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On the types of Bolboceratidae (Coleoptera: Scarabaeoidea) in the Swedish Museum of Natural History in Stockholm

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Abstract

The investigation of the Bolboceratidae collection of the Stockholm Museum of Natural History (NHRS) yielded 12 type specimens of eight Afrotropical and one Australian species. The majority of these types belongs to species described by Carl Henrik Boheman (1796–1868) based on specimens collected by Johan August Wahlberg (1810–1856) in southern Africa. In two of these species, we found ambiguity among potential syntypes. Therefore, based on comparison with original descriptions, we designate lectotypes for *Bolboceras caffrum* Boheman, 1857 and *Bolboceras exasperans* Péringuey, 1908, both of which are today classified in the genus *Bolbocaffer* Vulcano, Martínez & Pereira, 1969. Finally, we establish *Bolboceras matabele* Péringuey, 1908 (**syn. nov.**) as a junior subjective synonym of *B. exasperans*, we confirm a few synonymies that were historically established without study of type specimens, and we resurrect *Bolboceras dorsuale* Boheman, 1857 from previous synonymy under *B. maculicolle* Boheman, 1857 (*Mimobolbus dorsualis* (Boheman, 1857) **n. comb.** and **stat. rev.**).

Key words: Natural history collections, Nomenclature, Taxonomy, Stockholm museum, Boheman, Péringuey, Wahlberg, South Africa

Introduction

Bolboceratidae is a worldwide distributed scarabaeoid group that currently comprises about 650 species and subspecies (Schoolmeesters 2023). However, a significant amount of the species diversity is still unaccounted for with modern revisions, with certainly new taxa to be described. Bolboceratidae is considered one of the oldest distinct scarabaeoid lineages, potentially plesiomorphic in many respects (Crowson 1981; Ahrens *et al.* 2014; McKenna *et al.* 2019), and its members are primarily distributed in the southern hemisphere (Cambefort 1991). The taxonomic status of the group is still debated, and it is still treated either as a family Bolboceratidae Mulsant, 1842 (*e.g.*, Browne & Scholtz 1995; Scholtz & Browne 1996; Grebennikov & Scholtz 2004; Scholtz & Grebennikov 2005) or as a subfamily Bolboceratinae under Geotrupidae Latreille, 1802 (*e.g.*, Nikolajev 1970; Lawrence & Newton 1995; Verdú *et al.* 2004; Smith *et al.* 2006; Li *et al.* 2008; Bouchard *et al.* 2011; Lawrence *et al.* 2011). Yet, recent molecular phylogenies recovered bolboceratid beetles as sister to (*e.g.*, Zhang *et al.* 2018; McKenna *et al.* 2019) or a more distantly related group of Geotrupidae (*e.g.*, Ahrens *et al.* 2014; Dietz *et al.* 2023). Therefore, in this study we provisionally consider the bolboceratid scarab beetles as a family-level group, which is further separated into two subfamilies: Bolboceratinae, which includes 44 genera and most of the described species; and Athyreinae, with four extant and one fossil genera (Grebennikov & Scholtz 2004). However, the phylogenetic position of Bolboceratidae within Scarabaeoidea is still largely unclear and needs further investigation, as most of the published phylogenetic inferences relied on limited taxonomic coverage, and quite often small number of specimens (Grebennikov & Scholtz 2004; Verdú *et al.* 2004; Hunt *et al.* 2007; Ahrens *et al.* 2014; Bocak *et al.* 2014; Mckenna *et al.* 2015; Zhang *et al.* 2018).

The Australian bolboceratid fauna is nowadays deemed the most-species rich and has been comprehensively

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treated (Howden *et al.* 2007), as has the more species-poor fauna of the Western Palearctic and the Nearctic (Howden 1955, 1964; Baraud 1992). Nevertheless, remarkably little is known on the Bolboceratidae of other biogeographic regions. In the Afrotropics, apart from Krikken's (1984) generic review, only the faunas of southern and to some extent eastern Africa have been treated in modern taxonomic revisions (*e.g.*, Carpaneto *et al.* 1993; Gussmann & Scholtz 2000, 2001). Scattered and geographically isolated data are available on Indian and Southeast Asian Bolboceratidae, with some exceptions (Li *et al.* 2008; Krikken & Li 2013; Li *et al.* 2019). Most of the papers are focused on the description of one or, very rarely, a few new species, thus giving a very fragmented overview of the diversity of these scarabs across these large and fairly complex geographic areas. The hidden life and still enigmatic feeding habits of these scarabs, together with their relative rareness, have probably hampered any attempt of detailed ecological and systematic investigation. Adults of bolboceratid beetles are excellent fliers, and the majority of the species are primarily crepuscular to nocturnal, except for the Australasian genera *Gilletinus* Boucomont, 1932 and *Stenaspidius* Westwood, 1848, and some species of the Afrotropical genus *Bolbocaffer* Vulcano, Martínez & Pereira, 1969, which seem to be primarily diurnal (Howden 1955, 1975; Howden & Cooper 1977; Krikken 1984; Scholtz & Grebennikov 2005).

The nesting behavior of most species is still unclear, but the ability of bolboceratids to dig superficial to very deep burrows into the soil is well-known. For example, according to Howden *et al.* (2007), the Australian *Blackburnium insigne* (Lea, 1916) and *B. reichei* (Guérin-Méneville, 1838) are able to reach a depth of 2 m in sandy soil. Some species seem to create brood chambers at the end of their tunnels, which are supplied either with loose humus or fungal debris that may be used for provisioning the larvae. To date, the larval stages of a few species has been described and the number of successful rearings is preciously scarce (Howden 1955).

Bolboceratid beetles display an enormous variety of cephalic and prothoracic ornamentation (*i.e*. horns, cavities). Body size is variable (*ca*. 5–30 mm), but usually they are smaller in size than Geotrupidae. A relatively small number of species are bi-coloured (brown or black, with yellow spots; or yellow to pale brown with black spots), while the majority of bolboceratids are uniformly black to reddish-brown.

