JHR 49: 1–23 (2016)
doi: 10.3897/JHR.49.7714
http://jhr.pensoft.net

RESEARCH ARTICLE

JOURNAL OF Hymenoptera RESEARCH
A peer-reviewed open-access journal
The International Society of Hymenopterists

Revision of *Dvivarnus* (Scelionidae, Teleasinae)

Elijah J. Talamas[1], István Mikó[2], Robert S. Copeland[3]

1 *Systematic Entomology Laboratory, USDA/ARS c/o NMNH, Smithsonian Institution, Washington DC, USA* **2** *Frost Entomological Museum, Pennsylvania State University, State College, PA, USA* **3** *International Centre of Insect Physiology and Ecology, Nairobi, Kenya, and National Museums of Kenya, Nairobi, Kenya*

Corresponding author: *Elijah J. Talamas* (elijah.talamas@ars.usda.gov)

Academic editor: *M. Yoder* | Received 6 January 2016 | Accepted 21 March 2016 | Published 28 April 2016

http://zoobank.org/3028A70D-A5F5-48C2-85C4-7466F16E144F

Citation: Talamas EJ, Mikó I, Copeland RS (2016) Revision of *Dvivarnus* (Scelionidae, Teleasinae). Journal of Hymenoptera Research 49: 1–23. doi: 10.3897/JHR.49.7714

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).

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)
mmsp	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

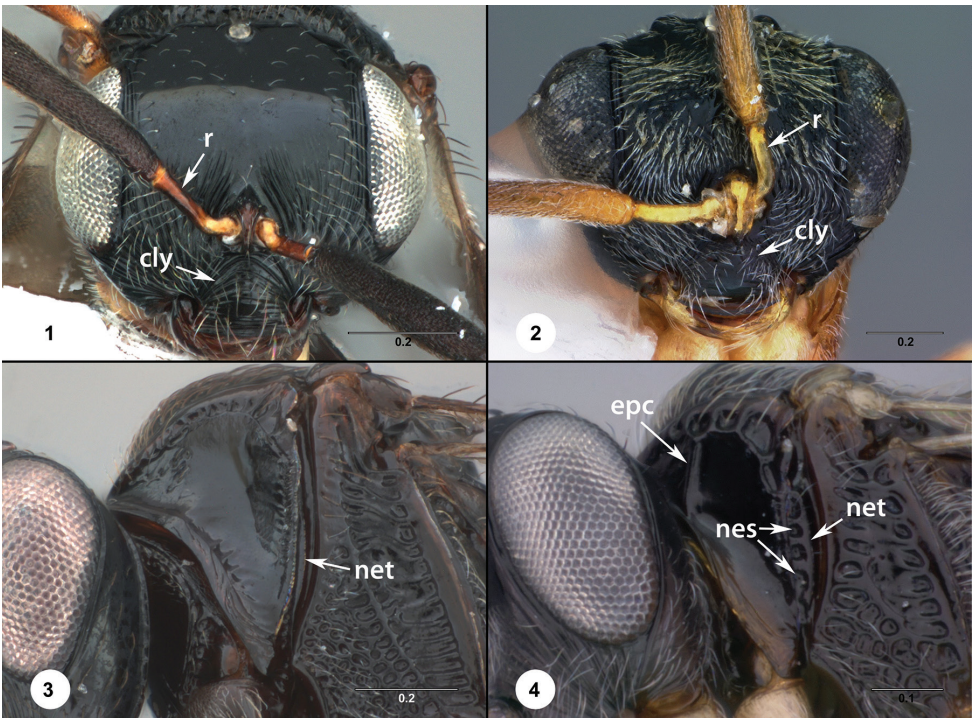

Figure 1–4. 1 *Trimorus* sp., female (OSUC 186090), head, anterior view **2** *Gryonoides pulchellus* Dodd, female (USNMENT00872146), head, anterior view **3** *Trimorus* sp., female (OSUC 192417), pronotum, anterolateral view **4** *Gryonoides glabriceps* Dodd, female (USNMENT00872142), pronotum, anterolateral 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

Dvivarnus Rajmohana & Veenakumari, 2011: 40 (original description. Type: *Dvivarnus punctatus* Rajmohana & Veenakumari, by monotypy. Diagnosis, keyed).

Description. Number of basiconic sensilla on A7: 0. Number of basiconic sensilla on A8: 2. Color of radicle: yellow. Length of radicle: shorter than apical width of clypeus. Length of A3: as long as pedicel or longer. Number of basiconic sensilla on A12: 1. Number of mandibular teeth: 3. Mandibular teeth: ventral tooth the longest. Facial striae: present. Dorsal limit of facial striae: facial striae exceeding horizontal

plane at margin of anterior ocellus. Torular triangle: present. Height of torular triangle: less than height of clypeus. Central keel: present. Surface of dorsal frons in dorsal view: convex. Orbital carina: present. Genal patch: absent. Vertex patch: absent. Hyperoccipital carina: absent. Anterior margin of occipital carina dorsally: crenulate. Pronotal cervical sulcus: present. Sculpture of pronotal cervical sulcus: shallowly foveolate. Pronotal suprahumeral sulcus: present. Sculpture of pronotal suprahumeral sulcus: foveolate. Proximity of suprahumeral and pronotal cervical sulci: pronotal suprahumeral sulcus terminating before reaching pronotal cervical sulcus. Posterior pronotal sulcus: absent. Sculpture of propleural epicoxal sulcus: foveolate. Sculpture of posterior scutellar sulcus: foveolate. Sculpture of mesoscutal suprahumeral sulcus: foveolate. Length of mesoscutal suprahumeral sulcus: less than one half length the distance from the tegula to the anterior apex of mesoscutum. Sculpture of mesoscutal humeral sulcus: foveolate. Lateral scutoscutellar sulcus: reaching transaxillar carina. Transaxillar carina: present. Setae on lateral margin of mesoscutellum: present. Posterior scutellar sulcus: present. Acropleural sulcus: present. Length of acropleural sulcus: elongate. Subalar pit: present. Course of prespecular sulcus and mesepimeral sulcus: not continuous dorsally. Mesopleural pit: present. Sculpture of femoral depression: transversely rugose. Mesopleural carina: present. Proximity of ventral apex of mesopleural carina and ventral mesopleural carina: carinae adjacent. Sculpture of mesopleural epicoxal sulcus: foveolate. Sculpture of postacetabular sulcus: foveolate. Sculpture of mesopleuron below femoral depression: areolate rugose. Episternal foveae: indistinguishable from surface sculpture. Sculpture of mesepimeral sulcus: foveolate. Metascutellar spine: present. Shape of metascutellar spine in dorsal view: pointed. Length of metascutellar spine: longer than proximal striated region of metascutellum. Apical semitransparent lamella on metascutellar spine: absent. Sculpture of metascutellum: longitudinally striate throughout. Proximal striation of metascutellum: extending onto surface of metanotal spine.Setation of central propodeal area: present. Posterior propodeal projection: present. Metapleural sulcus: present. Setation of metapleuron: Area delimited posteriorly by paracoxal and vertical part of metapleural sulcus is covered with dense setae, remainder of metapleuron glabrous. Sculpture of paracoxal sulcus: foveolate. Dorsal margin of T1 in lateral view: concave. Length of pits on anterior T1: almost reaching posterior margin of tergite. Transverse line of pits on anterior T1: present. Transverse line of pits on anterior T2: present. Lateral patch on T2: present. Transverse line of pits on anterior T3: absent. Width of T3: as wide or slightly wider than mesoscutum. Sculpture of T3: punctate. Length of apical setae on T3: not longer than non-apical setae. Posterolateral patch on T3: present. Lateral patch on T4: present. Lateral patch on T6: present. Transverse line of pits on anterior S2: present. Felt field on S2: present. Transverse line of pits on anterior S3: absent.

