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Bolbaffroides dhofarensis (Coleoptera: Bolboceratidae), a new species from Oman

DAVID KRÁL[1], OLIVER HILLERT[2], LADISLAV MENCL[3] & DAVID SOMMER[1]

[1] *Department of Zoology, Faculty of Science, Charles University, Viničná 7, CZ-128 43 Praha 2, Czech Republic.*
kral@natur.cuni.cz; https://orcid.org/0000-0002-7930-1927
dejv.sommer@gmail.com; https://orcid.org/0000-0003-4519-9677

[2] *Kieferndamm 10, D-15566 Schöneiche bei Berlin, Germany.*
o.hillert@yahoo.de; https://orcid.org/0000-0002-8652-1936

[3] *Masarykovo náměstí 5, CZ-281 26 Týnec nad Labem, Czech Republic.*
l.mencl@centrum.cz

Abstract

Bolbaffroides dhofarensis Král, Hillert, Mencl & Sommer, **new species**, from Dhofar Governorate in south-western Oman is described. Relevant diagnostic characters (*e.g.*, head and pronotum shape) of the new species and type material of two morphologically similar species, *B. rollii* (J. Müller, 1941) and *B. validus* (Klug, 1843) are photographically documented.

Key words: Scarabaeoidea, Bolboceratinae, Bolboceratini, taxonomy, description, Dhofar, Arabian peninsula, Palaearctic region, Afrotropical region.

Introduction

Bolbaffroides Nikolajev, 1979 belongs to the less numerous genera of the family Bolboceratidae. Until recently, this genus included only seven taxa on the species level, distributed in the Saharo-Sindian region and adjacent semi-arid regions in eastern Africa (Krikken 1978, 1984; Nikolajev 2003; Nikolajev *et al.* 2016; Schoolmeesters 2021). Originally, several species of the current genus *Bolbaffroides* were described in the genus *Bolboceras* Kirby, 1819 (Krikken 1978). Subsequently, Vulcano *et al.* (1969) described the new genus *Bolboceroides* Vulcano, Martinez & Pereira, 1969 with the type species *Bolboceras capense* Klug, 1843. Krikken (1978) transferred all taxa of the current genus *Bolbaffroides* to the genus *Bolboceroides* and described a new species and a new subspecies in this genus. Krikken (1978) also established and revised a species group "*Bolboceroides validus*", and made a diagnosis for this species group and individual taxa. Following Krikken's (1978) revision, Nikolajev (1979) described the new subgenus *Bolbaffroides* and defined it within the genus *Bolbaffer* Vulcano, Martinez & Pereira, 1969. However, Nikolajev (1982) did not mention this subgeneric status in his review of the genus *Bolbaffer*. Finally, Krikken (1984) elevated the taxon *Bolbaffroides* to a genus and transferred all taxa from the "*Bolboceroides validus* group" to this genus.

The phylogenetic relationships in the genus *Bolbaffroides* and its relationship to other genera are unknown. Krikken (1978) merely stated that the genus *Bolbaffroides* was closely related to the "*Bolboceras iphicles* group" (now genus *Namibiobolbus* Krikken, 1984), but in a subsequent paper (Krikken 1984) changed his mind, and considered the genus *Bolbaffroides* to be closely related to the genus *Bolbohamatum* Krikken, 1980.

The biology of the genus *Bolbaffroides* is still unknown. Adults may feed on subterranean fungi like many other genera in the family Bolboceratidae (*cf.* Howden *et al.* 2007). Adults of *Bolbaffroides* are often collected at light in open vegetation in semi-arid or arid areas (Krikken 1978).

Recently collected *Bolbaffroides* material in the Dhofar Governorate, Oman, included another undescribed species whose formal description we present below.

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Material and methods

The material was examined with an Olympus SZ61 stereomicroscope and a Nikon SMZ 745 stereomicroscope, measurements were taken with an ocular grid. The habitus photographs were taken using a Canon EF-S 60mm f/2.8 Macro USM lens attached to a Canon EOS 70D camera. Partially focused images of each specimen were combined using Zerene Stacker (Zerene Systems LLC, Richland, USA). All images were digitally enhanced using Adobe Photoshop CC.

The following codes identify the collections housing the material examined (curators are given in parentheses).

BMCP	Bruno Massa collection, Palermo, Italy;
DSCP	David Sommer collection, Praha, Czech Republic;
GMCL	Geoffrey Miessen collection, Liège, Belgium;
JPCH	Jan Pelikán collection, Hradec Králové, Czech Republic;
LMCT	Ladislav Mencl collection, Týnec nad Labem, Czech Republic;
MCST	Museo Civico di Storia Naturale, Trieste, Italy (Andrea Colla);
MNHB	Museum für Naturkunde, Berlin, Germany (Joachim Villers, Bernd Jäger);
OHCB	Oliver Hillert collection, Schöneiche bei Berlin, Germany;
NMPC	National Museum, Praha, Czech Republic (Jiří Hájek);
PKCL	Pavel Kučera collection, Liberec, Czech Republic;
SJCP	Stanislav Jákl collection, Praha, Czech Republic.

Specimens of the newly described species are provided with one red label "Bolbaffroides | dhofarensis sp. nov. | HOLOTYPUS ♂, ALLOTYPUS ♀ [or] PARATYPUS ♂ [or] ♀ | David Král, Oliver Hillert, | Ladislav Mencl & David | Sommer det. 2021" (see Figs. 7A–B). Verbatim label data are cited for the type material, individual lines of every label are separated by a vertical bar ("|"), individual labels by a double vertical bar ("||"). Information in quotation marks (" ") indicates the original spelling. Our remarks and additional comments are found in brackets ("[]"), [p]—preceding data within quotation marks are printed, [hw]—the same but handwritten.

Morphological terminology used mainly follows Krikken (1978) and Sommer *et al.* (2021). In accordance with the concept of the Scarabaeoidea family / subfamily classification used in the studies of Ahrens *et al*. (2014) and Scholz & Grebennikov (2016) we consider Bolboceratidae to be a family.