Mycophagy is hypothesized to be plesiomorphic within Scarabaeoidea (Crowson 1981; Scholtz & Grebennikov 2005). Indeed, the consumption of fungi, and presumably hypogeous fungi (*i.e.*, truffles and false-truffles within Basidiomycota and Ascomycota), is common in adults and larvae of Bolboceratidae (Houston & Bougher 2010; Houston 2011).

The present study is part of a project that aims at assembling a worldwide catalog of the family Bolboceratidae, which includes high-quality photographs of name-bearing type specimens, distribution maps of the known species, and information of potential biological associations.

The Stockholm museum of Natural History (NHRS) has a good number of Coleoptera types, most of them associated with old Swedish entomologists, such as De Geer, Paykull, Dalman, Schönherr, Boheman, Fåhraeus among others (Lönnberg 1916; Forshage 2020). For groups in which a major part of the species diversity has been discovered and described only in the 20th century, the holdings are not as impressive, though the catches from a series of exotic collecting expeditions in the early 20th century (Sjöstedt, Mjöberg, Malaise, Hedin, etc.) were systematically distributed to world specialists and yielded numerous scattered types (Engström 1989; Forshage & Vårdal 2019). Bolboceratidae are generally not numerous in collections, and the total holdings in the Stockholm museum amounts to 207 specimens currently identified to 53 species-level taxa. However, several of these specimens are misidentified, and a significant portion is yet unidentified. Many of these specimens are from the Afrotropical region, several from the Australian and Palearctic regions, and in lower number from the Oriental, Nearctic, and Neotropical regions. Most of this material is standing in the world collection of the NHRS, which is ordered in accordance with Boucomont's world catalog (Boucomont 1912). Additional bolboceratids are located in the general Swedish collection (only *Odonteus armiger* (Scopoli, 1772)), while a separate "unidentified" collection was assembled by MF in 2002–2003 from scarab specimens found scattered in the collections and not yet merged with the general collection.

During a recent critical scrutiny of the bolboceratid collection of the Stockholm museum, we found 12 type specimens belonging to nine nominal taxa. Most of these taxa are the species described by Carl Henrik Boheman (1796–1868) based on Johan August Wahlberg's (1810–1856) collections in southern Africa in 1837–1845 and 1854–1856. Additionally, we accounted for a small number of types that come from later revisions, sharing of type series, and from early 20th century Swedish collecting expeditions.

A brief sketch of Johan August Wahlberg and his collections

Johan August Wahlberg (1810–1856) spent two extensive collecting trips in southern Africa, in 1837–1845 and 1854–1856. He was commissioned as a collector by the Swedish Royal Academy of Sciences (KVA) for its museum, the Swedish Museum of Natural History in Stockholm. Initially, this was planned as a substantially shorter trip, but Wahlberg got hooked on the explorer/collector lifestyle and financed his extended stay with elephant hunting for ivory (which eventually killed him as he was run over by an injured elephant). Before that, he was a teacher of natural history at the Swedish forestry school (Skogshögskolan) and an ardent amateur naturalist, perhaps primarily ornithologist but also coleopterist. His older brother was the prominent entomologist and botanist Peter Fredrik Wahlberg (1800–1877), whose position as a professor of natural history at the Karolinska Institutet in Stockholm as well as the secretary of the Swedish Academy of Sciences certainly contributed to his appointment to the journey. Wahlberg himself started working on the bird specimens (a task completed by the museum's vertebrate professor Carl J. Sundevall), while the entomology professor Carl H. Boheman took care of the insect yields. Large parts of Coleoptera were treated by Boheman himself (Boheman 1848, 1851, 1857, 1860), remaining groups were handed over to Olof I. Fåhraeus (Fåhraeus 1870–1872), and Lepidoptera went to Johan Wallengren (Wallengren 1859, 1865). While a major part of the collections came to the Stockholm museum, some portions were sent directly to the local Museum of Natural History in Göteborg or to the school in Vänersborg, which was Wahlberg's alma mater. Specimens that never came into the Stockholm museum are clearly not part of Boheman's type series. A more delicate problem is the fact that the museum during the middle and late 19th century was distributing "duplicates", both to major schools ("läroverk") in Sweden as reference collections, and as exchange material to other natural history museums, and the specimens sent out included even type specimens. Whereas this may possibly be the fate of some insect type series, it does seem to be a problem of lesser magnitude than it is in birds. The vertebrate zoology professor Sundevall was indeed a leading force in this duplicate distribution program, and the scattering of bird type series has been recently reconstructed (Dean *et al.* 2022).

Material and methods

The entire Bolboceratidae collection of the Stockholm museum was critically checked, in order to find also non-labeled type specimens. Putative type specimens were searched using their provenance (*i.e.*, collecting localities and museum accession catalogs), morphology, and original descriptions. The same specimens were then photographed and compared with other museum's holdings. We used the genus-level classification proposed by Krikken (1984) for the Afrotropical Bolboceratidae. As the majority of the type specimens examined and treated in this research were not previously studied by other authors, we reassessed the generic placement of the respective species names using Krikken's diagnostic key (1984) and, when possible, morphological comparison with type species.

Type labels are provided *verbatim*: data on a same label are separate by a comma (","), while data of different labels are separated by a slash ("/"). The taxonomic history section of the species names only contemplates catalogs, taxonomic, systematic, and phylogenetic works. Either ecological or natural history papers are excluded from the lists. We used TaxonWorks (TaxonWorks Community 2022) to manage and retrieve the taxonomy and nomenclature of the taxa treated in this study.

For the correct identification of type localities, we consulted the review by Dean *et al.*'s (2022) review of South African localities visited by Wahlberg, as well as Wahlberg's travel journals (Wahlberg 1994).

