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## Molecular phylogenetics, systematics and host-plant associations of the *Bruchidius albosparsus* (Fåhraeus) species group (Coleoptera, Chrysomelidae, Bruchinae) with the description of four new species

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### Abstract

*Bruchidius* Schilsky is a large paraphyletic genus of seed beetles (Coleoptera: Chrysomelidae: Bruchinae) which consists of multiple lineages that are usually associated with narrow sets of host-plants. In this study we focus on a group that mostly develops on wattle trees (acacias) belonging to the genus *Vachellia* Wight & Arn. This group originally included nine species and was designated as the *Bruchidius centromaculatus* (Allard) species group, but recent phylogenetic analyses revealed that these species belong to a much wider group of species with similar morphologies. For reasons of anteriority we call this enlarged group *Bruchidius albosparsus* (Fåhraeus). Here we review the morphology of species in this group and provide new diagnoses and ecological data for 10 species. The following combinations and synonymies are proposed: *Bruchidius tanaensis* (Pic, 1921) (= *Bruchus tanaensis* Pic, 1921) **comb. nov.** and *Bruchidius albosparsus* (Fåhraeus, 1839) (= *Bruchus spadiceus* Fåhraeus, 1839) **syn. nov.** Four new species are also described: *B. eminingensis* **sp. nov.**, *B. gerrardiicola* **sp. nov.**, *B. glomeratus* **sp. nov.** and *B. haladai* **sp. nov.** Finally we carried out molecular phylogenetic analyses on a multi-marker dataset of 59 specimens and 35 species, including 14 species from the group. The resulting trees allow us to confirm the monophyly of the group of interest and provide a more detailed picture of their evolutionary relationships.

**Key words:** *Bruchidius*, molecular phylogenetics, morphology, systematics, *Vachellia*

### Introduction

With more than 250 species, the genus *Bruchidius* Schilsky is one of the two most diverse seed beetle genera (the other being *Acanthoscelides* Schilsky; Kergoat 2004); it is widely distributed in the Old World where it reaches a high level of diversity both in temperate and tropical regions (Udayagiri & Wadhi 1989). *Bruchidius* species are specialized seed feeders with a narrow host-plant range that usually encompasses plants from the same genus or botanical tribe (Jermy & Szentesi 2003; Delobel *et al.* 2004; Kergoat *et al.* 2004; Delobel & Delobel 2006; Delobel & Le Ru 2008; Tuda 2008; Delobel 2014); most species are associated with legume plants (Fabaceae) but a few species are also known to develop on Apiaceae (*B. cinerascens* (Gyllenhal)) or Cistaceae (e.g. *B. biguttatus* (Olivier) or *B. cisti* (Fabricius)). Several molecular phylogenetic analyses (Kergoat & Silvain 2004; Kergoat *et al.* 2005a, 2007, 2008) have revealed that the genus *Bruchidius* is clearly paraphyletic and consists of multiple lineages with distinctive host preferences. Some of these lineages partially correspond to species groups that have been defined on the basis of morphological characters (e.g. Borowiec 1985, 1988; Anton & Delobel 2003).

However, molecular studies also reveal that some of these species groups are paraphyletic, as in the case of the *Bruchidius seminarius* (Linnaeus) species group (Kergoat *et al.* 2004). It is only recently that studies have integrated molecular analyses, ecological data and morphological characters to better reassess the boundaries of seed beetle species groups and their evolutionary relationships (e.g. Delobel *et al.* 2013 for the *Bruchidius ituriensis* (Decelle) species group). Because the genus *Bruchidius* as currently defined is paraphyletic, the definition of monophyletic species groups is an important issue because it will likely serve as a backbone with which new, smaller monophyletic genera can be defined in the future.