Examined type material for comparison with the most morphologically similar species:

Bolbaffroides rollii (J. Müller, 1941)

(Figs. 4A–D, 5A–C, 7C-D)

Bolboceras Rollii J. Müller, 1941: 347 (type locality: "[Eritrea] Asmara").

Type material examined. Eritrea. Holotype, ♂ [aedeagus destroyed] (MCST) (Figs. 4A–D), "ERITREA | Asmara | Dott Rolli. 1939 [p] || Museo Civico | di Trieste [p] || TYPUS [p, red label] || Bolboceras | Rollii n. sp. | Typus [hw] | det. G. Müller 940 [p] || jk [= Jan Krikken] [19]7709[= ix.1977] [hw] [see also Fig. 7C]". **Paratype,** ♀ (MCST) (Figs. 5A–C), "TESSENEI 8.35 [= viii.1935] | Eritrea | [A.] Remedelli [lgt.] [p] || ♀ [hw] || Museo Civico | di Trieste [p] || COTYPUS [p, red label] || identisch mit | 1 ex[emplar]. aus Sua- | kin [= nowadays Sawakin in Sudan, ca. 19°05'59"N 37°19'49"E] (Deut[sche]. Tief- | see exped[ition]. Wien | Mus[eum].) | vom Felsche | als unbe- | kannt bez[eichnet] [hw] [see also Fig. 7D]".

Bolbaffroides validus (Klug, 1843)

(Figs. 6A–D, 7 E–F)

Bolboceras validus Klug, 1843: 47 (type locality: " Das wüste Arabien [= the desert of Arabia]").

Type material examined. "Arabia deserta". Holotype, ♂ [aedeagus destroyed] (MNHB) (Figs. 6A–D), "validus | Klug * | Arab. des. Ehrbg. [= Arabia deserta, Ehrenberg lgt.] [hw, green label, very poorly readable] || validum Kl. [= Klug] * [hw, blue label] || 25661 [p] || Type [p, red label] || jk [= Jan Krikken] [19]76 [hw] || Zool. Mus. [=

Zoologiches Museum] | Berlin [p, yellow label] || Bolbaffroides | validus (Klug) [hw] || HOLOTYPUS | Bolboceras | validus Klug, 1845 | labelled by MNHUB 2015 [p, red label] [see also Fig. 7E]".

Note. "Arabia deserta" was one of three regions into which the Romans divided the Arabian peninsula: Arabia Deserta, Arabia Felix, and Arabia Petraea. Also known as Arabia Magna ("Great Arabia"), signified the desert interior of the Arabian peninsula. Today, this region covers approximately the territory of Bahrain, Oman, Qatar, Saudi Arabia, and United Arab Emirates. Based on known material of *B. validus*, we can assume that the specimen probably was collected in the territory of Saudi Arabia (Klug 1843; Krikken 1978; Nikolajev 2003).

Taxonomy

Bolbaffroides dhofarensis Král, Hillert, Mencl & Sommer, new species

(Figs. 1A–D, 2A–D, 3A–C, 7A–B)

Type locality. Oman, Dhofar Province, Jabal al Qamar, wadi W of Al Mughsayl, 16°50'41"N 53°41'10"E, ca. 600 m a.s.l.