Type specimens were photographed with a Canon cameras EOS 6D and 550D, and a Canon MP-E 65mm, f/2.8, 1–5× macrolens. For each photographed specimen, we generated a 2D image by combining 70–75 focus stacking pictures in Zerene Stacker 1.04. All images were subsequently edited and enhanced in Adobe Photoshop 2020.

When necessary, lectotypes were designated. Examined specimens are deposited in the following institutes:

MNHN: Muséum nationale d'Histoire naturelle, Paris, France;

NHRS: Naturhistoriska Riksmuseet, Stockholm, Sweden;

SAMC: Iziko South African Museum, Cape Town, South Africa;

SMTD: Senckenberg Museum für Tierkunde, Dresden, Germany.

Results and discussion

Systematic treatment

Bolbelasmus (*Bolbelasmus*) Boucomont, 1910

Type species: *Bolboceras coreanum* Kolbe, 1886

Bolbelasmus (*Bolbelasmus*) *gallicus* (Mulsant, 1842)

Bolboceras gallicum Mulsant 1843: 350; Gemminger & Harold 1869: 1078; Boucomont 1902: 4, 1910: 335
Bolboceras gallicus: Marseul 1857: 83; Jaquelin du Val 1863: 34
Bolboceras gallicus var. *provincialis* Mulsant 1843: 351; Boucomont 1912: 17; Nikolajev *et al.* 2016: 33
Bolboceras gallicus var. *conjunctus* Mulsant 1843: 351; Boucomont 1912: 17; Nikolajev *et al.* 2016: 33
Bolbelasmus gallicus: Boucomont 1912: 17; Winkler 1929: 1035; Seabra 1943: 50; Cartwright 1953: 97; Baguena Corella 1967: 261; Baraud 1977: 159; Krikken 1977: 280–282, 284; Paulian & Baraud 1982: 61; Baraud 1992: 44–45; Martín-Piera & López-Colón 2000: 178–181, 498; López-Colón 2003: 140; Verdú *et al.* 2004: 512; Agoglitta *et al.* 2006: 182; Král *et al.* 2006: 82; Li *et al.* 2008: 479; Hillert *et al.* 2016: 223; Nikolajev *et al.* 2016: 33; Niogret *et al.* 2019: 9

Non-type material examined:

Sex undetermined (NHRS): Gall. Mer. / Muls. / 9358 E92+; Sex undetermined (NHRS): Same label data as previous specimen / 9359 E92+; Sex undetermined (NHRS): Same label data as previous specimen / 9360 E92+; Sex undetermined (NHRS): Same label data as previous specimen / 9361 E92+; Sex undetermined (NHRS): Same label data as previous specimen / 9363 E92+; Sex undetermined (NHRS): Ital. / Dohrn / Bolbocerus gallicus Nizza Exempl. Typ.

Historical and taxonomic remarks

Five specimens from Etienne Mulsant (1797–1880) were found in the Coleoptera collection of the NHRS. These may possibly be part of a large syntype series, or represent specimens collected and identified by Mulsant later than 1842. Although we cannot completely rule out that these specimens are syntypes, the following points suggest us to consider them as non-types: (i) in his original description, Mulsant states that this species is "rare", which would have probably refrained the author to send specimens to colleagues; (ii) labels of these five specimens are homogeneous and printed; and finally, (iii) Mulsant had a substantial correspondence with Boheman in Stockholm (now in the KVA archives) later than the description of *B. gallicus*.

As there are currently no problems associated with the identity of *B. gallicus* (Hillert *et al.* 2016), there is no reason to designate a lectotype. After his death, the insect collection of Etienne Mulsant was inherited by his son, Victor Mulsant (1818–1886), who deposited it in the Institution Ste. Marie St. Chamond (Loire) (Paulian 1944). A large part of this collection was destroyed during the II World War, while the survived lot was recurated and moved permanently to the MNHN (Paulian 1944). Paulian (1944) provides a list of holotypes and potential syntypes of the insect species authored by Mulsant, as well as "cotypes" of taxa described by other authors and incorporated in the same collection. According to this list, at least one syntype of *B. gallicus* should be in the MNHN, but we could not locate it. Interestingly, during his entomological career, Mulsant had fairly lively collaborations and correspondences with Claudius Rey (1817–1895), Achille Godart (1798–1887), and Francisque Guillebeau (1821–1897). Part of these author's collections are today preserved at the Musée des Confluences, Lyon. Nonetheless, no potential syntypes of *B. gallicus* have been found there (Harold Labrique personal communication).

Finally, in the NHRS, we found an additional 19th century specimen from "Nizza", with a label saying "Exempl. Typ." We know however that the notion of "type" in 19th century curation often indicated just the literal sense of being a specimen considered typical, rather than a type in nowadays' nomenclatural sense. And since Nice is not among the localities mentioned by Mulsant in the original description, we can safely deduce that this specimen is not a syntype either.

Bolbocaffer Vulcano, Martínez & Pereira, 1969

Type species: *Bolboceras sansibaricum* Kolbe, 1894

Bolbocaffer caffrum (Boheman, 1857) (Fig. 1A–F)

Bolboceras caffer Boheman 1857: 371; Gemminger & Harold 1869: 1077; Boucomont 1902: 4
Bolboceras caffrum: Péringuey 1901: 484–485; Boucomont 1912: 8; Paulian 1941: 58–59
Bolbocaffer caffrum: Howden & Cooper 1977: 34; Krikken 1984: 41

Type material examined:

LECTOTYPE, ♂ (NHRS): Caffra-ria / *J.* Wahlb / 358 69 / 9266 E92 + / Naturhistoriska Riksmuseet Stockholm, Loan no 565/97; (labels verbatim, link to images). **PARALECTOTYPE,** ♀ (NHRS): Caffra-ria / *J.* Wahlb / 357 69 / 9265 E92 +.

