

Linzer biol. Beitr.	56/1	121-128	August 2024
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The male of *Rediviva (Redivivoides) kamieskroonensis* (KUHLMANN, 2012) (Hymenoptera, Melittidae), with an updated key and additional records of the subgenus

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Abstract: The male of the South African bee *Rediviva (Redivivoides) kamieskroonensis* (KUHLMANN, 2012) is here described and illustrated for the first time. An updated key for the identification of males of the subgenus *Redivivoides* is presented and additional records of these rarely collected South African endemic bee species are provided.

Key words: *Rediviva*, *Redivivoides*, taxonomy, bees, South Africa.

Introduction

The South African endemic bee genus *Redivivoides* MICHENER, 1981 was described based on a single species (MICHENER 1981) and was later revised by KUHLMANN (2012) who added another six species. Based on a molecular phylogenetic study KAHNT et al. (2017) discovered that *Redivivoides* renders the iconic oil-collecting bee genus *Rediviva* FRIESE, 1911 paraphyletic, supporting the hypothesis that *Redivivoides* females lost their oil-collecting structures as suggested by KUHLMANN (2012). As a result, *Redivivoides* was downgraded to a subgenus of *Rediviva* that in total currently comprises 33 species (KUHLMANN et al. 2020). *Redivivoides* species have been rarely found and little is known about their biology and distribution. This also applies to its taxonomy where the males of two species have not been discovered so far.

In this publication the hitherto unknown male of *R. kamieskroonensis* (KUHLMANN, 2012) is described and it is illustrated jointly with the closely related *R. capensis* (KUHLMANN, 2012) to facilitate identification. In addition, an updated key to *Redivivoides* males and new records of further species are provided.

Material and Methods

Terminology used in the descriptions follows those of MICHENER (2007). T is used as abbreviation of metasomal tergum and S for a metasomal sternum. Body length is measured from the vertex to the apex of the metasoma.

Images were taken with a digital microscope (Keyence VHX-5000) using the VH-Z20R/Z20T (20x to 200x) zoom lens and the OP-42305 super diffused illumination adapter. Images were stacked for extended depth-of-field and processed using Adobe

Photoshop Elements 2021 (Adobe Systems Software Ireland Limited, Republic of Ireland) and then assembled into the figure plates.

All specimens are in the research collection of M. Kuhlmann, Zoological Museum of Kiel University, Kiel, Germany (RCMK).

Permits for fieldwork and wild bee collecting in South Africa were granted by Cape Nature for Western Cape Province (permit numbers 202/1999, 250/2000, 368/2001, AAA004-00212-0035, AAA004-00446-0035, AAA004-01055-0035, 0056-AAA008-00076, CN44-87-21440) and by Northern Cape Department of Environment and Nature Conservation for Northern Cape Province (025/2002, 056/2003, 0055/04, 0332/05, 0648/06, 0317/07, FAUNA 074/2008, FAUNA 1299/2008, FAUNA 082/2010, FAUNA 557/2011, FAUNA 638/2012, FAUNA 155/2013, FAUNA 1213/2014, FAUNA 0529/2016, FAUNA 0345/2017, FAUNA 0461/2022).

The male of *Rediviva (Redivivoides) kamieskroonensis*

Females of *R. capensis* and *R. kamieskroonensis* are very similar but can be readily and reliably distinguished by the different widths of their heads. Both species co-occur in the Kamiesberg Mts. and were partly found in the same locality. So, it was immediately clear that the single male with its conspicuously broad head collected there must represent the unknown male of *R. kamieskroonensis*. To facilitate their identification males of both species are here illustrated based on specimens collected at the same site, although in different years.