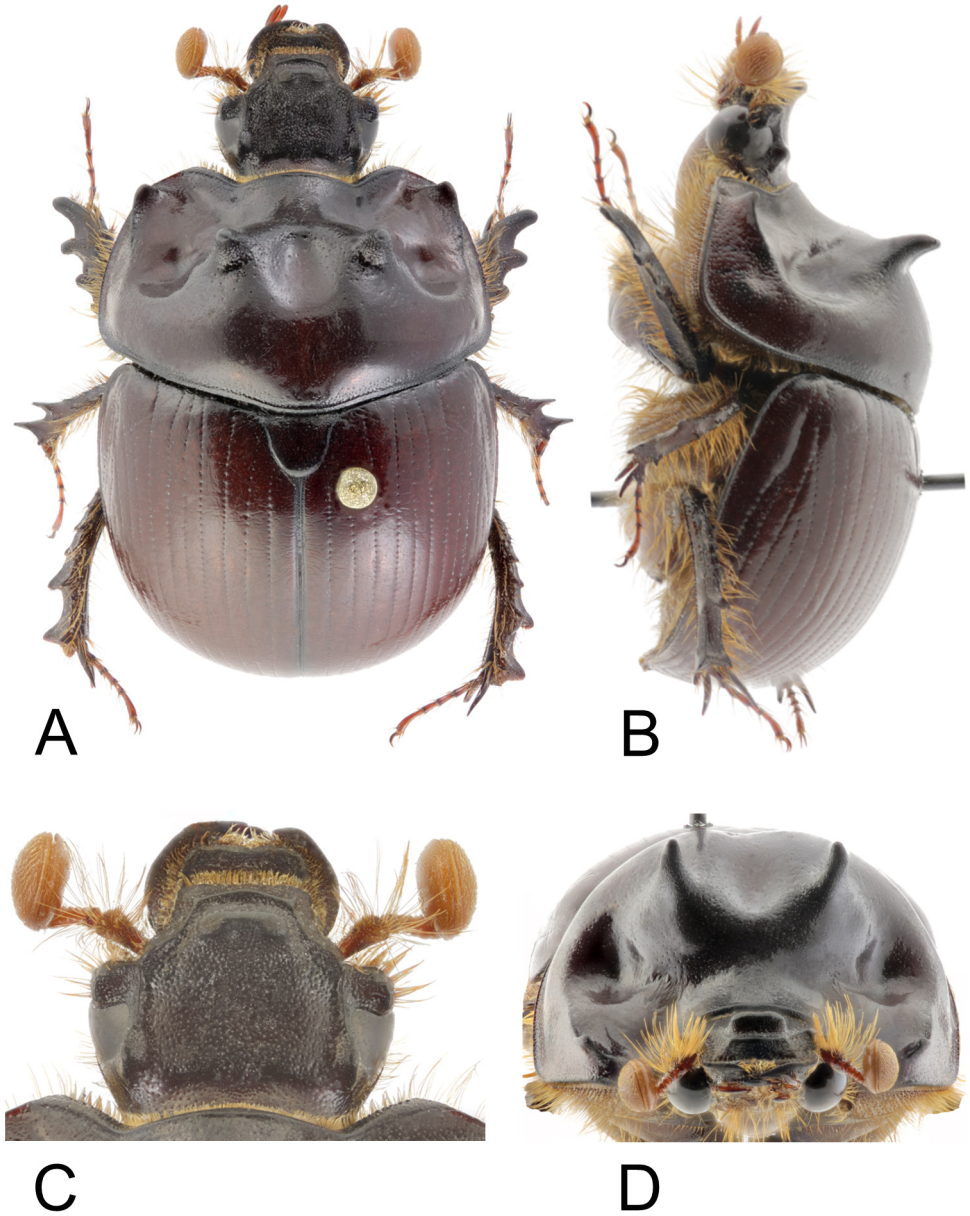

FIGURE 1A–D. *Bolbaffroides dhofarensis* Král, Hillert, Mencl & Sommer, **new species**, holotype (♂). A, habitus in dorsal view; B, habitus in left lateral view; C, head in dorsal view; D, head and pronotum in frontal view. Not to scale.

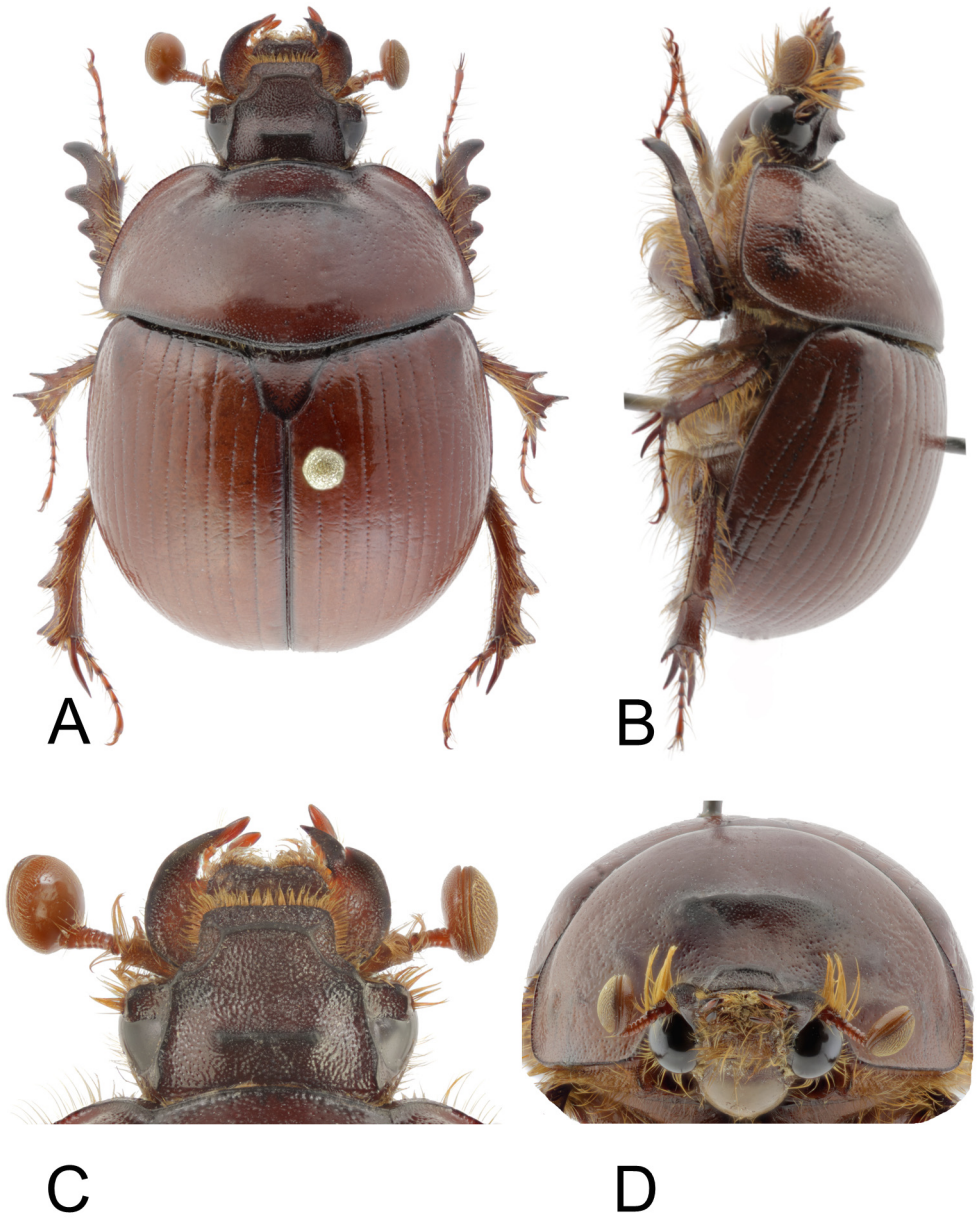

FIGURE 2A–D. *Bolbaffroides dhofarensis* Král, Hillert, Mencl & Sommer, **new species**, allotype (♀). A, habitus in dorsal view; B, habitus in left lateral view; C, head in dorsal view; D, head and pronotum in frontal view. Not to scale.