Diagnosis. Per the characters presented by Veenakumari et al (2011), *Dvivarnus* can be differentiated from other teleasines by the combination of the dense punctation 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. Punctation on T3 can be found in some species of *Trimorus* (Fig. 20), but the punctation is surrounded by rugulae of varying intensity. In *Dvivarnus*, the punctation 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. 50) and the longitudinal furrow on the metanotal trough (Fig. 48). 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**

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

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

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)).

Dvivarnus agamades (Kozlov & Lê): Talamas & Buffington, 2014: 104 (description, synonymy).

Description. Whorl of setae on flagellomeres in male: absent. Shape of A3–A11 in male: cylindrical.

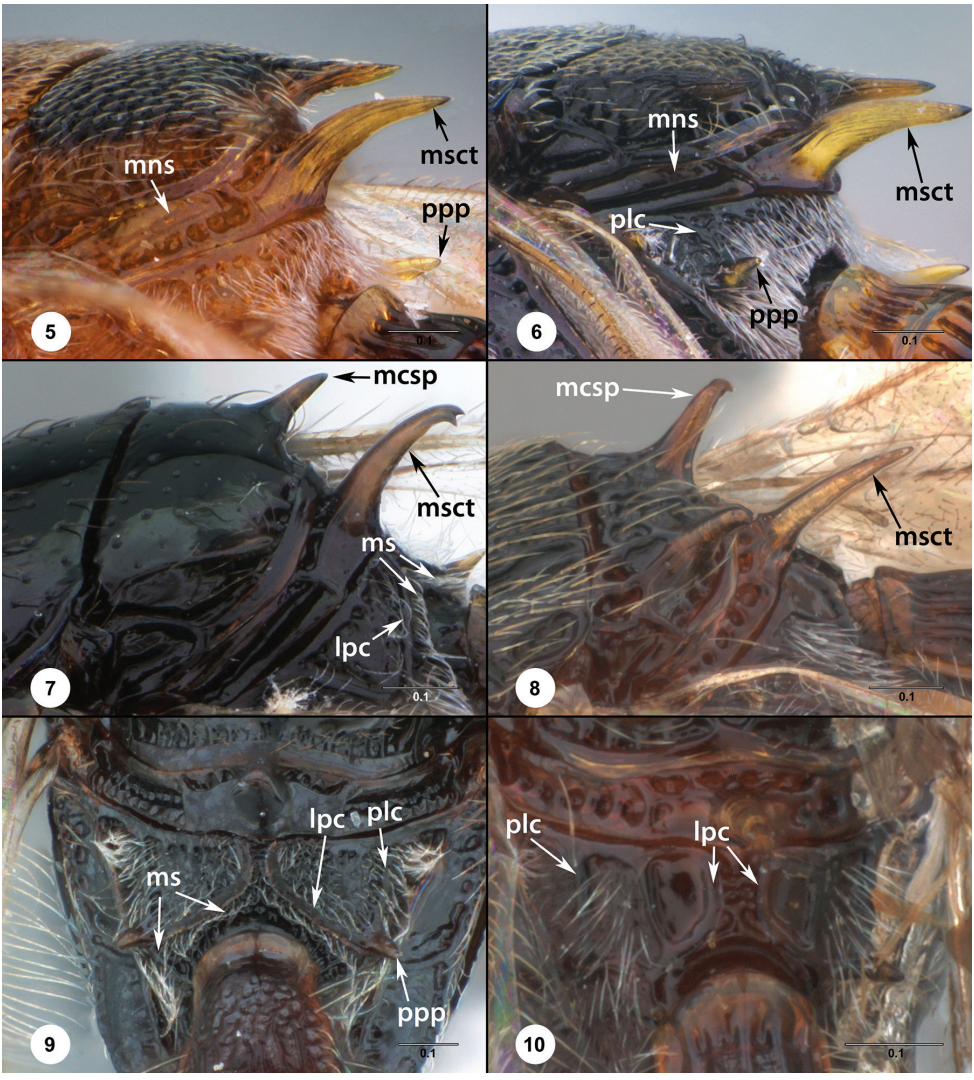

Figure 5–10. 5 *D. agamades*, female (USNMENT01109190), mesosoma, posterolateral view **6** *D. mikuki*, female (USNMENT01109213), mesosoma, posterolateral view **7** *Trimorus* sp., female (OSUC 186090), posterior mesosoma, dorsolateral view **8** *Gryonoides glabriceps* Dodd, female (USNMENT00872142), posterior mesosoma, dorsolateral view, anterolateral view **9** *Trimorus* sp., female (OSUC 1924417), mesosoma, posterior view **10** *Gryonoides glabriceps* Dodd, female (USNMENT00872142), mesosoma, posterior view. Scale bars in millimeters.

Color of antennae in female: A1–A2 orange, otherwise brown. Color of mesosoma: dorsal mesoscutellum black, otherwise orange. Color of head: black. Number of labial palpomeres: 1. Number of maxillary palpomeres: 4. Setation of torular triangle: present. Continuity of torular triangle and central keel: torular triangle closed dorsally, continuous complete central keel. Color of interantennal process: yellow. Setation of