***Rediviva (Redivivoides) kamieskroonensis* (KUHLMANN, 2012) (Figs 1-3, 7-8, 11-13)**

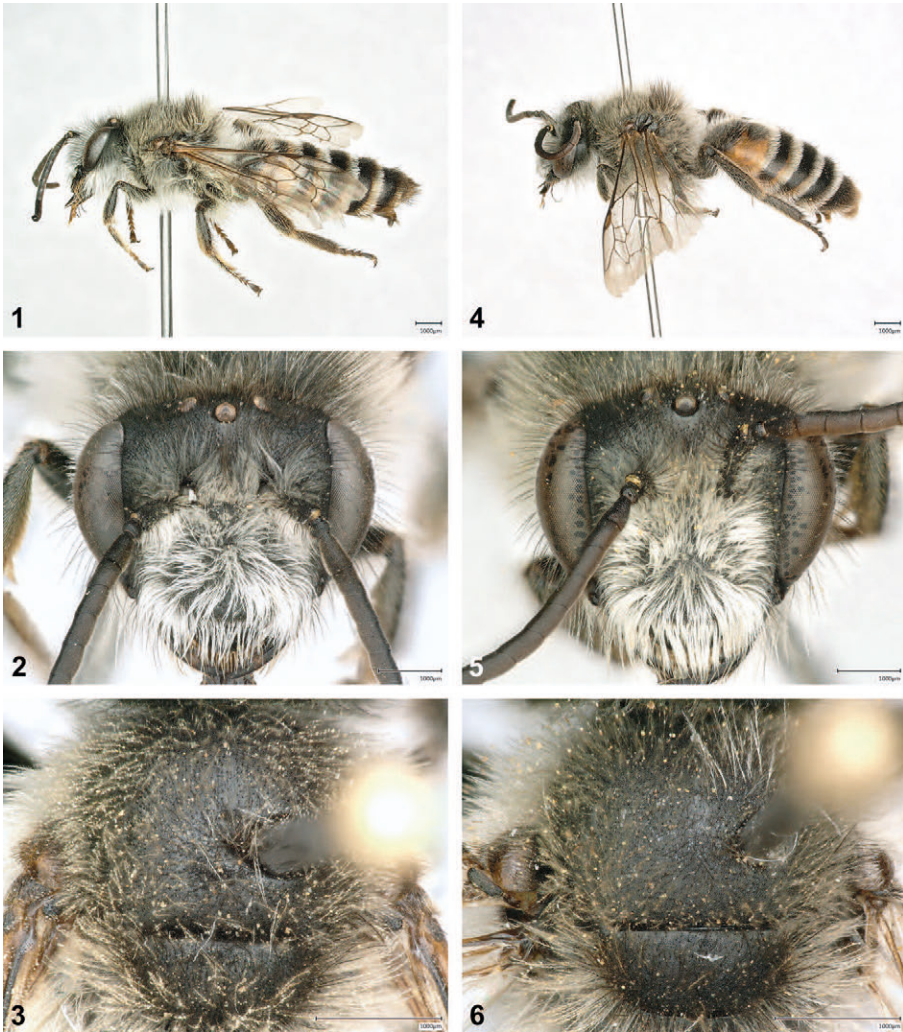
Redivivoides kamieskroonensis KUHLMANN, 2012: 9-11. Holotype ♀ (14 km E Kamieskroon, South Africa) (South African National Collection, Pretoria, South Africa).

The hitherto unknown male of *R. kamieskroonensis* is here described for the first time.

Diagnosis: The male of *R. kamieskroonensis* can be separated from other *Redivivoides* species by the following character combination: Metasomal terga partly bright red (Figs 1, 4, 7, 9), scutum impunctate, shagreened and predominantly matt (Figs 3, 6), S6 apically with deep, almost semi-circular emargination (Fig. 8), S7 without lateral lobes (Fig. 11) and apical plate of S8 rectangular (Fig. 12).

Description

Male. Body-length: 10.5 mm (Habitus: Fig. 1). **Head:** Head distinctly wider than long (Fig. 2). Integument black except tip of mandible partly dark reddish-brown. Face densely covered with long, whitish-grey to brown, erect hairs intermixed with black hairs especially along the inner eye margins and on vertex. Clypeus mostly flat, apico-medially almost impunctate; medially finely punctate, interspaces smooth and shiny. Malar area medially narrow, almost linear. Antenna black, flagellum at base ventrally dark yellowish-brown. **Mesosoma:** Integument black. Scutum impunctate, finely shagreened and matt (Fig. 3). Scutum, scutellum, metanotum, mesepisternum and propodeum covered with long white to yellowish-grey erect hairs, on the disc of scutum and scutellum black hairs intermixed (Fig. 3). **Wings:** Slightly yellowish-brown; wing venation brown. **Legs:** Integument black, tibiae apically and tarsi partly dark yellowish to red-brown. Vestiture whitish with a few darker hairs on the dorsal side of the mid- and hindtibia. **Metasoma:** Integument dorsally mostly black, except T1 apically red, T2 red



Figs 1-6: *Rediviva* (*Redivivoides*) *kamieskroonensis* (KUHLMANN, 2012), ♂ (1) lateral view; (2) head; (3) scutum. *R. (R.) capensis* (KUHLMANN, 2012), ♂ (4) lateral view; (5) head; (6) scutum.

with a black spot anterior-medially, T3-T6 apically with a red margin (Fig. 7). Discs of T1-T2 sparsely covered with a long erect greyish-white hair, on following terga with short to apically longer black hairs; apical tergal hair band missing on T1, on T2-T5 well developed and white (Fig. 7). Terga impunctate, finely shagreened with a silky shine (Fig. 7). **Terminalia:** Genitalia (Fig. 13), S6 (Fig. 8), S7 (Fig. 11) and terminal plate of S8 (Fig. 12) as illustrated.