Type material (31 specimens). **Oman, Dhofar. Holotype,** ♂ (NMPC) (Figs. 1A–D), "OMAN, Dhofar Province | *Jabal al Qamar* | W Al Mughsayl - Wádí | N 16.84497° E 53.68615° | 20 - 31.8.2012 | lgt. P. Kučera [p] [see also Fig. 7A]". **Paratypes: allotype,** ♀ (NMPC) (Figs. 2A–D), same data as holotype [see also Fig. 7B]; **paratypes,** 1 ♀ (LMCT), 6 ♂♂ 6 ♀♀ (PKCL), same data as holotype [see also Figs. 7A–B]; 1 ♂ (LMCT) (Figs. 3A–C), "same data as holotype || 2170 | Dok.L.Mencl,2015 [green label of ducumentation of LM]"; 1 ♂ (LMCT), "OMAN, Dhofar Province | *Jabal Samhán* | Tawi Atayr (Wádí Darbat) | N 17.08804° E 54.62313° | (786 m.n.m.) 25. 08. 2012 | lgt. P. Kučera [p]"; 1 ♂ 1 ♀ (SJCP), "Sultanate Oman, 1.1997 [= i.1997] | Dzhophar prov., Rakyut env. [ca. 16°44'52"N 53°25'23"E] | St. Jakl leg. 100 m [p]"; 1 ♂ (NMPC), "OMAN mer. | Darbaat | 18. - 21. 9. 2003 | R. Červenka lgt. [p] || ex coll. R. Červenka | National Museum | Prague, Czech Republic [p]"; 1 ♂ 1 ♀ (SJCP), "Sultanate of Oman 50m | Dhofar prov., 20 km E of | Salalah, Wadi Nashib [ca. 17°07'N 54°18'E] | 16.-22.ix.[20]06. St. Jakl leg. [p]"; 1 ♂ (OHCB), 1 ♀ (SJCP), "Sultanate of Oman | Dhofar prov. 16.-22.ix. | Wadi Nashib [ca. 17°07'N 54°18'E], 20 km E of | Salalah, 2006, 50 m alt. | St. Jakl leg. [p]"; 1 ♂ (NMPC), "S. Oman, W from Salalah | 20km W from Al | Mughsayl [ca. 16°50'N 53°41'E] h-640m slopes | to Arabian Sea (Camels) | 8-24.7.2007. | Krueger, Saldaitis leg [p]"; 1 ♂ (DSCP) 1 ♂ (NMPC), "Sultanate of Oman | Dhofar prov. 21.-31.VIII. | Wadi al Mughsayl [ca. 16°53'N

53°47'E] | 50 m, 29.-31.VIII.2007 | St. Jakl leg. [p]"; 1 ♀ (DSCP), "OM—prov. Dhofar | WADI AL MUGSHSAYL [ca. 16°53'N 53°47'E] | 06.-08.ix.2007 | Z. Košťál leg. [p]"; 1 ♂ 1 ♀ (BMCP), "Oman Dhofar 6.ix.2018 | Wadi Mughshail 47 m | 16°55"N 53°44'37"E | A. Carapezza leg. (light) [p]"; 1 ♂ (JPCH), "S Oman, Dhofar Gov. | 16km NW of Rayzut | 25.-26.9.2018 | lgt. Jan Pelikán || 16°59'50.956"N 192m | 53°49'11.832"E *wadi* | *riverside*, *pastures* | (at light) || COLLECTION | JAN PELIKÁN | HRADEC KRÁLOVÉ | CZECH REPUBLIC [p]" 1 ♂ 1 ♀ (GMCL), "Oman- Dhofar | 19km WSW Al Mughsayl | 7-12.VIII.2014 | S. Prepsl leg. [p].

Description of holotype (♂). *Body.* Remarkably convex, surface dark brown, shiny (Figs. 1A–B).

Head (Figs. 1A–D). Labrum scarcely emarginate apically, sides rounded, surface rugulose punctate, finely ridged along anterior margin. Clypeus with complete marginal ridge, which is slightly convex anteromedially, concave laterally; posteriorly thickened and elevated. Almost entire surface of head densely, coarsely, contiguously punctate. Frontoclypeal suture indistinct. Tranversal carina situated before genal angles, considerably developed, horn-like, almost straight, on margins thickened and elevated. Genae rectangular, bordered, separated from frons by distinct ridge extending from genal angle to vertex, posteriorly thick and elevated, anteriorly angulate, anterior margin medially thick and elevated.

Pronotum (Figs. 1A–B, D) distinctly transversal, broadest in about half of its length, sides feebly rounded, anterolateral angle shortly rounded, acute apically. Pronotal margin completely bordered, anterior margin reinforced with punctation. Pronotal punctation distinct, double, irregular, consisting of deeply impressed punctures, punctures separated by different distance, intermixed with very fine, pinned punctures. Sides of pronotum densely punctate. Marginal carina distinctly widened and elevated, with a row of fine punctures; lateral fovea present, densely punctate. Lateral hornlike apophyses well developed, directed distinctly upwards, rugopunctate subapically; between lateral and anterior apophyses distinct, deeply oval concavity with small fine punctation. Anterior hornlike apophyses distinctly elevated, almost straight in lateral view and angled anteriorly in lateral view.

Scutellum (Fig. 1A) triangularly elongate, punctate basally, shiny.

Elytra (Figs. 1A–B) approximately as long as wide, evenly convex, glabrous, surface shiny. Humeral umbone weak with a few fine small punctures. Between suture and humerus 7 distinct striae present along entire elytral length, all striae with distinct punctures, separated each other by approximately 1–2 their diameter; intervals flat, almost impunctate.