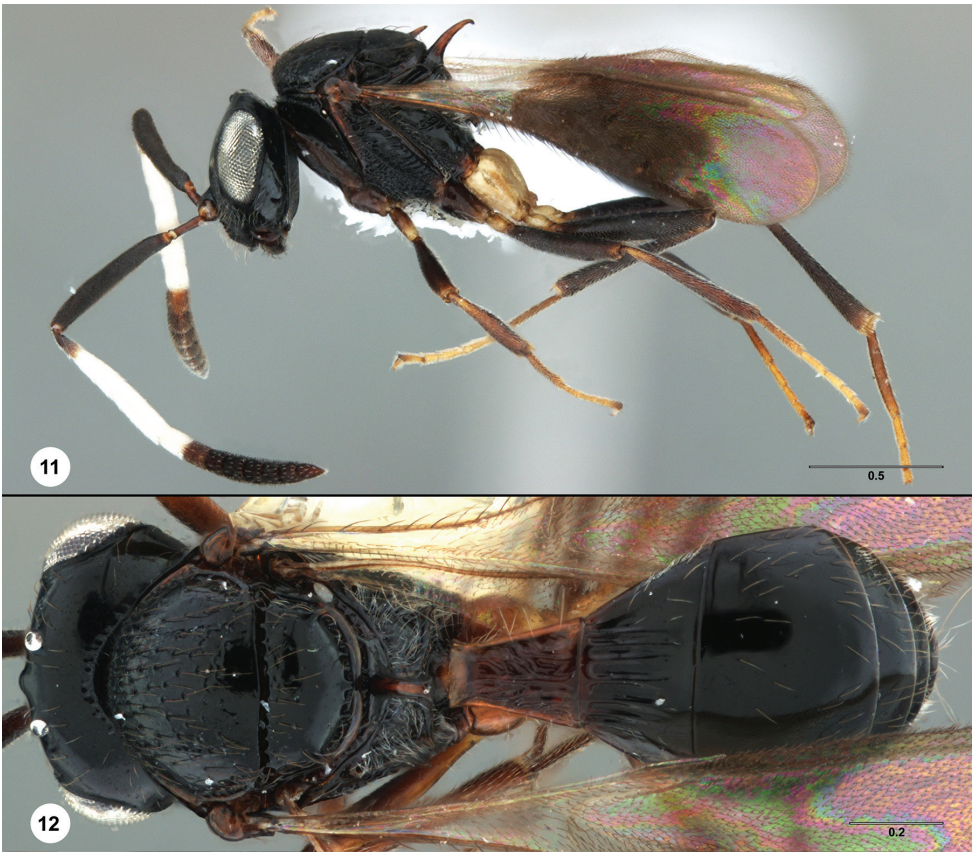

Figure 11–12. 11 *Trimorus* sp., female (OSUC 186090) head, mesosoma, metasoma, lateral view **12** *Trimorus* sp., male (OSUC 345677), head, mesosoma, metasoma, dorsal view. Scale bars in millimeters.

frons: transverse strip directly above interantennal process glabrous, otherwise setose. Sculpture of dorsal frons: dorsoventrally strigose. Sculpture of vertex: rugulose; very finely punctate. Epomial carina: present. Netrion in lateral view: present only at ventral limit of pronotum. Sculpture of vertical face of pronotum: smooth. Ventral propleural area: smooth. Sculpture of propleural cervical sulcus: foveolate. Sculpture of mesoscutum: punctate to finely areolate, coarser in posterior half. Notaulus: weakly indicated posteriorly amid sculpture. Sculpture of scutoscutellar sulcus: smooth; smooth along posterior margin of mesoscutum, anterior margin of mesoscutellum with ridges laterally. Orientation of transaxillar carina: parallel to longitudinal axis of body. Sculpture of mesoscutellum: punctate to areolate; rugose. Density of setae on lateral margin of mesoscutellum: dense. Posterior margin of mesoscutellum: concave between mesoscutellar spines. Median mesoscutellar spine: present. Lateral extreme of posterior scutoscutellar sulcus: foveae extending to axillula. Sculpture of metanotal trough: foveolate. Sculpture of lateral propodeal area: irregularly rugose. Lateral propodeal carina: present. Plica: present. Forewing pattern in female: wing uniform in color. Forewing color

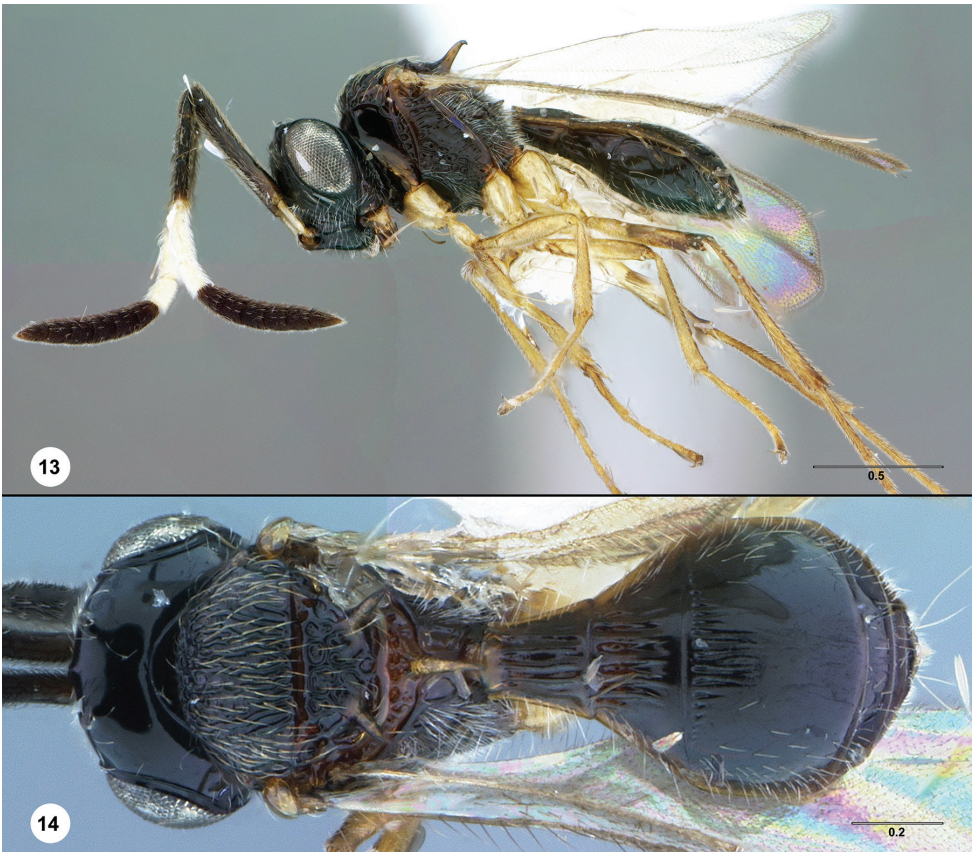

Figure 13–14. *Gryonoides glabriceps*, female (USNMENT00872142), **13** head, mesosoma, metasoma, lateral view **14** head, mesosoma, metasoma, dorsal view. Scale bars in millimeters.

in male: uniform throughout. Sculpture of metapleural sulcus: smooth. Sculpture of dorsal metapleural area: smooth; transversely rugose. Sculpture of ventral metapleural area: transversely rugose. Number of setae on lateral T1: 2; 3; 4; many. Sculpture of T4: smooth. Lateral patch on T5: present.

Diagnosis. *Dvivarnus agamades* can be separated from *D. elektrolythron* 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 Luói, 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,

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. Budsawong (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 Kraborg, # 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, 16°43.156'N, 101°35.118'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, 12°32.149'N, 99°28.265'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, 12°32.149'N, 99°28.265'E, Kaeng Krachan National Park, no date, Malaise trap, Thongbai (2 females, USNMENT01109174, USNMENT01109178 (CNCI)). Phetchaburi Prov., km33 / helipad, T4693, 735m, 12°50.177'N, 99°20.688'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. Setation of torular triangle: present. Continuity of torular triangle and central keel: torular triangle opened dorsally, not continuous reduced central keel. Color of interantennal process: yellowish brown. Setation of frons: transverse strip directly above interantennal process glabrous, otherwise setose. Sculpture of dorsal frons: strigose. Sculpture of vertex: strigose.