Here we tackle the *Bruchidius centromaculatus* (Allard) species group, which has been defined by Anton & Delobel (2003). The authors recognized nine species: *B. andrewesi* (Pic), *B. arabicus* Decelle, *B. aurivillii* (Blanc), and six species with “eyed” female last visible tergite (this structure is also referred as pygidium) that were the subject of their paper: *B. centromaculatus* (Allard), *B. cretaceus* (Pic), *B. elnairensis* (Pic), *B. meridionalis* Anton & Delobel, *B. raddiana*e Anton & Delobel, and *B. simulans* Anton & Delobel. Recent phylogenetic analyses have revealed that the *B. centromaculatus* species group was paraphyletic and that it belonged to a much wider group of species with similar morphologies and host preferences (Kergoat *et al.* 2007, 2008). Morphological characters common to all members of this group may be described as follows: (i) body short and thick; (ii) eyes bulging, widely separated; (iii) antennae short, reaching at most elytral base, slightly sexually dimorphic; (iv) pronotum campaniform, its basal lobes with denser white setation; (v) elytra with basal protuberance bearing two small teeth (vi) elytral and pygidial setation scaly, usually three-colored, the proportion of light and dark setae variable among individuals of each species; (vii) preapical notch of posterior femora with minute tooth or tooth apparently absent; (viii) tibial mucro well developed; (ix) male ventrite 1 with usually large and well visible basocentral area of thin erect setae; (x) last visible tergite subvertical in male, with apex turned under and last ventrite notched medially; in female last visible tergite feebly convex to distinctly bulged, in some cases with a pair of apical foveae; (xi) aedeagus not notably bent, its ventral valve subtriangular, often acute, with small number of setae; (xii) hinge sclerites usually absent; (xiii) internal sac with or without spines, spines isolated or fused; (xiv) basal strut not particularly large, sometimes reduced, not emarginated; (xv) parameres not modified, with reduced number of setae, fused on at most half their length, often much less so; (xvi) tegminal strut often simple (without carina), in some cases with narrow or wide dorsal carina; (xvii) in female, vagina membranous, without sclerites; (xviii) entrance to bursa copulatrix with or without dorsal dentate sclerite; (xviii) spermathecal body ovoid, apical diverticulum usually thin and elongated, evenly curved or sinuous.

Through the recent collections of new specimens from East Africa and the examination of additional specimens in collection we revise the *Bruchidius centromaculatus* species group. For reason of anteriority we call this enlarged group the *Bruchidius albosparsus* (Fåhraeus) species group; the type species of the group is preserved in the Naturhistoriska Riksmuseet, Stockholm (NHRS). We provide new nomenclatural acts along with the description of new species. Additional information on host-plant associations and areas of distribution is also provided. Collections and sequencing of additional specimens (including species that have not been sequenced previously) also allow us to provide a more comprehensive phylogenetic framework that encompasses 14 species belonging to the group.

Abbreviations: CBAD, A. Delobel Collection, Fontenay-aux-Roses, France; CBGP, Centre de Biologie pour la Gestion des Populations, Montferrier/Lez, France; HNHM, Hungarian National History Museum, Budapest, Hungary; MNHN, Muséum National d’Histoire Naturelle, Paris, France; MRAC, Musée Royal de l’Afrique Centrale, Tervuren, Belgium; NHRS, Naturhistoriska Riksmuseet, Stockholm, Sweden; OLML, Oberösterreichisches Landesmuseum, Linz, Austria.

## Material and methods

**Sampling and morphological studies.** Most of the recently collected specimens belonging to the *Bruchidius albosparsus* species group were obtained through large-scale collections of legume pods in Democratic Republic of Congo and Kenya. Adult seed beetles were reared from the collected pods and later preserved in 95–100% ethanol. Other specimens (including the taxa used for molecular analyses) were obtained through various loans, collaborations and field missions.

Specimens were compared with type specimens preserved in MNHN, MRAC, and NHRS collections.