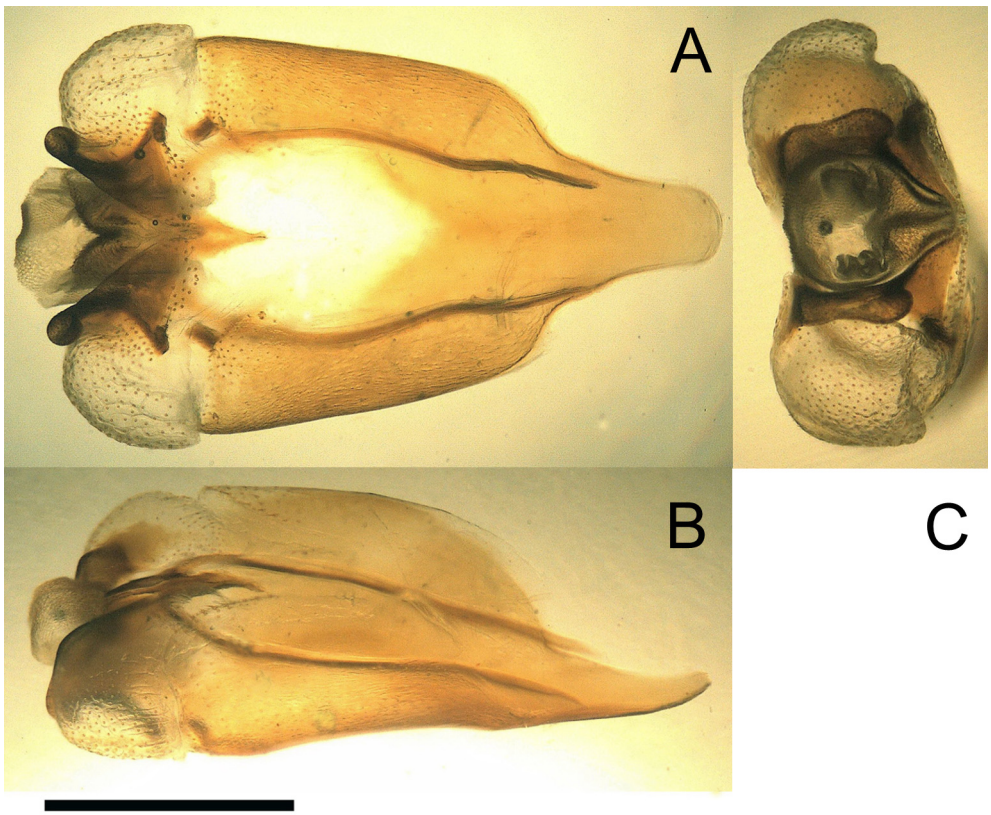

FIGURE 3A–C. *Bolbaffroides dhofarensis* Král, Hillert, Mencl & Sommer, **new species**, aedeagus of paratype from Al Mughsayl Wadi in LMCT. A, dorsal view; B, left dorso-lateral view; C, frontal view. Scale bar = 1 mm.

Ventrum. Surface pale brown, shiny with very long yellow-brown setae. Middle coxae distinctly separated.

Legs (Figs. 1A–B). Protibia with 7 external denticles, terminal spur acuminate, reaching half of protarsomere 2.

Aedeagus (Figs. 3A–C). Phallus simple, absent from pair of long sclerotized appendages.

Variability in males. Surface pale to dark brown; pronotum and head in several specimens darker than elytra. Transversal cephalic carina and pronotal hornlike apophyses in moderately developed and poorly developed (hypothelic) specimens short, less developed.

Female (allotype) (Figs. 2A–D). *Head* (Figs. 2A–D). Labrum scarcely emarginate apically, sides rounded, surface rugulose punctate, finely ridged along anterior margin. Clypeus with complete marginal ridge, slightly convex anteromedially, concave laterally. Almost entire surface of head densely, doubly, contiguously punctate; large punctures dense, rugulate, intermixed with fine ones. Frontoclypeal suture indistinct. Tranversal carina situated behind genal angles, well developed, almost straight, on margins and at middle only very weakly thickened and elevated. Genae rectangular, bordered, separated from frons by distinct ridge extending from genal angle to vertex, posteriorly slightly thick and elevated; angulate anteriorly, anterior margin medially thick and elevated.