Non-type material examined:

Sex undetermined (NHRS)**:** Caffra- ria / J. Wahlb / Type / Type / caffrum / 356 69 / 9264 E92 / Naturhistoriska Riksmuseet Stockholm Loan no 564/97 (aberrant specimen that bears type labels).

Historical and taxonomic remarks

Three specimens in the collection of the NHRS have type labels. One of them does not fit the original description and is not conspecific with the others, though this specimen is the one that carries the seemingly older type labels (Fig. 1I).

As indicated by the measurement ranges provided by Boheman (1857), the original description was clearly based on more than one specimen, but the exact number is not indicated. Boheman states that the examined specimens have protibiae with six external teeth, which we found to be incorrect for the specimen that bears the type labels, as it has seven external teeth, while the remaining two specimens have six.

It is likely that Boheman was working with the entire collections received from Johan August Wahlberg from South Africa, and it is perhaps unlikely that a single specimen from the same batch would go unidentified by him. However, a possible scenario is that Boheman wrote the description looking at the other two specimens, and then added the third specimen based on a more cursory look. That older type label might have been added to this aberrant specimen either by himself during later curation, again without further scrutiny, or by a subsequent curator (according to museum documents, in 1887–1888 the scarab collection of Stockholm museum was curated by Sven Lampa). Therefore, since there is no evidence to exclude the third, aberrant specimen from the type series, we deem it necessary to designate a lectotype. We choose the male syntype with tri-tuberculate frontoclypeal carina, as its morphology matches the original description (Fig. 1A–B).

Krikken (1984) officially assigned this species to the genus *Bolbocaffer* Vulcano, Martinez & Pereira, 1969, even though the same combination was formerly used in a systematic study of Australian bolboceratids (Howden & Cooper 1977). We confirm the placement of this species within the genus *Bolbocaffer*.

Locality label says only "Caffraria", but original description specifies "Port Natal" as type locality, corresponding to modern-day Durban, KwaZulu-Natal Province, South Africa. Wahlberg stayed in Port Natal multiple times during the 1839–1844 period and did a lot of collecting in the surroundings (Wahlberg 1994).

FIGURE 1. Type specimens of *Bolbocaffer caffrum* (Boheman, 1857) and *Bolbocaffer consocium* (Boheman, 1857). Dorsal habitus, laterofrontal view, and original labels of the lectotype (A–C) and paralectotype (D–F) of *B. caffrum*. Dorsal habitus, laterofrontal view, and original labels of the unique syntype (G–I) of *B. consocium.*

Bolbocaffer consocium (Boheman, 1857) (Fig. 1G–I)

Bolboceras consocium Boheman 1857: 372; Gemminger & Harold 1869: 1078; Péringuey 1901: 488–489; Boucomont 1902: 4; Péringuey 1908: 641, 643; Boucomont 1912: 8; Paulian 1941: 64; Petrovitz 1975: 623
Bolbocaffer consocium: Krikken 1984: 41

Type material examined:

SYNTYPE (seemingly unique), ♂ (NHRS): Caffra-ria / *J.* Wahlb / Type / Typus / 9270 E92 +.

Historical and taxonomic remarks

One specimen is labeled as type in the collection (Fig. 1G–I), and its morphology matches the original description. Although Boheman (1857) does not provide the number of specimens used to describe the species, the lack of measurement ranges would imply that the author based the description on a single specimen. However, since we cannot rule out the use of additional specimens, the type is considered a unique syntype rather than holotype.

The syntype of *B. consocium* has protibiae with seven external teeth, which seems to be a common character in *Mimobolbus* Vulcano, Martínez & Pereira, 1969 (Krikken 1984). However, the high variability of this trait makes it poorly diagnostic. On the other hand, the two knob-like tubercles on the anteromedial pronotal margin, and the frontoclypeal margin trituberculate allow us to associate, at least provisionally, the syntype of *B. consocium* to the genus *Bolbocaffer*, as already tentatively assumed by Krikken (1984).

This genus is in urgent need of revision, and a comprehensive comparative study of the external and genital morphology of its members might elucidate the systematic position of *B. consocium* too.

Locality label of *B. consocium* says only "Caffraria", but the original description specifies "Limpopo" as type locality. Wahlberg visited the Limpopo river on one of his Highveld trips, collecting in that area between December 1843 and March 1844 (Wahlberg 1994).

Interestingly, in the collection, we found another 19th-century specimen, whose labels say "Afr. mer. occid." // "Fhr." This latter abbreviation refers to Olof Immanuel Fåhraeus (1796–1894), who treated the Coleoptera from Wahlberg's expeditions alongside Boheman. "Africa meridionalis occidentalis" seems to refer to current Namibia, and it is likely that this specimen actually originates from Wahlberg's second journey in southern Africa 1854–1856 (Wahlberg 1994). Nevertheless, it does not carry any printed label associated with the Wahlberg material, and the specimen seems to have had a separate history. Furthermore, the material from Wahlberg's second journey was not available to Boheman in 1857 anyway, so we can safely deduce that it is not a type specimen.

Bolbocaffer exasperans (Péringuey, 1908) (Fig. 2A–F)

Bolboceras exasperans Péringuey 1908: 641, 643; Boucomont 1912: 9
Bolbocaffer exasperans: Krikken 1984: 41
Bolboceras matabele Péringuey 1908: 643–644; Boucomont 1912: 11 (**syn. nov.**) (Fig. 2G–I)

Type material examined:

Bolboceras exasperans: **LECTOTYPE**, ♂ (SAMC): Bolboceras exasperans, type, Py / Fount Gr., 1/1901, (Jutrzencka / 642 / Type, SAM/Ent, 5074; **PARALECTOTYPE**, ♀ (NHRS): Damara / *De Vylder* / Typus / Bolboceras exasperans, type, Py / 9274 E92 + / Naturhistoriska Riksmuseet Stockholm, Loan no 567/97 / exasperans Per.
Bolboceras matabele: **SYNTYPE** (seemingly unique), ♀ (SAMC): Plumtree, Rhodesia, 12/1/06 / Bolboceras matabele, type, Py / 14 / SAM / consocium Boh, H. Andreae det. / Type, SAM/Ent, 5082.