Epomial carina: indistinguishable from dorsoventral striation. Netrion in lateral view: extending dorsally to proximity of mesothoracic spiracle. Netrion sulcus: complete, extending dorsally to posterior margin of pronotum. Sculpture of vertical face of pronotum: dorsoventrally strigose anteriorly, longitudinal striate posteriorly. Sculpture of mesoscutum: finely punctate. Density of setation on medial mesoscutum: dense. Notaulus: absent. Sculpture of scutoscutellar sulcus: smooth. Orientation of transaxillar carina: projecting posterolaterally. Sculpture of mesoscutellum: finely areolate. Density of setae on lateral margin of mesoscutellum: sparse. Posterior margin of mesoscutellum: convex between mesoscutellar spines. Median mesoscutellar spine: present. Lateral extreme of posterior scutoscutellar sulcus: foveae terminating below mesoscutellar spine. Sculpture of metanotal trough: smooth with elongate furrow in ventral half. Lateral propodeal carina: absent. Forewing pattern in female: wing membrane and setae brown posterior to marginal vein and in distal third, separated by a band of hyaline membrane and white setae. Sculpture of metapleural sulcus: smooth. Sculpture of dorsal metapleural area: transversely rugose. Sculpture of ventral metapleural area: transversely rugose. Number of setae on lateral T1: 3. Sculpture of T4: punctate. Lateral patch on T5: present. Number of apical setae on T7: 2.

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 mesosoma of this species. It is derived from the words *elektron* which in Classical Greek means "amber" and, by extension in modern times, "electricity", and *lythron,* meaning "gore". The name is treated as a noun in apposition.

Link to distribution map. http://hol.osu.edu/map-large.html?id=403212

Material examined. Holotype, female: **IVORY COAST**: Savanes Rég., Korhogo Dept., Konborodougou, 18.III–21.III.1984, M. Matthews, USNMENT01109168 (deposited in CNCI).

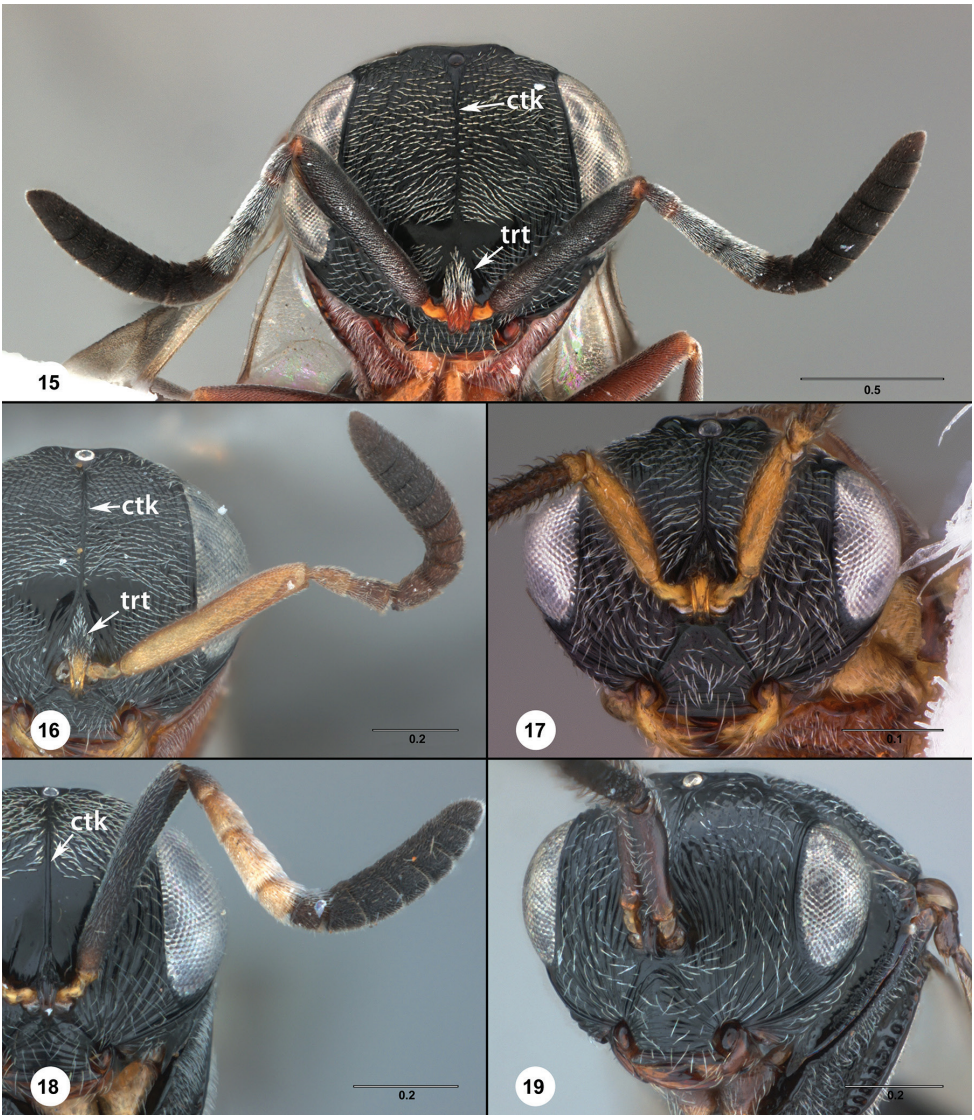

Figure 15–19. 15 *Dvivarnus elektrolythron*, female holotype (USNMENT01109168), head and antennae, anterior view **16** *D. agamades*, female (USNMENT01109190), head, anterior view **17** *D. agamades*, male (USNMENT01109177), head, anterior view **18** *D. mikuki*, female paratype (USNMENT01109214), head and antenna, anterior view **19** *D. mikuki*, male (USNMENT01109158), head, anterior view. Scale bars in millimeters.