Additional material examined:

South Africa: 1♂, 8 km WNW Leliefontein, Fynbos, road side, 30°15'58''S 18°03'17''E, 1190 m, 18.viii.2023, leg. M. Kuhlmann.

General distribution: Only known from the Kamiesberg Mts. in Namaqualand, NW South Africa.



Figs 7-10: *Rediviva (Redivivoides) kamieskroonensis* (KUHLMANN, 2012), ♂ (7) metasoma dorsal; (8) metasomal sternum S6. *R. (R.) capensis* (KUHLMANN, 2012), ♂ (9) metasoma dorsal; (10) metasomal sternum S6.

New records of *Rediviva (Redivivoides)* species

Here new records of *Rediviva (Redivivoides)* species are listed in alphabetical order. Specimens were collected after the publication of the revision of the subgenus (KUHLMANN 2012).

***Rediviva (Redivivoides) capensis* (KUHLMANN, 2012) (Figs 4-6, 9-10, 14-16)**

Redivivoides capensis KUHLMANN, 2012: 3-7. Holotype ♀ (20 km S Nieuwoudtville, South Africa) (Iziko South African Museum, Cape Town, South Africa).

Additional material examined:

South Africa: 1♂, 8 km WNW Leliefontein, Fynbos, road side, 30°15'58''S 18°03'17''E, 1190 m, 10.ix.2017, leg. M. Kuhlmann.

General distribution: Including this new northerly record the species is now known from the Kamiesberg Mts. (Namaqualand) in the north down south to Clanwilliam, W South Africa.



Figs 11-16: *Rediviva (Redivivoides) kamieskroonensis* (KUHLMANN, 2012), ♂ (11) metasomal sternum S7 dorsal; (12) apical plate metasomal sternum S8; (13) genitalia dorsal. *R. (R.) capensis* (KUHLMANN, 2012), ♂ (14) metasomal sternum S7 dorsal; (15) apical plate metasomal sternum S8; (16) genitalia dorsal.

***Rediviva (Redivivoides) namaquaensis* (KUHLMANN, 2012)**

Redivivoides namaquaensis KUHLMANN, 2012: 15-19. Holotype ♀ (Middlepos, South Africa) (Iziko South African Museum, Cape Town, South Africa).

Additional material examined:

South Africa: 2♀♀, 9♂♂, Keiski Mts., 3 km E Farm M'Vera, shale, 31°45'29''S 19°54'13''E, 1190 m, 19.viii.2017, leg. M. Kuhlmann; 4♂♂, idem, 26.viii.2017; 1♂, idem, 27.viii.2017; 3♂♂, idem, 12.viii.2023; 4♂♂, idem, 15.viii.2023; 5♂♂, idem, 28.viii.2023; 2♀♀, 2♂♂, Roggeveld Mts., 2 km S Farm Perdekloof, rivier, dolerite, 31°47'35''S 19°58'16''E, 1220 m, 2.ix.2017, leg. M.

Kuhlmann; 1♂, idem, 20.ix.2022; 1♂, Roggeveld Mts., 1 km S Farm Allemansdam, road side, 31°49'05''S 19°59'15''E, 1270 m, 1.ix.2017, leg. M. Kuhlmann; 1♂, Roggeveld Mts., 2 km SE Farm Allemansdam, burnt area, 31°49'32''S 19°59'55''E, 1290 m, 2.ix.2017, leg. M. Kuhlmann; 3♀♀, 2♂♂, idem, 24.viii.2018; 5♀♀, idem, 29.viii.2018; 3♂♂, idem, 10.ix.2018; 1♀, 6 km NNW Farm Kanariesfontein, 30 km W Sutherland, road side, 32°22'17''S 20°22'50''E, 1310 m, 16.ix.2017, leg. M. Kuhlmann; 5♀♀, 7♂♂, idem, 17.ix.2017; 2♀♀, 3 km NW Farm Kanolfontein, 22 km W Sutherland, road side, 32°23'17''S 20°26'32''E, 1350 m, 18.ix.2017, leg. M. Kuhlmann; 4♂♂, Farm Kanolfontein, 20 km W Sutherland, road side, 32°24'43''S 20°27'28''E, 1385 m, 7.ix.2012, leg. M. Kuhlmann; 3♂♂, idem, 17.ix.2017.

General distribution: This species has the centre of its distribution on the Bokkeveld Plateau and in the Roggeveld Mountains with a few records southwest of that area.

***Rediviva (Redivivoides) simulans* (MICHENER, 1981)**

Redivivoides simulans MICHENER, 1981: 121-122, figs 80, 82-84 (p. 43), 97 (p. 48). Holotype ♀ (Clanwilliam, South Africa) (Snow Entomological Museum, University of Kansas, Lawrence).