FIGURE 2. Type specimens of *Bolbocaffer exasperans* (Péringuey, 1908) and *Bolbocaffer matabele* (Péringuey, 1908). Dorsal habitus, laterofrontal view, and original labels of the lectotype (SAMC) (A–C) and paralectotype (NHRS) (D–F) of *B. exasperans*. Dorsal habitus, laterofrontal view, and original labels of the unique syntype (G–I) of *B. matabele* **syn. nov.**

Historical and taxonomic remarks

One specimen is labeled as type in the collection of the Stockholm museum. Considering the measurement range provided in the original description (Péringuey 1908), we suppose that *B. exasperans* was described on at least two male specimens. Indeed, no female characters are given. Additionally, the author indicates two fairly distant macroregions as type localities: Transvaal (northeastern South Africa) and Damaraland (northwestern Namibia).

At the Stockholm (NHRS) and Iziko museums (SAMC), we found two specimens that may be potentially part of the same type series. Both specimens bear a Péringuey's handwritten type label indicating the species name (Fig. 2C, F). The specimen in the NHRS has two printed labels with the name of the locality, "Damara", and the collector, "De Vylder". Gustaf de Vylder (1827–1908) made a trip to Southern Africa in 1873–1875 (de Vylder 1998), and all the collected specimens that were donated to the Stockholm museum in 1876 seem to have been labeled as "Damara" (a second lot of insect was donated in 1909 according to museum records, but this *Bolboceras* specimen apparently belongs to the first lot). Moreover, Péringuey had a substantial exchange with the Stockholm museum too, offering generous gifts of specimens as well as partaking in a bit of specimen exchange, while also studying southern African material on loan and corresponding with both Christopher Aurivillius and Yngve Sjöstedt from 1883 to 1922 (correspondence now in the KVA archives).

The specimen in the SAMC bears a handwritten label with the following information: "Fount Gr. / II-1901 / (Jutrzencka". This likely refers to Fountain Grove in Johannesburg, and the specimen seems to have been collected by R. von Jutrzencka. Unlike the specimen from "Damara" (NHRS), the specimen from the SAMC perfectly matches the original description of *B. exasperans*: the clypeal central tubercle is in line with the point of insertion of the antennae (clearly located forward in the specimen from the Stockholm museum); the head surface has deep, close and confluent punctures (somewhat wrinkled in the specimen from the Stockholm museum). Therefore, we decided to designate the SAMC's specimen as lectotype of *B. exasperans* Péringuey, 1908. The specimen found in the NHRS is considered to be a conspecific female, which is treated as paralectotype of *B. exasperans*.

In the same work, Péringuey described another South African boloboceratid, *Bolboceras matabele* Péringuey, 1908. In the SAMC, we found a single female specimen, whose morphology and labels match the original description of the species (Fig. 2G–I). The type locality of this species is Southern Rhodesia, Plumtree, which is nowadays in Zimbabwe. However, it is unclear whether Péringuey based the description of *B. matabele* on more than one specimen. So, we consider this single specimen a unique syntype rather than holotype. In addition, the morphological examination of this syntype, and the comparison with the type specimens of *B. exasperans* allowed us to establish *B. matabele* (**syn. nov.**) as a junior subjective synonym of *B. exasperans* (Fig. 2G–I).

If collecting labels of these type specimens are correct, then we can assume that *B. exasperans* occurs across a wide geographic area, from Namibia (Damaraland) eastward to western Zimbawe, and northeastern South Africa. This large geographic distribution implies that the species can broadly tolerate different climatic conditions.

Mimobolbus Vulcano, Martínez & Pereira, 1969

Type species: *Bolboceras ornatellum* Péringuey, 1901

Mimobolbus maculicollis (Boheman, 1857) (Fig. 3A–C)

Bolboceras maculicolle Boheman 1857: 375; Gemminger & Harold 1869: 1079; Péringuey 1901: 490–491; Boucomont 1902: 5, 1912: 11; Paulian 1941: 38
Mimobolbus maculicollis: Krikken 1984: 43

Type material examined:

Bolboceras maculicolle: **SYNTYPE** (seemingly unique), sex undetermined (NHRS): Caffra-ria / *J. Wahlb* / Type / Typus / 9296 E92 + / Naturhistoriska Riksmuseet Stockholm, Loan no 569/97 / maculicolle Boh / maculicollis Bhm, Caffr.
Bolboceras ornatellum: **SYNTYPE** (seemingly unique), ♀ (SAMC): MASHUNALD, Salisbury / *Bolboceras ornatellus, type, Py* / SAM / Female symbol / Type, SAM/Ent, 5089.

FIGURE 3. Type specimens of *Mimobolbus maculicollis* (Boheman, 1857), *Mimobolbus dorsualis* (Boheman, 1857), and *Mimobolbus nigropiceus* (Feslche, 1910). Dorsal habitus, laterofrontal view, and original labels of the unique syntype of *M. maculicollis* (A–C). Dorsal habitus, laterofrontal view, and original labels of the unique syntype of *M. dorsualis* (D–F). Dorsal habitus, laterofrontal view, and original labels of a syntype of *M. nigropiceus* (NHRS) (G–I).

Historical and taxonomic remarks

One specimen is labeled as type in the NHRS. The original description of *B. maculicollis* might have been based on a single specimen, but no explicit statement is provided (Boheman 1857). Since we cannot rule out that more than one specimen form the type series, the type specimen found in the collection of the Stockholm museum is considered to be a unique syntype rather than holotype.

As regarding the type locality of *B. maculicolle*, although the original locality label only says "Caffraria", Boheman (1857) indicates "Gariep" as type locality, which corresponds to today's Orange River (Fig. 3C). J. A. Wahlberg stopped by and collected along the Orange River several times during 1841–1844, on the way up and down to the Highveld (Transvaal) (Wahlberg 1994).