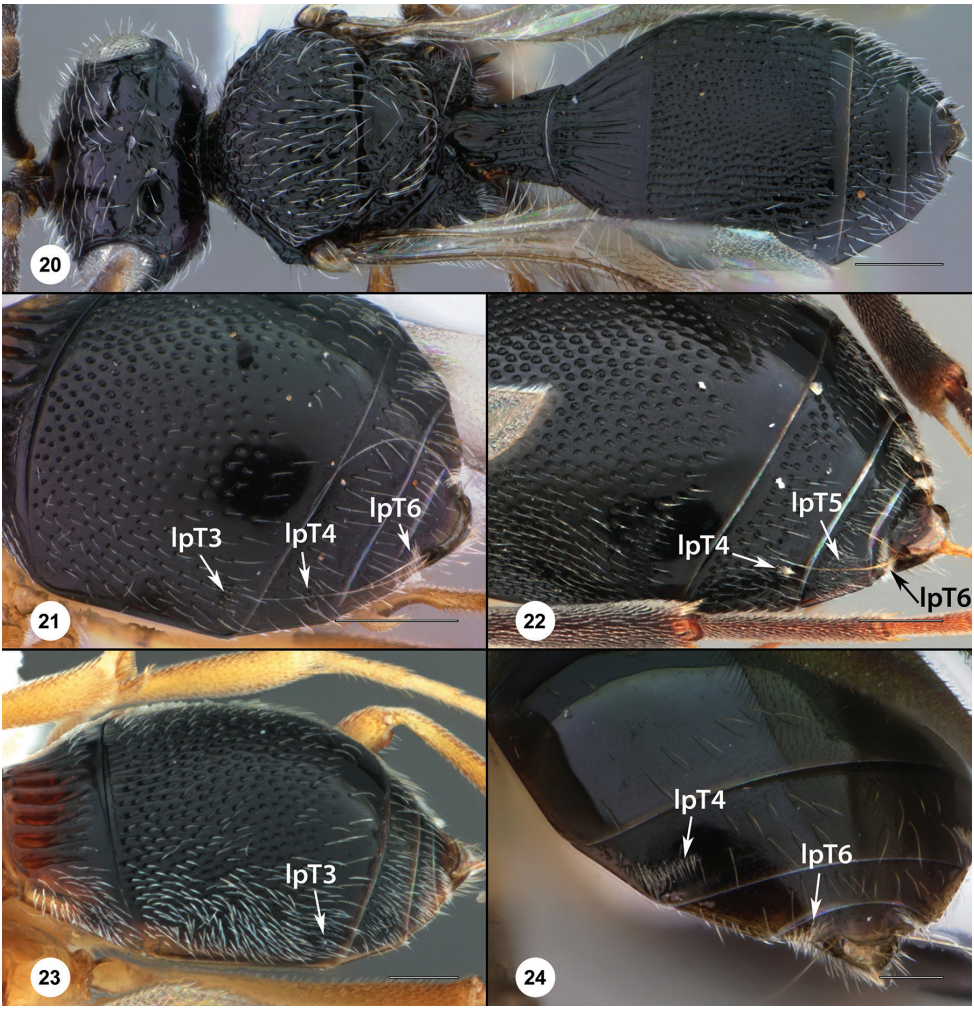

Figure 20–24. 20 *Trimorus* sp., female (USNMENT01109195), head, mesosoma, metasoma, dorsal view **21** *Dvivarnus mikuki*, female (USNMENT01109213), metasoma, dorsolateral view **22** *D. elektrolythron*, female (USNMENT01109168), metasoma, dorsolateral view **23** *D. agamades*, female (USNMENT01109174), 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

Description. Whorl of setae on flagellomeres in male: absent. Shape of A3–A11 in male: cylindrical. Color of antenna in male: brown. Color of antennae in female:

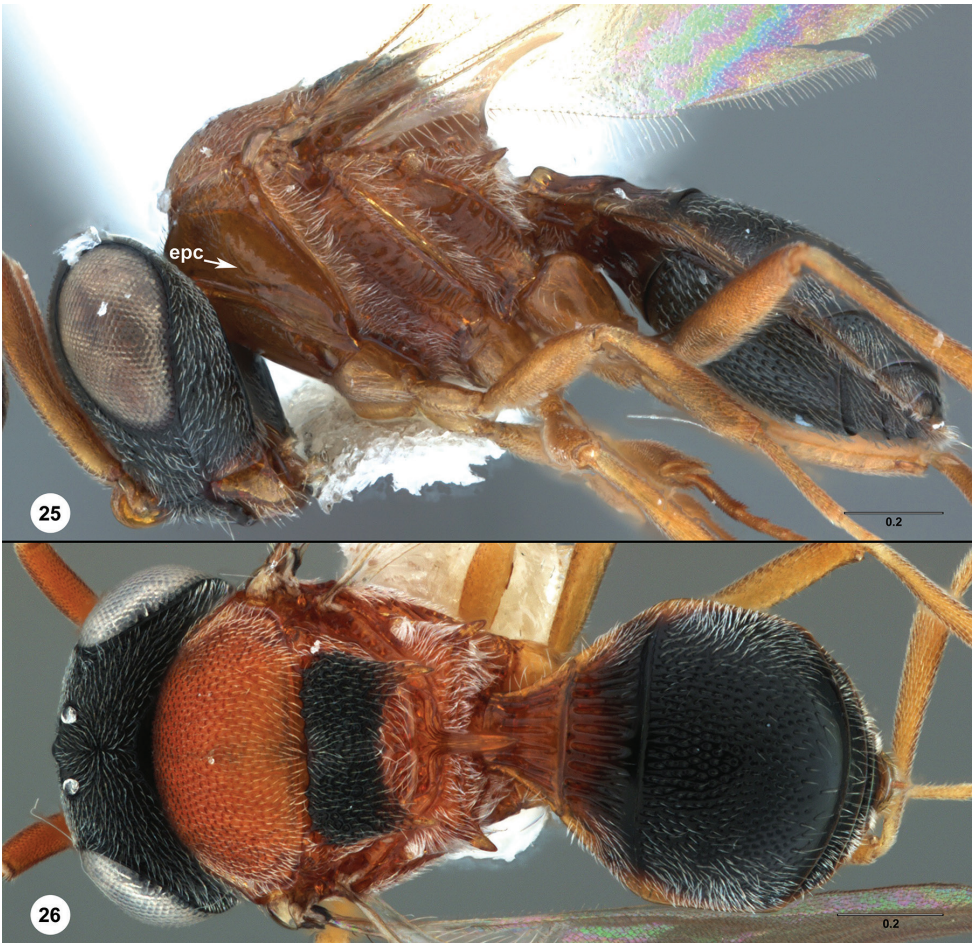

Figure 25–26. *Dvivarnus agamades*. **25** female (USNMENT01109183), head, mesosoma, metasoma, lateral view **26** female (USNMENT01109174), head, mesosoma, metasoma, dorsal view. Scale bars in millimeters.

A1 brown, A2 brown to yellow, A3–A5 yellow with white setae, A6–A16 brown. Color of mesosoma: black, with yellow metascutellar spine. Color of head: black. Setation of torular triangle: absent. Continuity of torular triangle and central keel: torular triangle closed dorsally, continuous complete central keel. Setation of frons: area above interantennal process glabrous, otherwise setose. Sculpture of dorsal frons: dorsoventrally strigose. Sculpture of vertex: smooth; concentrically strigose. Epomial carina: absent. Netrion in lateral view: present only at ventral limit of pronotum. Ventral propleural area: smooth. Sculpture of propleural cervical sulcus: smooth. Sculpture of mesoscutum: punctate to finely areolate, coarser in posterior half. Density of setation on medial mesoscutum: dense. Notaulus: absent; weakly

Figure 27. *Dvivarnus elektrolythron*, female holotype (USNMENT0109168), head, mesosoma, metasoma, lateral view. Scale bar in millimeters.

indicated posteriorly amid sculpture. Sculpture of scutoscutellar sulcus: smooth. Orientation of transaxillar carina: parallel to longitudinal axis of body. Shape of axillula: bent ventrolaterally distally. Sculpture of mesoscutellum: punctate to areolate. Density of setae on lateral margin of mesoscutellum: sparse. Posterior margin of mesoscutellum: concave between mesoscutellar spines. Median mesoscutellar spine: absent. Lateral extreme of posterior scutoscutellar sulcus: foveae extending to axillula. Sculpture of metanotal trough: smooth with elongate furrow in ventral half. Lateral propodeal carina: absent. Plica: present. Forewing pattern in female: wing membrane and setae brown posterior to marginal vein and in distal third, separated by a band of hyaline membrane and white setae. Forewing color in male: uniform throughout. Sculpture of metapleural sulcus: transverse portion smooth, dorsoventral portions foveolate. Sculpture of dorsal metapleural area: smooth. Sculpture of ventral metapleural area: transversely rugose; smooth. Number of setae on lateral T1: 3; 4. Sculpture of T4: smooth. Lateral patch on T5: absent. Number of apical setae on T7: 4. Transverse line of pits on anterior S1: present.