Examination of external structures was carried out under a stereoscopic microscope (Wild MZ8). After dissection, genitalia were heated in hypertonic NaOH solution, mounted in water-soluble DMHF (dimethyl hydantoin formaldehyde), and examined under a light microscope (Leitz Laborlux K). For figures, digital photographs of microscope preparations were taken using a hand-held Canon Powershot G3 camera, and transferred to a vector graphics-editing program. Body lengths were measured on mounted specimens (i.e. glued on cardboard), from apex of pronotum to apex of last visible tergite. The general shape of the median lobe is given as w/l, maximum width excluding basal hood/ total length, from tip of ventral valve to base of basal hood.

**DNA extraction, Polymerase chain reactions and Sequencing.** For this study, 59 specimens from 35 species (including 14 species from the *Bruchidius albosparsus* species group) were included in the molecular dataset (see Table 1). To define a balanced set of outgroups we used the studies of Kergoat *et al.* (2011) and Delobel *et al.* (2013). This set included two species that are closely related to the *Bruchidius albosparsus* species group (*B. meibomiaca* Arora and *B. securiger* Delobel & Anton) and five species that are slightly more distantly related (*B. afrasperae* Delobel & Le Ru, *B. hieki* Decelle, *B. ituriensis* (Decelle), *B. mulunguensis* (Decelle) and *B. pardellus* Delobel). We also included 10 additional seed beetle taxa and a representative of a distinct chrysomelid subfamily (*Crioceris duodecimpunctata* (Linnaeus), from the subfamily Criocerinae) to root the tree. Non-destructive DNA extractions of new specimens were conducted using Qiagen DNAeasy tissue kits (Qiagen, Hilden, Germany). Polymerase chain reaction (PCR) amplifications were conducted for four mitochondrial gene fragments: 1,008 bp of the cytochrome oxidase I (COI), 778 bp of the cytochrome b (Cytb), 411 bp of the ribosomal 12S RNA (12S), and 543 bp of the ribosomal 16S RNA (16S). Four nuclear gene regions were also sequenced: 776 bp of the 28S ribosomal DNA domain D2-D3 (28S-D2D3), 698 bp of the 28S ribosomal DNA domain D4-D5 (28S-D4D5), 702 bp of the 28S ribosomal DNA domain D6-D7 (28S-D6D7), and 1,840 bp of the 18S ribosomal DNA (18S). For the 28S-D6D7 domain we used the set of primers and the settings detailed in Ceotto *et al.* (2008). For the 18S gene, three overlapping regions were sequenced following Kergoat *et al.* (2014). For all remaining genes, we used the primers and settings detailed in Kergoat *et al.* (2011). Newly generated PCR products were processed by Eurofins MWG Synthesis GmbH (Ebersberg, Germany). Both strands were sequenced for all specimens to minimize PCR artefacts and ambiguities. Sequences of complementary strands were edited and reconciled using Geneious v5.1 software (available at: [www.geneious.com/](http://www.geneious.com/)). All the sequences generated in this study were deposited in GenBank (see Appendix S1 for the accession numbers). Unlike the sequences of coding genes (COI and Cytb), the sequences of ribosomal genes were variable in length. Their alignment was accomplished using MAFFT 7 (Katoh & Standley 2013) with default option settings. For all protein-coding genes, we used Mesquite 3.0 (available at: [www.mesquiteproject.org](http://www.mesquiteproject.org)) to check the coding frame for possible errors or stop codons. The combination of the eight gene fragments resulted in a combined matrix of 59 specimens and 6,756 aligned characters.

**Phylogenetic Analyses.** Phylogenetic analyses were conducted using Maximum likelihood (ML) and Bayesian inference (BI). For both methods we carried out partitioned analyses to improve phylogenetic accuracy (Nylander *et al.* 2004). Partitions and substitution models were determined using PartitionFinder v1.1.1 (Lanfear *et al.* 2012). The corrected Akaike information criterion (AICc; Posada & Buckley 2004) was used as a metric for ML analyses whereas the Bayesian information criterion (BIC) was used for BI analyses.