Krikken (1984) provisionally assigned *B. maculicolle* to the genus *Mimobolbus*. The study of the type species of *Mimobolbus—Bolboceras ornatellum* Péringuey, 1901—allowed us to confirm the placement of *B. maculicollis* within the same genus.

Mimobolbus dorsualis (Boheman, 1857) (Fig. 3D–F) n. comb. and stat. rev.

Bolboceras dorsuale Boheman 1857: 376; Gemminger & Harold 1869: 1078; Péringuey 1901: 490; Boucomont 1902: 4, 1912: 9; Paulian 1941: 38

Type material examined:

SYNTYPE (seemingly unique), sex undetermined, (NHRS): Caffra-ria / *J. Wahlb* / Type / 9273 E92 + / dorsalis Bhm. Caffr.

Historical and taxonomic remarks

One specimen is labeled as type in the collection of the NHRS. Boheman (1857) does not provide exact information on the number of specimens examined, but measurement data would indicate that a single specimen may have been used to describe the species. Nonetheless, for the reasons explained above, we decide to consider this specimen as a unique syntype rather than holotype.

Péringuey (1901) proposed for the first time *B. dorsuale* as junior subjective synonym of *B. maculicolle*, stating to have examined and compared the type specimens of the two species. Later, Paulian (1941), probably overlooking Péringuey's work, reproposed the same synonymy, but the type specimens of the two species names were not studied by the French author.

In this study, we re-examined and compared the external morphology of the two unique syntypes of *B. maculicolle* and *B. dorsuale*, and we concluded that *B. dorsuale* must be treated as a valid and distinct species. So, this species name is reinstated as valid and assigned to the genus *Mimobolbus* (Krikken 1984). We found particularly informative the different punctation on the postermedial edge of the pronotum and scutellum (more densely and coarsely punctate in *M. dorsualis*), and the presence of a wide dark area, increasingly wider toward the elytral apex in *M. dorsualis* (dark area absent in *M. maculicollis*) (Fig. 3A–B, D–E).

The locality label of the *B. dorsuale* type says "Caffraria", but the original description specifies "Boschjemans Rand" as type locality, which corresponds to modern-day Pietermaritzburg, KwaZulu-Natal Province, South Africa. Wahlberg visited this place several times during 1840–1845 during his journeys from Port Natal up into the Highveld (Wahlberg 1994). The collecting localities of the type specimens of *B. maculicolle* (Highveld plateau, *ca.* 1,500–2,000 m a.s.l.) and *B. dorsuale* (coastal region) would also suggest a geographic separation of these two taxa.

The validation of *B. dorsuale* and its assignment to the genus *Mimobolbus* increase the number of species in the genus to 25 (*cf.* Krikken 1984). Due to low phenotypic variability between species, the identification of *Mimobolbus* species is still very difficult. A comprehensive taxonomic review of the genus based on a thorough morphological and perhaps molecular investigation is needed.

Mimobolbus nigropiceus (Felsche, 1910) (Fig. 3G–I)

Bolboceras nigropiceum Felsche 1910: 43; Boucomont 1912: 11; Paulian 1941: 51; Vulcano *et al.* 1969: 163
Mimobolbus nigropiceus: Krikken 1984: 43

Type material examined:

SYNTYPE, ♂ (NHRS): Kilimandj., *Sjöstedt* / Kibonoto kulturz / 12 maj / Type / 9307 E92 + / Bolboceras nigropiceum n. sp. / nigropiceum Fels / NHSR-AL-JB, 000000372; **SYNTYPE**, ♂ (STMD): Coll. C. Felsche, Kauf 20, 1918 / Kilimandjaro, *Sjönstedt.* 1905– / Obstgarten, Steppe / *nigropiceum Felsch, Caffr.* / Typus.

Historical and taxonomic remarks

One specimen in the collection bears an identification label that says "Bolboceras nigropiceum n.sp." (Fig. 3I), along with a couple of additional labels saying "Kilimandj. / *Sjöstedt*" and "Kibonoto / kulturz". This is part of the large material collected by Yngve Sjöstedt (1866–1948) during his Kilimanjaro expedition 1905–1906 (Sjöstedt 1910, 1911). Kibonoto (currently more often Kibong'oto) is a village on the southwestern slope of Kilimanjaro, in the farming zone ("Kulturzone") specified by Sjöstedt (1910) at 1,100–1,900 m a. s. l., where a "zoological station" was erected for Sjöstedt and served as a base camp during the expedition. Thus, he collected there regularly during a large part of the expedition. The original description specifies that the specimens were collected in "Obstgarten-Steppe" (orchard steppe) but no date is given (other specimens with similar labels but more details are collected between July 1905 and February 1906). Sjöstedt spent a great effort to send out specimens collected during his expedition to specialists for study. So, probably Carl Felsche received part of this material for investigation, and among them the two specimens that were used to describe *B. nigropiceum* (Felsche 1910). Afterwards, Felsche might have retained one of the two specimens, which is still preserved in his collection in Dresden (SMTD; see section "Type material examined"), and sent the second syntype back to Stockholm. In this study, we investigated the morphology and labels of these two specimens (NHRS, SMTD), and we consider both of them syntypes of *B. nigropiceum*. The identity of these syntypes is not problematic, so we consider that the designation of a lectotype is not necessary.