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,

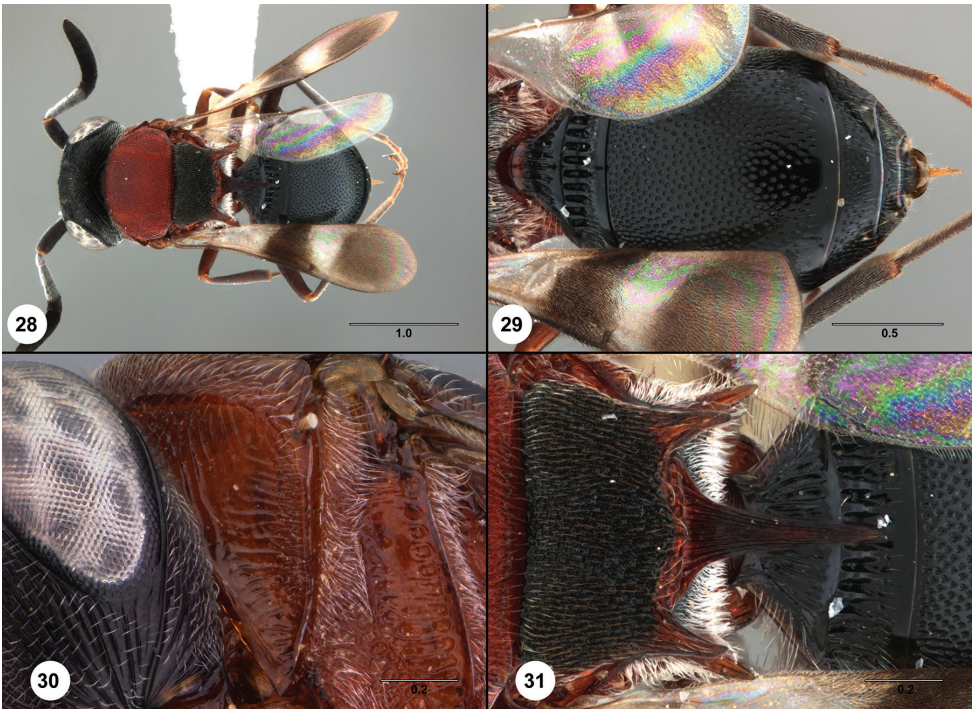

Figure 28–31. *Dvivarnus elektrolythron*, female holotype (USNMENT0109168) **28** head, mesosoma, metasoma, dorsal view **29** metasoma, dorsal view **30** pronotum, anterolateral view **31** posterior mesosoma, dorsal view. Scale bars in millimeters.

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

Material examined. Holotype, female: **KENYA**: Nairobi Co., International Centre of Insect Physiology and Ecology (ICIPE) campus, nr. stream / meadow / degraded shrub-grassland, 1600m, 01.22317°S 36.89653°E, Kasarani, 27.V-3.VI.2014, Malaise trap, R. Copeland, USNMENT01059120 (deposited in NMKE). *Paratypes*: (11 females, 8 males) **BENIN**: 25km N Cotonou, Abomey-Calavi, XII-1988, J. S. Noyes (1 male, USNMENT01109165 (CNCI)). **KENYA**: Kilifi Co., 3.30958° S 39.96538°E, Arabuko-Sokoke Forest 80 m, 22.VIII-5.IX.2014, Malaise trap, R. Copeland (1 male, USNMENT01109193 (USNM)). Kilifi Co., indigenous forest / secondary forest, 19m, 03.30946°S 40.01941°E, Gede Forest, 11.XII-25.XII.2011, Malaise trap, R. Copeland (2 females, USNMENT01059122-01059123 (USNM)).

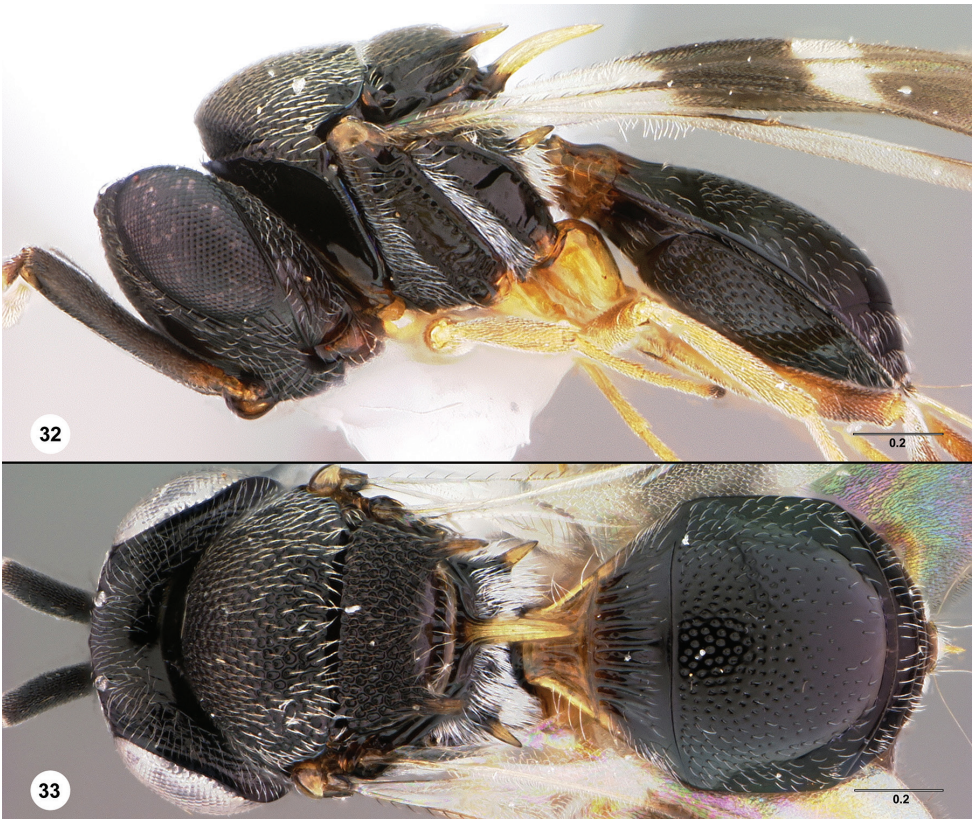

Figure 32–33. *Dvivarnus mikuki.* **32** female holotype (USNMENT01059120), head, mesosoma, metasoma, lateral view **33** female paratype (USNMENT01059121), head, mesosoma, metasoma, dorsal view. Scale bars in millimeters.