Additional material examined:

South Africa: 1♀, 4♂♂, Lamberts Bay, Strandveld, sand, 32°06'19''S 18°18'16''E, 5 m, 7.ix.2017, leg. M. Kuhlmann.

General distribution: The species is widespread in the winter rainfall region of western South Africa.

***Rediviva (Redivivoides) variabilis* (KUHLMANN, 2012)**

Redivivoides variabilis KUHLMANN, 2012: 24-29. Holotype ♀ (Grootvlei, South Africa) (Iziko South African Museum, Cape Town, South Africa).

Additional material examined:

South Africa: 2♀♀, 8 km WNW Leliefontein, Fynbos, road side, 30°15'58''S 18°03'17''E, 1190 m, 10.ix.2017, leg. M. Kuhlmann; 11♀♀, 1♂, idem, 14.ix.2017; 6♂♂, idem, 18.viii.2023.

General distribution: The species has been found in most parts of Namaqualand down south to the northern parts of the Roggeveld Mts. south of Calvinia.

Remarks: According to own observations the species apparently is oligolectic on Fabaceae as females seem to exclusively collect pollen on flowers of this family. Nests get parasitized by the cuckoo bee *Nomada redivivoides* KUHLMANN, 2023 (KUHLMANN 2023).

Updated key to males of *Rediviva (Redivivoides)* species

The key is based on KUHLMANN (2012) with modifications marked in **bold print**. Figure numbers in normal print refer to KUHLMANN (2012). The male of *R. eardleyi* (KUHLMANN) is still unknown.

- 1 Metasomal terga extensively and brightly red, rarely only on a narrow stripe of the apical part of the discs of T1 – T3 (Figs 3C, 13C)2
- Metasomal terga black or brown, sometimes apical tergal margins narrowly translucent dark reddish brown (Figs 8C, 11C, 16C).....4

- 2 Scutum impunctate, shagreened and matt (Figs 3, 6).....3**
- Scutum finely punctate, at least on disc between punctures smooth and shiny (Fig. 13B); S6 – S8 and genitalia as in Figs 13D–H.....*R. simulans* (MICHENER)
- 3 S6 apically with very shallow emargination or almost straight (Fig. 10); S7 with lateral lobes (Fig. 14); apical plate of S8 oval (Fig. 15)..... *R. capensis* (KUHLMANN)**
- **S6 apically with deep, almost semi-circular emargination (Fig. 8); S7 without lateral lobes (Fig. 11); apical plate of S8 rectangular (Fig. 12).....**
.....*R. kamieskroonensis* (KUHLMANN)
- 4 Metasomal terga finely shagreened and dull (Fig. 11C); prepygidial and pygidial fimbria yellowish brown (Fig. 11C); S6 – S8 and genitalia as in Fig. 11D–H.....**
.....*R. namaquaensis* (KUHLMANN)
- Metasomal terga between punctures smooth and shiny at least on T1 – T2 (Fig. 8C, 16C); prepygidial and pygidial fimbria brown to black (Fig. 8C, 16C); S6 – S8 and genitalia different5
- 5 Metasomal terga with oily bluish shine; S6 – S8 and genitalia as in Fig. 16D–H.....**
.....*R. variabilis* (KUHLMANN)
- Metasomal terga without oily bluish shine; S6 – S8 and genitalia as in Fig. 8D–H.....
.....*R. karooensis* (KUHLMANN)

Discussion

In the present study, the male of *R. kamieskroonensis* is described, so in the subgenus only the male of *R. eardleyi* (KUHLMANN, 2012) remains unknown. Due to the apparent general rarity of most *Redivivoides* species little data is available about their biology, in particular host plant relationships. Thus, further fieldwork is required to get more information on the ecology of species and their distribution.

Acknowledgements

I am very grateful for the long-standing support of the owners of farms who allowed access and fieldwork on their properties. I thank Cape Nature and Northern Cape Department of Environment and Nature Conservation for granting research and collecting permits.

Zusammenfassung

Das Männchen der südafrikanischen Bienenart *Rediviva* (*Redivivoides*) *kamieskroonensis* (KUHLMANN, 2012) wird hier erstmals beschrieben und photographisch dokumentiert. Ein aktualisierter Schlüssel zur Bestimmung der Männchen der Untergattung *Redivivoides* sowie weitere Funde der selten gesammelten und für Südafrika endemischen Bienenarten werden vorgelegt.

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Zeitschrift/Journal: [Linzer biologische Beiträge](#)

Jahr/Year: 2024

Band/Volume: [0056_1](#)

Autor(en)/Author(s): Kuhlmann Michael

Artikel/Article: [The male of *Rediviva* \(*Redivivoides*\) *kamieskroonensis* \(KUHLMANN, 2012\) \(Hymenoptera, Melittidae\), with an updated key and additional records of the subgenus 121-128](#)