Maximum Likelihood analyses were performed using RAxML v8 (Stamatakis, 2014). Based on the AICc results we used 11 partitions with either a General time reversible (GTR)+G+I model or a GTR+G model (Table 2). The best ML tree was obtained using a heuristic search implementing 100 random-addition replicates. Clade support was then assessed using a non-parametric bootstrap procedure (1,000 replicates were used). Nodes supported by bootstrap values (BV)  $\geq 70\%$  were considered as strongly supported following Hillis & Bull (1993).

Bayesian inference analyses were carried out using MrBayes 3.2.3 (Ronquist *et al.* 2012). Based on the BIC results we used eight partitions (Table 2) but instead of using a specific model for each partition we used the mixed model option. The latter allows to sample across the substitution model space in the Bayesian Markov Chains Monte Carlo (MCMC) analysis itself, removing the need for a priori model testing (Huelsenbeck *et al.* 2004). We conducted two independent runs with four MCMC (one cold and three incrementally heated) that ran for 50 millions generations, with trees sampled every 1,000 generations. A conservative burn-in of 25% was then applied after checking for stability on the log-likelihood curves and the split-frequencies of the runs. Support of nodes for MrBayes analyses was provided by clade posterior probabilities (PP) as directly estimated from the majority-rule consensus topology. Nodes supported by  $PP \geq 0.95$  were considered as strongly supported following Erixon *et al.* (2003).

**TABLE 1.** Taxon sampling. If known, rearing information is provided (otherwise the abbreviation N/A is used). Specimens belonging to the *Bruchidius albosparsus* species group are listed first. The following abbreviations are used for countries: Canary Islands, Spain (Can. Islds); Democratic Republic of Congo (DRC), Republic of South Africa (RSA).