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,

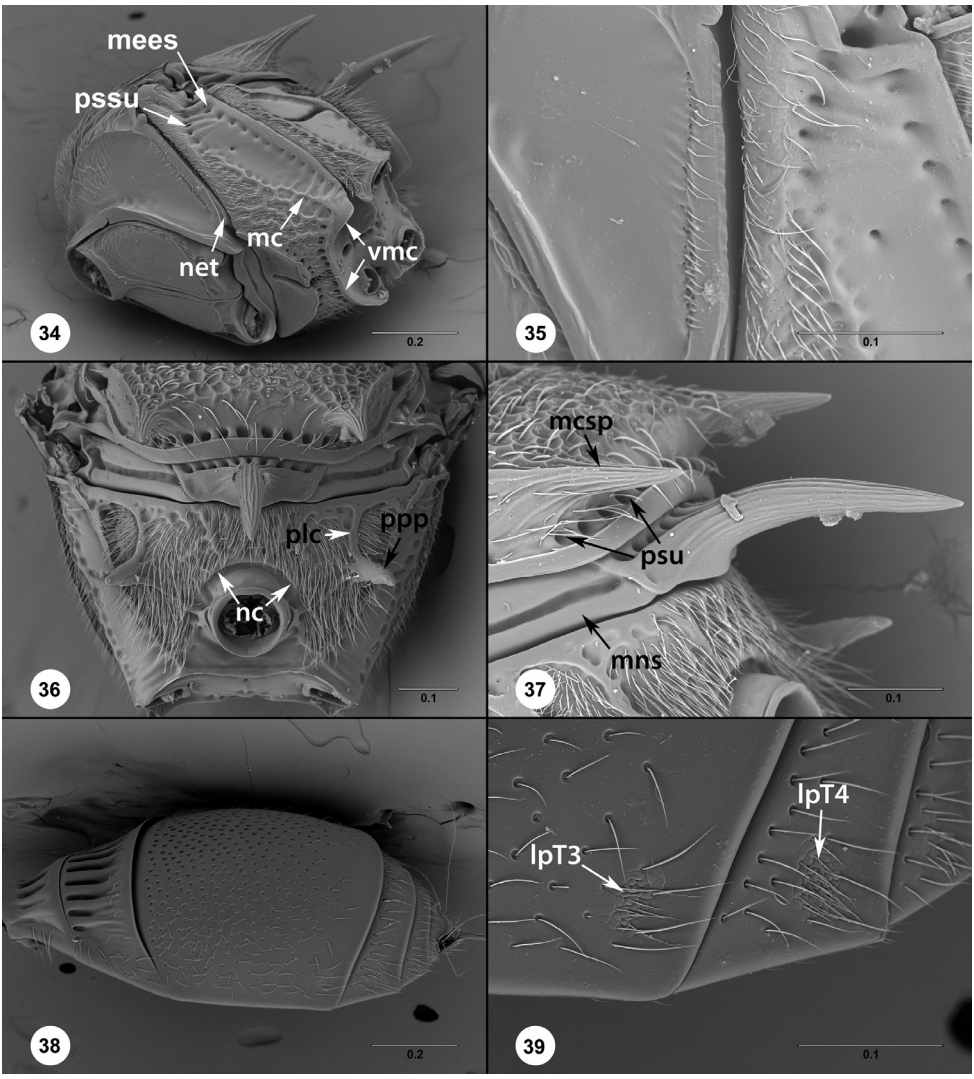

Figure 34–39. *Dvivarnus mikuki*, female paratype (USNMENT010591135) **34** mesosoma, anterolateral view **35** posterior pronotum, lateral view **36** mesosoma, posterior view **37** posterior mesosoma, posterolateral view **38** metasoma, dorsolateral view **39** T3–T5, dorsolateral view. Scale bars 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)).

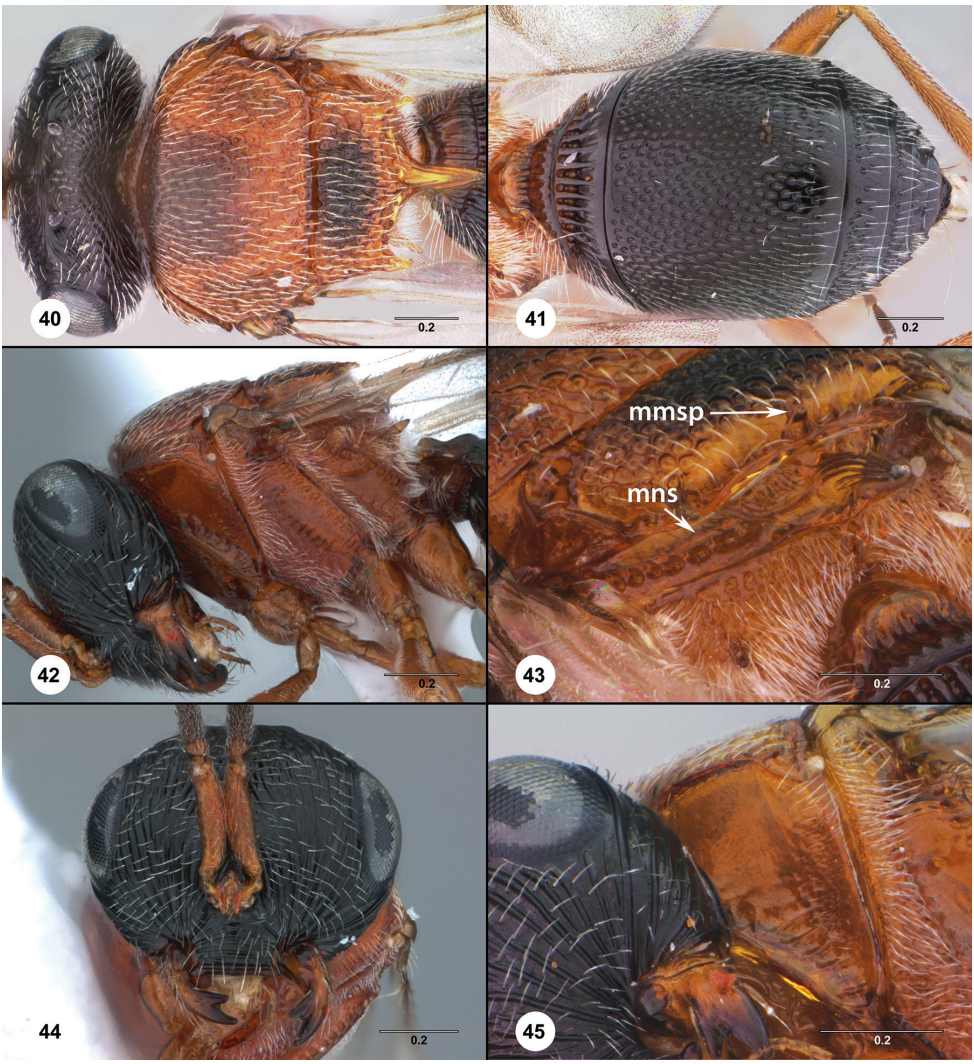

Figure 40–45. *Dvivarnus* sp., male (USNMENT01109212). **40** head and mesosoma, dorsal view **41** metasoma, dorsal view **42** head and mesosoma, lateral view **43** mesosoma, posterodorsal view **44** head, anterior view **45** pronotum, anterolateral view Scale bars in millimeters.