Mimobolbus rufotestaceus (Boheman, 1857) (Fig. 4A–C)

Bolboceras rufotestaceum Boheman 1857: 373; Gemminger & Harold 1869: 1080; Péringuey 1901: 491; Boucomont 1902: 6, 1912: 13; Paulian 1941: 44
Mimobolbus rufotestaceus: Krikken 1984: 43
Bolboceras sebakuensis Péringuey 1908: 642; Paulian 1941: 44 (synonym) **synonymy confirmed** (Fig. 4D–F)
Mimobolbus sebakuensis: Krikken 1984: 43

Type material examined:

Bolboceras rufotestaceum: **SYNTYPE** (seemingly unique), ♀ (NHRS): Caffra-ria / *J. Wahlb.* / Type / *rufotestaceus Bhm, Caffr* / *rufotestaceum Boh.* / Typus / 9327, E92 + / 360 69.
Bolboceras sebakuensis: **SYNTYPE** (seemingly unique), ♂ (SAMC): RHODESIA, Sebakwe / *Bolboceras sebakuense, type, Py* / SAM / Type SAM/Ent, 5086.

Historical and taxonomic remarks

One specimen is labeled as type in the collection of the Stockholm museum. In the original description, Boheman (1857) does not indicate the number of specimens that form the type series of *B. rufotestaceum,* although the author

provided a measurement range, which would imply the study of more than one specimen. Therefore, the specimen found in the Stockholm museum is considered to be a unique syntype rather than holotype.

Locality label says only "Caffraria", but the original description specifies "Gariep" as type locality, which corresponds to the Orange River. Wahlberg stopped by and collected along the Orange River several times during 1841–1844, on the way up and down to the Highveld, Transvaal (Wahlberg 1994).

Paulian (1941) considered *B. sebakuensis* Péringuey 1908 to be a junior synonym of *B. rufotestaceum* without studying the type material of both species. Later, Krikken (1984) included *B. sebakuensis* among the members of the genus *Mimobolbus* as a new combination. However, it is unclear whether Krikken overlooked the synonymy proposed by Paulian, or whether he checked and compared the type material of *B. rufotestaceum* and *B. sebakuensis*, invalidating the previous synonymy.

After having carefully examined and compared the type specimens of these two species names, we confirm the synonymy proposed by Paulian (1941).

FIGURE 4. Type specimens of *Mimobolbus rufotestaceus* (Boheman, 1857) and *Mimobolbus sebakuensis* (Péringuey, 1908). Dorsal habitus, laterofrontal view, and original labels of the unique syntype of *M. rufotestaceus* (A–C), and the unique syntype of its junior synonym *M. sebakuensis* **syn. nov.** (D–F).

Bolboceratex Krikken, 1984

Type species: *Bolboceras posticatum* (Boheman, 1860)

Bolboceratex posticatus (Boheman, 1860) (Fig. 5A–D)

Bolboceras posticatum Boheman 1860: 114; Gemminger & Harold 1869: 1079; Péringuey 1901: 489; Boucomont 1902: 5, 1912: 12; Paulian 1941: 35
Bolboceratex posticatus: Krikken 1984: 33; Gussmann & Scholtz 2000: 1115
Bolboceras inchoatum Péringuey 1901: 489; Boucomont 1912: 10; Gussmann & Scholtz 2000: 1116 (Fig. 5D–F)
Bolboceras petulans Kolbe 1907: 30; Péringuey 1908: 645; Boucomont 1912: 12; Paulian 1941: 35

FIGURE 5. Type specimens of *Bolboceratex posticatus* (Boheman, 1860) and *Bolboceratex inchoatus* (Péringuey, 1901). Dorsal habitus, laterofrontal view, and original labels of the unique syntype of *B. posticatus* (A–C), and the unique syntype of its junior synonym *B. inchoatus* (D–F).

Type material examined:

Bolboceras posticatum: **SYNTYPE** (seemingly unique), ♀ (NHRS): *J. Wahlb.* / N'Gami, Africæ / Typus / 359 69 / 9308, E92 + / *posticatum Boh.* / *(Subg. Bolboceras Kirby), posticatus Bhm.* / Type.

Bolboceras inchoatum: **LECTOTYPE**, ♀ (SAMC): *Delagoa*, B. J. de Coster, i.90 / *Bolboceras inchoatus, typ.,* ♀*, P.* / SAM / LECTOTYPE, ♀, *Bolboceras inchoatum* Péringuey, 1901, des. Gussmann&Scholtz, manuscr. 1998 / Type SAM/Ent 5091 / Bolboceratex posticatus (Boheman), det. S. Gussmann.

Historical and taxonomic remarks

In the NHRS collection, we found one specimen labeled as type, whose morphology and collecting labels match the original description of *Bolboceras posticatum.* Thus, unlike to what supposed by Gussmann & Scholtz (2000), we confirm that a unique syntype of *B. posticatum* is still preserved in the Coleoptera collection of the NHRS (Fig. 5). Although the original description of *B. posticatum* does not suggest that it is based on more than one specimen (Boheman 1860), we cannot rule out that additional specimens were used. So, this single specimen is considered a unique syntype rather than holotype.

Locality label says only "Caffraria", but original description specifies type locality as "Ngami". Wahlberg collected at Lake Ngami during 1854–1856 within his second expedition (Wahlberg 1994).

According to Paulian (1941), the original descriptions of *B. petulans* Kolbe, 1907 and *B. inchoatum* Péringuey, 1901 clearly indicate that the two taxon names must be treated as junior synonyms of *B. posticatum,* Gussmann & Scholtz (2000) studied the type specimens of *B. petulans* and *B. inchoatum,* but they could not locate the syntype of *B. posticatum.* The same authors confirmed the synonymy of *B. petulans* with *B. posticatum,* but *B. inchoatum* was neither included among the synonyms not its status discussed (see however S. Gussmann's identification label in Fig. 5F). In this study, we could only examine the type material of *B. inchoatum* and confirm the synonymy proposed by Paulian (1941).