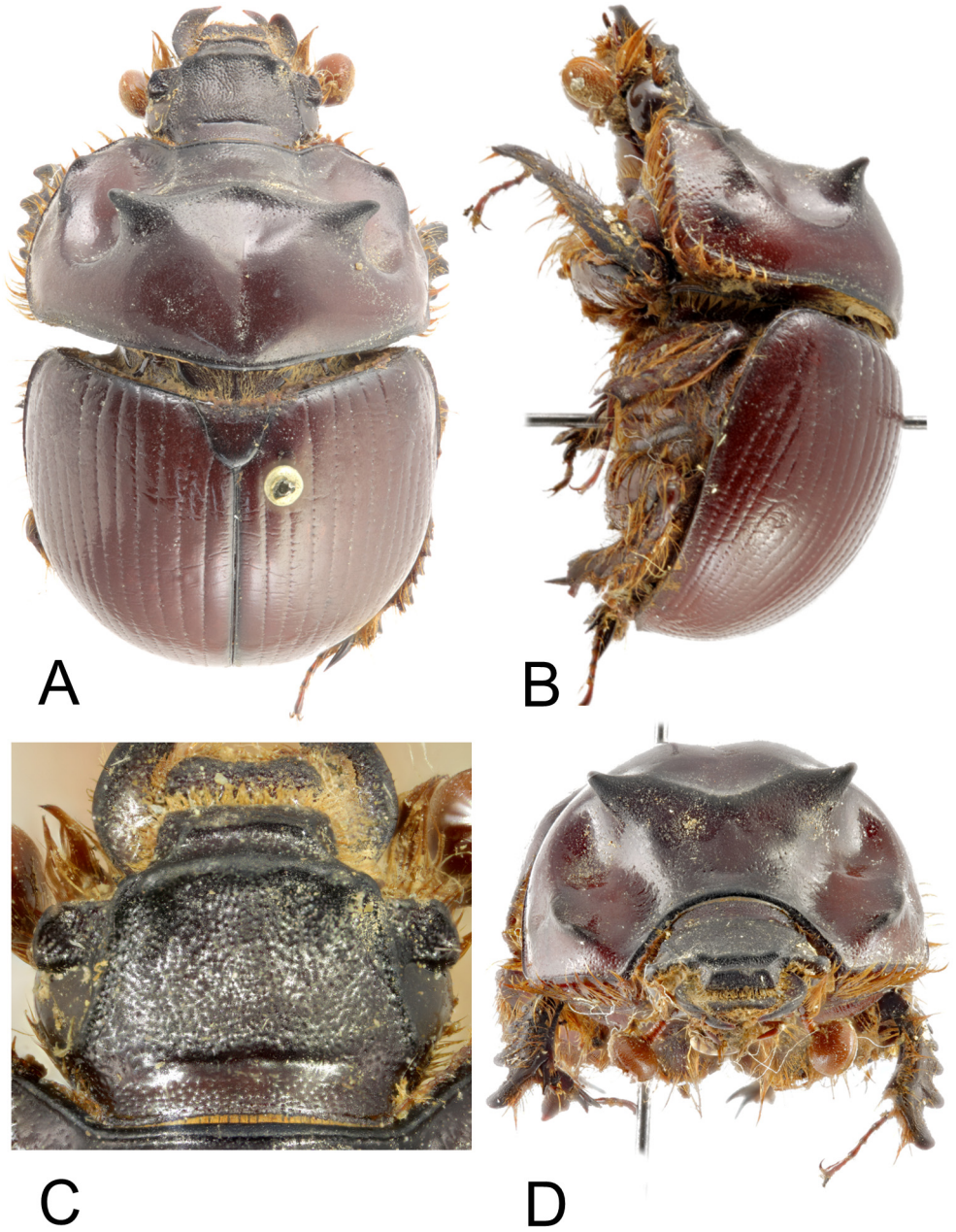

FIGURE 4A–D. *Bolboaffroides rollii* (J Müller, 1941), holotype (♂). A, habitus in dorsal view; B, habitus in left lateral view; C, head in dorsal view; D, head and pronotum in frontal view. Not to scale.

Pronotum (Figs. 2A–B, D) distinctly transverse; broadest in about half of its length; sides feebly rounded, anterolateral angle shortly rounded, slightly acute apically. Pronotal margin completly bordered, anterior margin reinforced with punctation. Pronotal punctation distinct, double, irregular, consisting of deeply impressed punctures, punctures separated by different distance, intermixed with very fine, pinned punctures. Sides of pronotum densely punctate. Anterior transverse protrusion distinct, widely semicircular, lateral ridges weak and round.

Elytra (Figs. 2A–B). Surface shiny, glabrous. Humeral umbone weak with few fine small punctate.

Variability in females. Smaller females with less noticeable anterior transversal protrusion on pronotum and transversal carina on frons.

Measurements. Total body length 18–22 mm, holotype - 20 mm, allotype - 18 mm.

Differential diagnosis. The new species is classified in the genus *Bolbaffroides* mainly by possessing a combination of the following characters: head with one transversal carina, anterior clypeal margin unarmed; pronotum all around bordered; pronotum with two lateral and two anterior hornlike apophyses in male, or with anterior transversal protrusion in female; middle coxae distinctly separated; femora unarmed; protibia with 6–7 exterior teeth; tarsomeres simple in both sexes; meso-metaventral plate not bordered anteriorly; abdominal ventrites simple in both sexes (see Nikolajev 1979, for details). The new species differs from all those described so far by the following diagnostic characters:

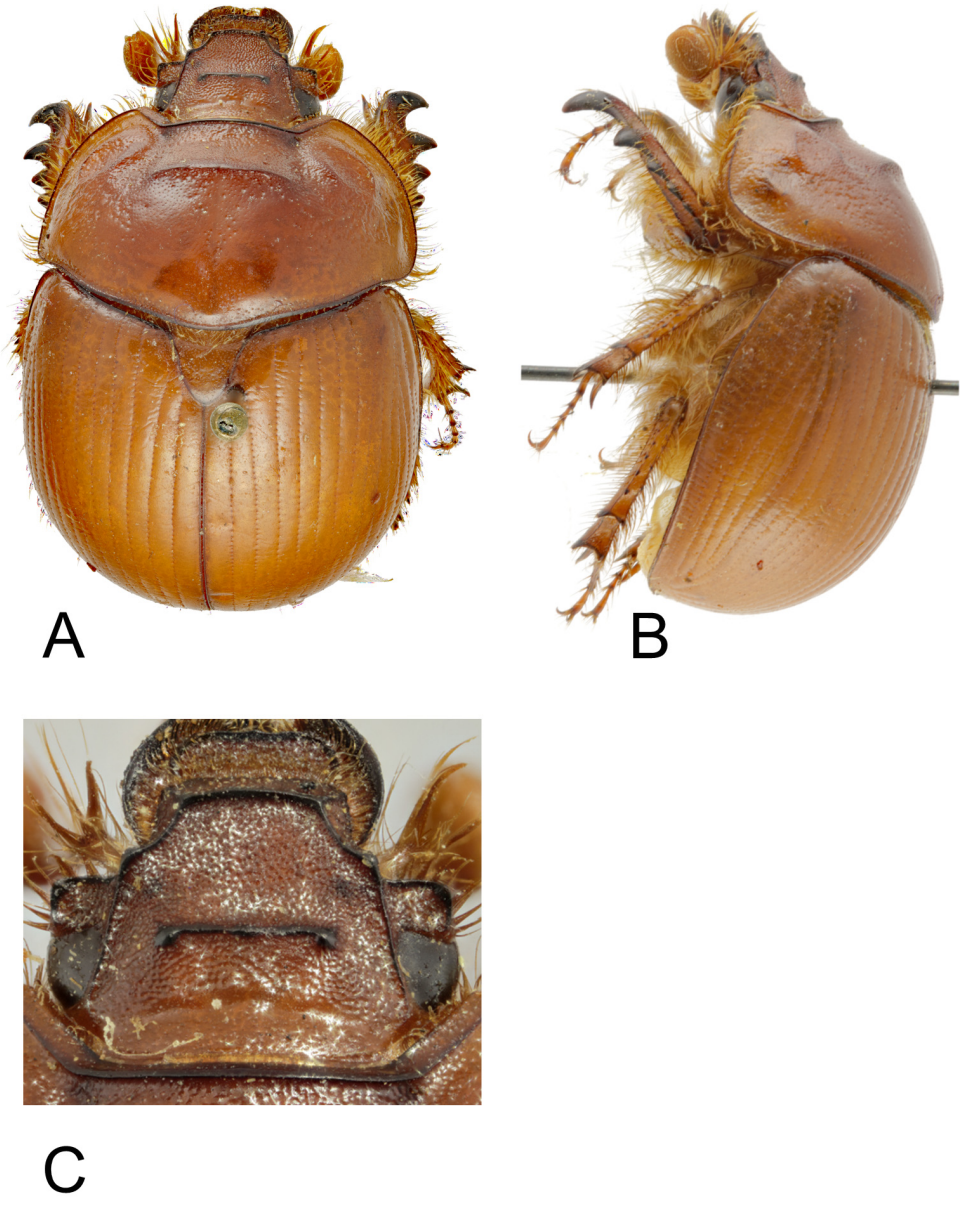

FIGURE 5A–C. *Bolboaffroides rollii* (J. Müller, 1941), paratype (♀). A, habitus in dorsal view; B, habitus in left lateral view; C, head in dorsal view. Not to scale.

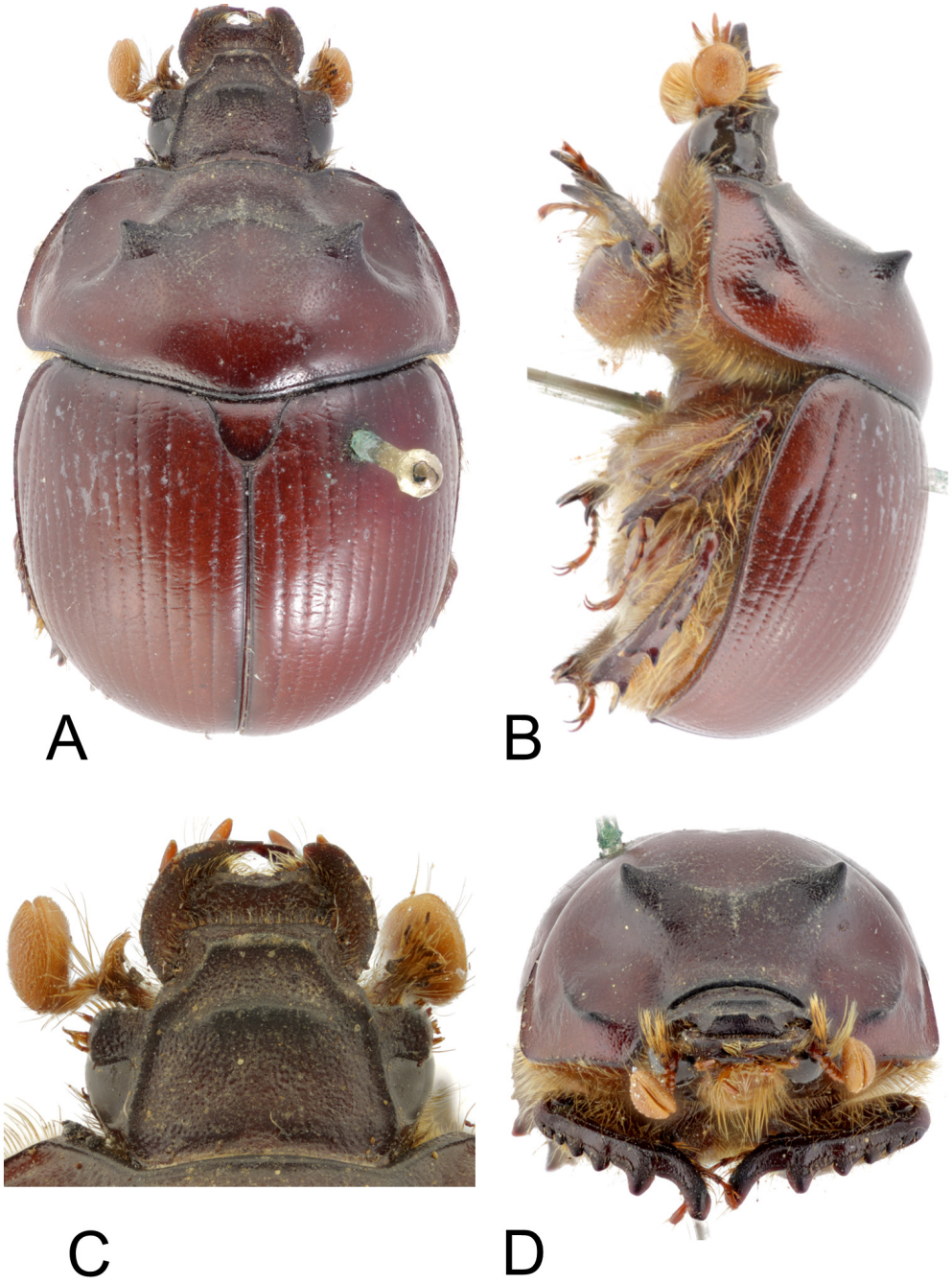

FIGURE 6A–D. *Bolboaffroides validus* (Klug, 1843), holotype (♂). A, habitus in dorsal view; B, habitus in left lateral view; C, head in dorsal view; D, head and pronotum in frontal view. Not to scale.