Dvivarnus sp., male

Figures 40–45

Dvivarnus sp., male

Figures 46–50

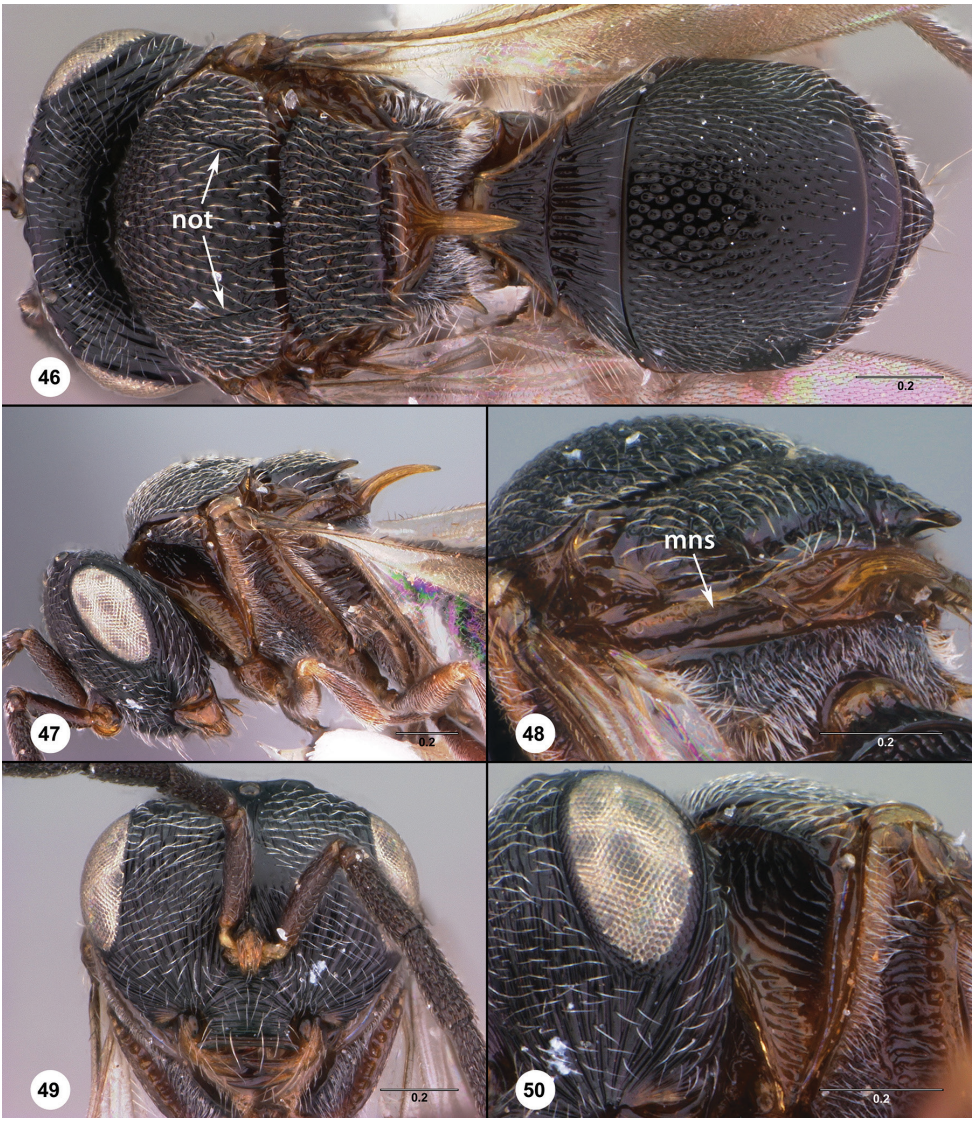

Figure 46–50. *Dvivarnus* sp., male (USNMENT01109164) **46** head, mesosoma metasoma, dorsal view **47** head and mesosoma, lateral view **48** mesosoma, posterolateral view **49** head, anterior view **50** pronotum, anterolateral view. Scale bars in millimeters.

Acknowledgements

We thank Lubomír Masner, Andy Bennet (CNCI), and Luciana Musetti (OSUC) for the loans of material that made this revision possible. We thank Norman Johnson (OSUC) for developing and maintaining the Hymenoptera Online Database, Specimage, and vSysLab, which underlie the cybertaxonomy conducted here and Joe Cora (OSUC) for providing invaluable database support. Ashton Smith, Trenton Jung, and

Pei Luo (USNM) contributed many of the photographs used to illustrate these species. Luke Kresslein (USNM) contributed scanning electron micrographs. We thank Juliet Muriuki, Mzee Hamisi Muhamed Shee, Kazungu Katana, Beatrice Elesani and Mathias Ngonyo for excellent field work. Dr. Miguel Alonso-Zarazaga (MNCN) provided valuable input on etymology. This work was made possible by funding from the Systematic Entomology Lab, USDA-ARS. The USDA does not endorse any commercial product mentioned in this research. USDA is an equal opportunity provider and employer. István Mikó was supported by the U. S. National Science Foundation (grant DBI-1356381).

References

Balhoff JP, Mikó IM, Yoder MJ, Mullins P, Deans AR (2013) A semantic model for species description applied to the ensign wasps (Hymenoptera: Evaniidae) of New Caledonia. Systematic Biology 62: 639–659. doi: 10.1093/sysbio/syt028

Hagedorn G, Catapano T, Güntsch A, Mietchen D, Endresen D, Sierra S, Groom Q, Biserkov J, Glöckler F, Morris R (2013) Best practices for stable URIs. http://wiki.pro-ibiosphere.eu/wiki/Best_practices_for_stable_URIs

Kozlov MA, Lê XH (1986) [New species of scelionids (Hymenoptera, Scelionidae) of the fauna of Vietnam.] Trudy Zoologicheskogo Instituta Akademii Nauk SSSR 159: 89–102.

Lê XH (2000) Egg-parasites of family Scelionidae (Hymenoptera). Fauna of Vietnam (vol. 3). Science and Technics Publishing House, Hanoi, 386 pp.

Mikó I, Copeland RS, Balhoff JP, Yoder MJ, Deans AR (2014) Folding Wings like a Cockroach: A Review of Transverse Wing Folding Ensign Wasps (Hymenoptera: Evaniidae: *Afrevania* and *Trissevania*). PLoS ONE 9: e94056. doi: 10.1371/journal.pone.0094056

Nixon GEJ (1936) The African species of Teleasinae (Hym., Proctotrupoidea, Fam. Scelionidae). Annals and Magazine of Natural History 17: 114–191.

Talamas EJ, Buffington ML (2014) Updates to the nomenclature of Platygastroidea in the Zoological Institute of the Russian Academy of Sciences. Journal of Hymenoptera Research 39: 99–117. doi: 10.3897/JHR.39.7698

Veenakumari K, Rajmohana K, Manickavasagam S, Mohanraj P (2011) On a new genus of Teleasinae (Hymenoptera: Platygastridae) from India. Biosystematica 5: 39–46

Yoder MJ, Mikó I, Seltmann K, Bertone MA, Deans AR (2010) A gross anatomy ontology for Hymenoptera. PLoS ONE 5(12): e15991. doi: 10.1371/journal.pone.0015991

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.

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).