Blackbolbus Howden & Cooper, 1977

Type species: *Bolboceras taurus* Westwood, 1848

Blackbolbus taurus (Westwood, 1848)

Bolboceras taurus Westwood 1848: 15; Gemminger & Harold 1869: 1080; Boucomont 1902: 6; Blackburn 1904: 490; Boucomont 1912: 12; Lea 1916: 278

Blackbolbus taurus Howden 1985: 32; Howden & Cooper 1977: 23–24; Howden *et al.* 2007: 55

Bolboceras bubalus Gillet 1925: 2 Howden & Cooper 1977: 24; Howden 1985: 32 (synonym) (Fig. 6A–F)

Type material examined:

Bolboceras bubalus: **LECTOTYPE**, ♂ (NHRS): Leederville, W.A., H. M. Giles, 5.9.08., 2 male symbol / *bubalus n.sp., Gillet* / Typus / 309 83 / Riksmuseum Stockholm / *Lectotype, male symbol, B. bubalus Gillet* DET. H.F. Howden 83 / 9263, E92 +; **PARALECTOTYPE**, ♀ (NHRS): Leederville, W.A., H. M. Giles, 5.9.08., 2 female symbol / Allotypus / 310 83 / Riksmuseum Stockholm / bubalus Gill.

Historical and taxonomic remarks

In the collection of the Stockholm museum, we found two specimens labeled as lectotype and allotype as designated by Howden (1985). Gillet (1925) originally described *B. bubalus* from at least two specimens, one male and one female, collected by H. M. Giles in Leederville, Western Australia, in 1908 (we have not been able to find

biographical data about Giles more than that he was working as head keeper at the Perth Zoo, and collected insects across Western Australia).

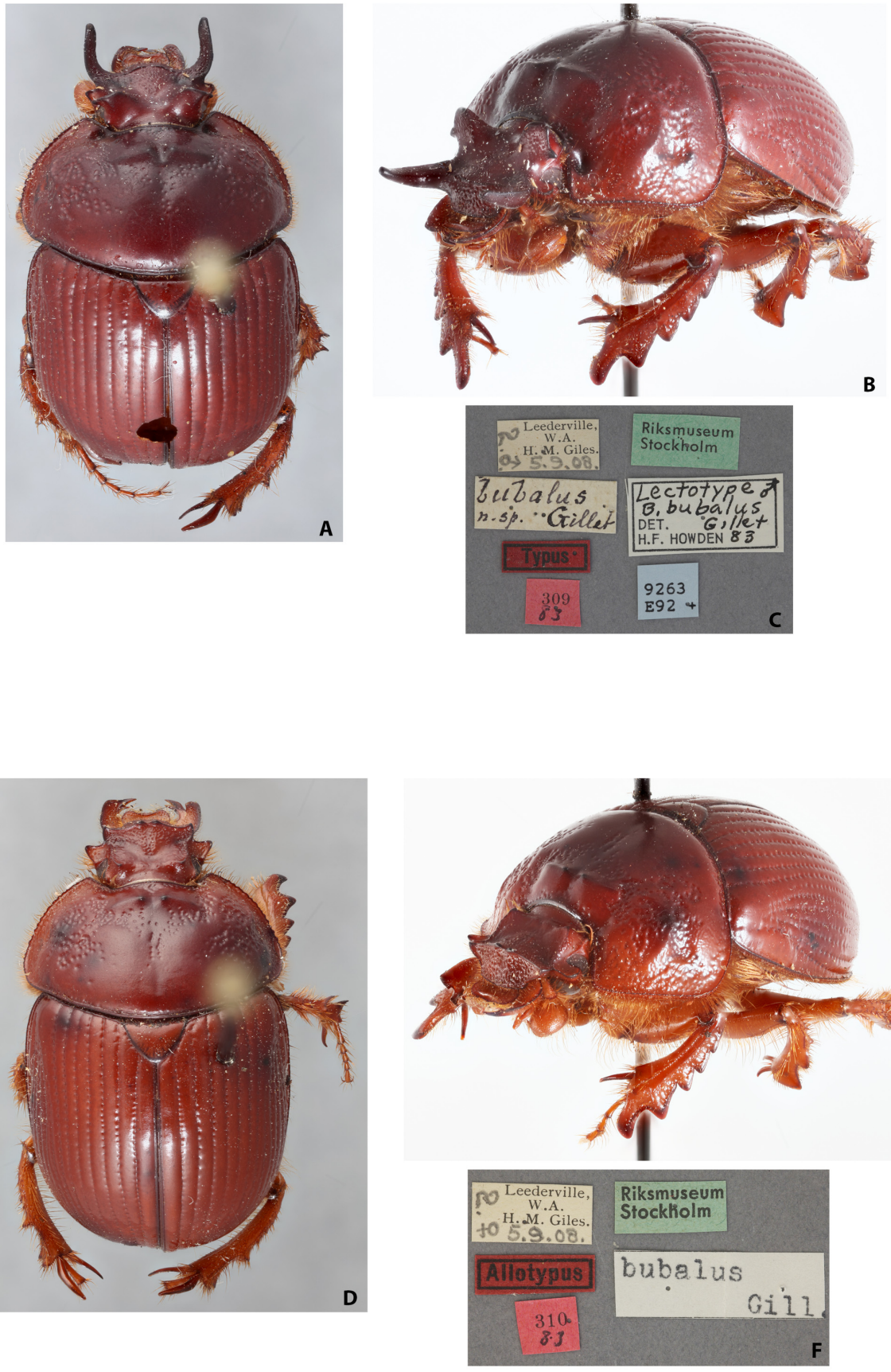

FIGURE 6. Type specimens of *Blackbolbus bubalus* (Gillet, 1925). Dorsal habitus, laterofrontal view, and original labels of the lectotype (A–C) and paralectotype of *B. bubalus* (=*Blackbolbus taurus* (Westwood, 1848)) (D–F).

Howden (1985) extensively revised the genus *Blackbolbus*, and after examination of the type specimens, he proposed the junior subjective synonymy between *B. taurus* and *B. bubalus*. As we consider that the taxonomy of *B. bubalus* does not need any further treatment, we solely provide high-quality pictures of its type specimens (Fig. 6).

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