeters.

Figure 13–14. Gryonoides glabriceps, female (USNMENT00872142), 13 head, mesosoma, metasoma, lateral view 14 head, mesosoma, metasoma, dorsal view. Scale bars in millimeters.


**Diagnosis.** *Dvivarnus agamades* can be separated from *D. electrolythron* and *D. mikuki* by the foveolate metanotal trough (Fig. 5). Females may be separated on the basis of the non-patterned forewing.

**Link to distribution map.** http://hol.osu.edu/map-large.html?id=343746

**Material examined.** *Paratype: VIETNAM*: Gia Lai Prov., K’Bang Dist., rice / sweet potato, Buôn Luổi, 26.XI.1978, X. H. Lê (1 male, OSUC 184258 (ZIN)).

**Other material: (19 females, 8 males)** *INDIA*: Delhi Union Terr., Indian Agricultural Research Institute (IARI) area, New Delhi, 26.X.1979, Boucek (1 male, USNMENT01109192 (CNCI)). Karnataka St., Bangalore, 21.VI-30.VI.1987, K. Ghorpade (1 female, USNMENT01109190 (CNCI)). Karnataka St., Indian Council of Agricultural Research (ICAR), Bangalore, XII-2003, Malaise trap, J. Poorani (1 male,
Revision of Dvivarnus (Scelionidae, Teleasinae) 11

USNMENT01109189 (CNCI)). Karnataka St., grass / roadside, Malur, 28.IV.1988 (1 male, OSUC 230647 (OSUC)). Tamil Nadu St., Nilgiris Dist., Gudalur, 19.VI.1987 (1 male, OSUC 59262 (OSUC)). **LAOS**: Vientiane Prov., Gi Sion, Ban Na (Ban Tha Ngon Na), 7.II-21.II.1965 (1 female, USNMENT00877588 (BPBM)). **NEPAL**: Central Develop. Reg., nr. Birganj, MT #25, Lothar, 450ft, 29.VIII-5. IX.1967, Malaise trap (1 male, USNMENT01109175 (CNCI)). **TAIWAN**: Taiwan Prov., Nantou Co., Wushe, 1150m, 13.IV.1983, flight intercept trap, H. Townes (1 female, PSUC_000096246 (CNCI)). Taiwan Prov., Nantou Co., Wushe, 1150m, 22.V.1983, flight intercept trap, H. Townes (1 female, PSUC_000096141 (CNCI)). Taiwan Prov., Nantou Co., Wushe, 1150m, no date, Malaise trap, H. Townes & M. Townes (1 female, USNMENT01109188 (CNCI)). Taiwan Prov., Nantou Co., Wushe, 1150m, no date, H. Townes (4 females, USNMENT01109183, USNMENT01109184, USNMENT01109185, USNMENT01109187 (CNCI)). **THAILAND**: Chaiyaphum Prov., Taad Fah Waterfall, water supply station, T862, 245m, 15°56.468’N, 102°05.855’E, Tad Ton (Tat Tone) National Park, 8.IX-9.IX.2006, yellow pan trap, T. Jaruphan & O. Budswawong (1 female, OSUC 342789 (OSUC)). Chaiyaphum Prov., dry dipterocarp forest, T16, 250m, 15°59.037’N, 102°02.103’E, Tad Ton (Tat Tone) National Park, 28.VI.2006, Malaise trap, C. Nichumnan (1 female, OSUC 374197 (OSUC)). Kanchanaburi Prov., Khong Krabor, # 4781, 210m, 14°29.972’N, 98°53.035’E, Khuean Srinagarindra National Park, no date, Malaise trap, Boonnam & Phumarin (1 male, USNMENT01109177 (CNCI)). Kanchanaburi Prov., Mae Kamint River, headquarters, # 3466, 14°38.123’N, 98°59.657’E, Khuean Srinagarindra National Park, no date, Malaise trap, Somboon & Daorueng (1 female, USNMENT01109173 (CNCI)). Kanchanaburi Prov., Mae Kamint River, tourist center, T4422, 210m, 14°38.312’N, 98°59.643’E, Khuean Srinagarindra National Park, no date, Malaise trap, Somboon & Daorueng (1 male, USNMENT01109169 (CNCI)). Khon Kaen Prov., Disturb (Moob Cave), T2, 296m, 16°44.837’N, 102°00.160’E, Phu Pha Man National Park, 13.VI-20.VI.2006, Malaise trap, R. Phatai (1 female, OSUC 374198 (OSUC)). Nakhon Si Thammarat Prov., TV aerial, T3108, 966m, 08°14.262’N, 99°48.289’E, Namtok Yong National Park, no date, Malaise trap, Yai & Amnad (1 female, USNMENT01109170 (CNCI)). Phetchabun Prov., Kaeng Krachan Nat. Park 12º32.141’N, 99º27.914’E T4540, no date, Malaise trap, Thongbai (1 female, USNMENT01109172 (CNCI)). Phetchabun Prov., helicopter landing ground, T266, 890m, 16º43.156’N, 101º35.118’E, Nam Nao National Park, 8.VII-9.VII.2006, pan trap, N. Hongyothi (1 female, OSUC 284994 (OSUC)). Phetchaburi Prov., Huai Palao Forest Unit 3, Pa La-U Waterfall, T4564, 12º32.149’N, 99º28.265’E, Kaeng Krachan National Park, no date, pan trap, Thongbai (1 female, USNMENT01109180 (CNCI)). Phetchaburi Prov., Huai Palao Forest Unit 3, Pa La-U Waterfall, T4566, 12º32.149’N, 99º28.265’E, Kaeng Krachan National Park, no date, Malaise trap, Thongbai (2 females, USNMENT01109174, USNMENT01109178 (CNCI)). Phetchaburi Prov., km33 / helipad, T4693, 735m, 12º50.177’N, 99º20.688’E, Kaeng Krachan National Park, no date, Malaise trap, Sirichai (1 male, USNMENT01109179 (CNCI)).
**Dvivarnus elektrolythron** Talamas & Mikó, sp. n.