- *Bolbaffroides dhofarensis* Král, Hillert, Mencl & Sommer, **new species**, is distinguished from *B. kubaricus* (Krikken, 1978) and *B. scotti* (Paulian, 1948) by the structure of phallus (phallus of *B. dhofarensis* without a pair of long sclerotized ventral appendages) (*cf.* Figs. 3A–C and Krikken 1978: figs. 6, 12) and by sparser punctation of pronotal disc (punctation is markedly denser on the pronotal disc in *B. kubaricus* and *B. scotti*) (cf. Figs. 1A, 2A and Krikken 1978: pl. 2, figs. 5–6);

- *Bolbaffroides carenicollis* (Laporte, 1840) posses opaque elytra (Krikken 1978: p. 305), while all other species of the genus *Bolbaffroides*, including *B. dhofarensis* Král, Hillert, Mencl & Sommer, **new species**, have shiny elytra (Figs. 1A–B, 2A–B, Krikken 1978: p. 305);

- pronotal hornlike apophyses in *B. dhofarensis* Král, Hillert, Mencl & Sommer, **new species**, and *B. serripes tsavoensis* (Krikken, 1978) are directed distinctly upwards (Figs. 1A–B, D and Krikken 1978: figs. 8; pl. 1; pl. 2, fig. 1), in contrast to *B. rollii*, *B. serripes serripes* (Fairmaire, 1882), and *B. validus*, with lateral hornlike apophysis

directed obliquely to the sides in frontal and lateral aspects (Krikken 1978: fig. 1–2, 7, 9; pl. 2, fig. 3; Nikolajev 2003: fig. 22).

- additionally, *B. dhofarensis* Král, Hillert, Mencl & Sommer, **new species**, is distinguished from *B. serripes tsavoensis* by the transversal cephalic carina. At the former, this carina is slightly convex, on margins thickened and elevated (Figs. 1A–D), while at the latter is almost straight, very narrow and low, and thickened and elevated not only on margins, but also at the middle (Krikken 1978: pl. 1; pl. 2, fig. 1).

Females and small undeveloped males are morphologically very difficult to identify.

Etymology. Toponymic; an adjective derived from the name of the Dhofar Governorate, Oman where the new species was collected.

Collecting events. Part of the type material was caught at a light source in semi-arid areas covered only with sparse shrubs. The specimen collected by Jan Pelikán came to light a few minutes after sunset (S. Jákl personal communication 2019 & J. Pelikán personal communication 2020).

Distribution. So far known only from several localities near the coast west of Salalah, at an altitude of about 47–786 m a. s. l. in the Dhofar Governorate, Oman.

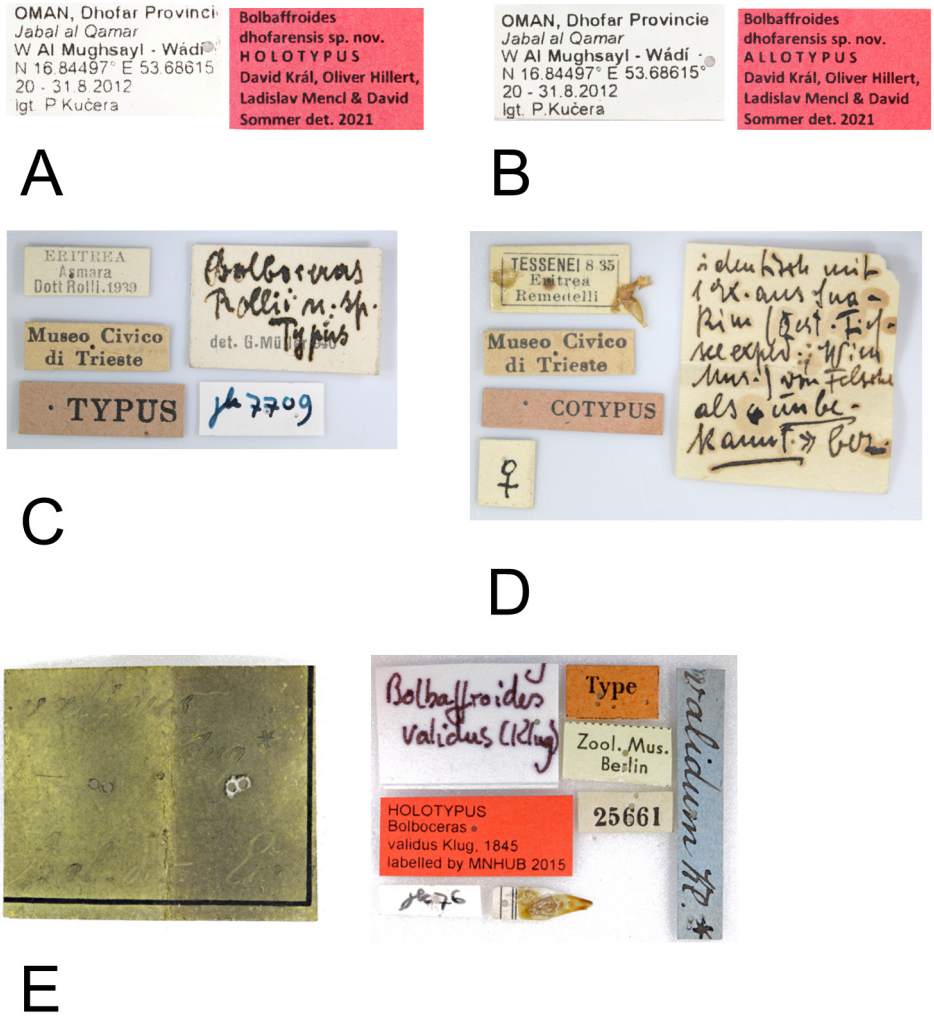

FIGURE 7A–F. *Bolbaffroides* spp., type labels. A, *B. dhofarensis* Král, Hillert, Mencl & Sommer, **new species**, holotype; B, *B. dhofarensis* Král, Hillert, Mencl & Sommer, **new species**, allotype; C, *B. rollii* (J. Müller, 1941), holotype; D, *B. rollii*, paratype; E–F, *B. validus* (Klug, 1843), holotype.

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Academy of Sciences, Czech Republic) and Stefano Ziani (GeoL@b APS, Faenza (RA), Italy), for critical comments to the manuscript. The work of David Sommer was supported by the Institutional Research Support grant of the Charles University, Prague (No. SVV 260571/2021) and by the Charles University Grant Agency (GAUK)—project no. 1388119.

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