http://zoobank.org/0CBCE486-CEBD-4924-9AF2-74EEA6A222B0
http://bioguid.osu.edu/xbiod_concepts/403212

Figures 15, 22, 27–31

**Description.** Color of antennae in female: brown throughout with dense white setae on A2–A4. Color of mesosoma: mesoscutellum and propodeum black, metascutellar spine brown, otherwise red. Color of head: except interantennal process, black. Seta


**Diagnosis.** *Dvivarnus elektrolythron* may be separated from females of *D. mikuki* and *D. agamades* by the incomplete central keel on the frons (Fig. 15), the form of the lateral patch on T4 (Figs 22, 29), and by the medially convex posterior margin of the mesoscutellum.

**Etymology.** The epithet for this species refers to the bright red color on the meso

Figure 15–19. 15 Dvivarnus elektrolythron, female holotype (USNMENT01109168), head and antennae, anterior view 16 D. agamades, female (USNMENT01109190), head, anterior view 17 D. agamades, male (USNMENT01109177), head, anterior view 18 D. mikuki, female paratype (USNMENT01109214), head and antenna, anterior view 19 D. mikuki, male (USNMENT01109158), head, anterior view. Scale bars in millimeters.
Figure 20–24. 20 Trimorus sp., female (USNMENT01109195), head, mesosoma, metasoma, dorsal view 21 Dvivarnus mikuki, female (USNMENT01109213), metasoma, dorsolateral view 22 D. elektrolythron, female (USNMENT01109168), metasoma, dorsolateral view 23 D. agamades, female (USNMENT01109174), metasoma, dorsolateral view 24 Trimorus sp., female (OSUC 186090), metasoma, posterodorsal view. Scale bars in millimeters.

Dvivarnus mikuki Talamas & Mikó, sp. n.
http://zoobank.org/1EC45732-63E1-40D5-94DE-453A560A9EEF
http://bioguid.osu.edu/xbiod_concepts/403211
Figures 6, 18–19, 21, 32–39


**Diagnosis.** *Dvivarnus mikuki* can be separated from *D. agamades* and *D. elektrolythron* by the glabrous torular triangle and by the color of the mesosoma, which is entirely black except for the metascutellar spine. Additionally, *D. mikuki* can be separated from *D. agamades* by the absence of an epomial carina, the form of the metanotal trough, which is non-foveolate and is dorsoventrally divided by a transverse furrow,
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Figure 28–31. Dvivarnus elektrolythron, female holotype (USNMENT0109168) 28 head, mesosoma, metasoma, dorsal view 29 metasoma, dorsal view 30 pronotum, anterolateral view 31 posterior mesosoma, dorsal view. Scale bars in millimeters.

and by the banding pattern on the wings of females. From D. elektrolythron it can be separated by the broad lateral patch on T4 and the convex posterior margin of the mesoscutellum between the mesoscutellar spines.

Etymology. The word “mikuki” means “spears” in Swahili, the language of Kenya where the holotype specimen originates, and refers to the many spines found on the mesosoma. The name is treated as noun in apposition.

Link to distribution map. http://hol.osu.edu/map-large.html?id=403211

Kwale Co., indigenous forest, 39.52462°E, Muhaka Forest, 41m 4.32664°S, 13.XII-27.XII.2014, Malaise trap, R. Copeland (1 female, USNMENT01109214 (NMKE)).
Kwale Co., indigenous forest, Muhaka Forest, 41m, 4.32664°S, 39.52462°E, 27.XII-10.I.2015, Malaise trap, R. Copeland (1 female, USNMENT01109213 (NMKE)).
Kwale Co., indigenous forest, 76m, 04.52814°S 39.24028°E, Marenje Forest, 11.VII-25.VII.2014, Malaise trap, R. Copeland (1 male, USNMENT01109194 (NMKE)).
Kwale Co., indigenous forest, 76m, 04.52814°S 39.24028°E, Marenje Forest, 25.VII-8.VIII.2014, Malaise trap, R. Copeland (3 females, USNMENT01059121, 01059124, 01059135 (USNM)).

**NIGERIA**: Oyo St., International Institute of Tropical Agriculture (IITA), Ibadan, X-1987, screen sweeping, J. S. Noyes (1 male, USNMENT01109162 (CNCI)). Oyo St., International Institute of Tropical Agriculture (IITA), Ibadan, no date, screen sweeping, J. S. Noyes (1 male, USNMENT01109163 (CNCI)).

**ZIMBABWE**: Harare (Salisbury), no date, A. Watsham (1 female, 2 males,
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Figure 34–39. *Dvivarnus mikuki*, female paratype (USNMENT010591135) 34 mesosoma, anterolateral view 35 posterior pronotum, lateral view 36 mesosoma, posterior view 37 posterior mesosoma, posterolateral view 38 metasoma, dorsolateral view 39 T3–T5, dorsolateral view. Scale bars in millimeters.

USNMENT01109157, USNMENT01109158, USNMENT01109161 (CNCI). Harare (Salisbury), no date, pan trap, A. Watsham (1 female, USNMENT01109159 (CNCI)). Harare (Salisbury), no date, yellow pan trap, A. Watsham (1 female, USNMENT01109156 (CNCI)). Harare (Salisbury), Chishawasha, no date, A. Watsham (1 female, USNMENT01109167 (CNCI)). Harare (Salisbury), Chishawasha, no date, pan trap, A. Watsham (1 male, USNMENT01109160 (CNCI)).
Figure 40–45. *Dvivarnus* sp., male (USNMENT01109212). 40 head and mesosoma, dorsal view 41 metasoma, dorsal view 42 head and mesosoma, lateral view 43 mesosoma, posterodorsal view 44 head, anterior view 45 pronotum, anterolateral view Scale bars in millimeters.

*Dvivarnus* sp., male
Figures 40–45

*Dvivarnus* sp., male
Figures 46–50
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Figure 46–50. *Dvivarnus* sp., male (USNMENT01109164) 46 head, mesosoma metasoma, dorsal view 47 head and mesosoma, lateral view 48 mesosoma, posterolateral view 49 head, anterior view 50 pronotum, anterolateral view. Scale bars in millimeters.

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References


Supplementary material 1

URI table of HAO morphological terms
Authors: Elijah J. Talamas, István Mikó, Robert S. Copeland
Data type: Microsoft Excel Spreadsheet (.xls)
Explanation note: This table lists the morphological terms used in this publication and their associated concepts in the Hymenoptera Anatomy Ontology.
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Supplementary material 2

Semantic representations of phenotypes in Manchester syntax format of Dvivarnus
Authors: Elijah J. Talamas, István Mikó, Robert S. Copeland
Data type: Microsoft Rich Text Format (.rtf)
Explanation note: Semantic representations of phenotypes in Manchester syntax format of the taxonomic treatment of World Dvivarnus (Hymenoptera: Platygastroidea: Teleasinae).
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