Species	voucher code	Country	Rearred from
<i>Bruchidius albosparsus</i> (Fåhraeus, 1839)	BRU.GK360	DRC	unidentified acacia
<i>Bruchidius albosparsus</i> (Fåhraeus, 1839)	BRU.GK397	Kenya	<i>Vachellia seyal</i>
<i>Bruchidius albosparsus</i> (Fåhraeus, 1839)	BRU.Kg11	Kenya	<i>Vachellia nilotica</i>
<i>Bruchidius aurivillii</i> (Blanc, 1889)	BRU.Ac11	Senegal	<i>Vachellia tortilis</i>
<i>Bruchidius aurivillii</i> (Blanc, 1889)	BRU.GK95	Kenya	<i>Vachellia tortilis</i>
<i>Bruchidius aurivillii</i> (Blanc, 1889)	BRU.Sp11	Kenya	<i>Vachellia t. spirocarpa</i>
<i>Bruchidius centromaculatus</i> (Allard, 1868)	BRU.Cf41	Egypt	<i>Vachellia nilotica</i>
<i>Bruchidius centromaculatus</i> (Allard, 1868)	BRU.GK54	Kenya	<i>Vachellia gerrardii</i>
<i>Bruchidius elnairiensis</i> (Pic, 1931)	BRU.E11	Kenya	<i>Vachellia dolichocephala</i>
<i>Bruchidius eminingensis</i> Delobel <b>sp. nov.</b>	BRU.GK101	Kenya	<i>Vachellia seyal</i>
<i>Bruchidius gerrardiicola</i> Delobel <b>sp. nov.</b>	BRU.GK100	Kenya	<i>Vachellia seyal</i>
<i>Bruchidius glomeratus</i> Delobel <b>sp. nov.</b>	BRU.Kc11	Kenya	<i>Vachellia etbaica</i>
<i>Bruchidius grandemaculatus</i> (Pic, 1933)	BRU.G11	Kenya	<i>Vachellia nilotica</i>
<i>Bruchidius grandemaculatus</i> (Pic, 1933)	BRU.GK210	Kenya	<i>Vachellia nilotica</i>
<i>Bruchidius haladai</i> Delobel <b>sp. nov.</b>	BRU.GK245	Kenya	N/A
<i>Bruchidius ishwaensis</i> (Decelle, 1958)	BRU.Ki11	Kenya	<i>Vachellia reficiens</i>
<i>Bruchidius meridionalis</i> Anton & Delobel, 2003	BRU.GK112	Kenya	<i>Vachellia gerrardii</i>
<i>Bruchidius raddianae</i> Anton & Delobel, 2003	BRU.Bd11	Israel	<i>Vachellia t. raddiana</i>
<i>Bruchidius raddianae</i> Anton & Delobel, 2003	BRU.R11	Senegal	<i>Vachellia t. raddiana</i>
<i>Bruchidius raddianae</i> Anton & Delobel, 2003	BRU.GK335	Iran	<i>Vachellia farnesiana</i>
<i>Bruchidius tanaensis</i> (Pic, 1921)	BRU.GK104	Kenya	<i>Vachellia seyal</i>
<i>Bruchidius tanaensis</i> (Pic, 1921)	BRU.GK357	Kenya	<i>Vachellia hockii</i>
<i>Bruchidius tanaensis</i> (Pic, 1921)	BRU.GK385	Kenya	<i>Vachellia seyal</i>
<i>Bruchidius tanaensis</i> (Pic, 1921)	BRU.K213	Kenya	<i>Vachellia hockii</i>
<i>Bruchidius tanaensis</i> (Pic, 1921)	BRU.K313	Kenya	<i>Vachellia nubica</i>
<i>Bruchidius uberatus</i> (Fåhraeus, 1839)	BRU.U41	Senegal	<i>Vachellia n. adansonii</i>
<i>Bruchidius afrasperae</i> Delobel & Le Ru, 2008	BRU.GK384	Kenya	<i>Aeschynomene indica</i>
<i>Bruchidius chloroticus</i> (Dalm., 1833)	BRU.Cc11	Kenya	<i>Sesbania keniensis</i>
<i>Bruchidius cinerascens</i> (Gyllenhal, 1833)	BRU.Cd11	France	<i>Eryngium campestre</i>
<i>Bruchidius cinerascens</i> (Gyllenhal, 1833)	BRU.GK143	Greece	N/A
<i>Bruchidius guanchorum</i> Decelle, 1975	BRU.Ga11	Can. Islds	N/A
<i>Bruchidius guanchorum</i> Decelle, 1975	BRU.GK277	Can. Islds	N/A
<i>Bruchidius hiekei</i> Decelle, 1973	BRU.GK13	Kenya	<i>Aeschynomene schimperi</i>
<i>Bruchidius hiekei</i> Decelle, 1973	BRU.GK55	Tanzania	<i>Aeschynomene schimperi</i>
<i>Bruchidius hinnulus</i> (Fåhraeus, 1871)	BRU.GK388	Kenya	<i>Neonotonia wightii</i>
<i>Bruchidius hinnulus</i> (Fåhraeus, 1871)	BRU.GK391	Kenya	<i>Neonotonia wightii</i>
<i>Bruchidius hinnulus</i> (Fåhraeus, 1871)	BRU.GK392	Kenya	<i>Neonotonia wightii</i>
<i>Bruchidius incarnatus</i> (Boheman, 1833)	BRU.I11	Egypt	<i>Vicia faba</i>
<i>Bruchidius ituriensis</i> (Decelle, 1958)	BRU.GK162	Kenya	<i>Indigofera tinctoria</i>

.....continued on the next page

**TABLE 1.** (Continued)

Species	voucher code	Country	Reared from
<i>Bruchidius ituriensis</i> (Decelle, 1958)	BRU.GK201	Kenya	<i>Indigofera tinctoria</i>
<i>Bruchidius ituriensis</i> (Decelle, 1958)	BRU.GK407	Kenya	<i>Indigofera tinctoria</i>
<i>Bruchidius meibomiaca</i> Arora, 1980	BRU.GK271	Vietnam	<i>Dendrolobium umbellatum</i>
<i>Bruchidius meibomiaca</i> Arora, 1980	BRU.GK312	Vietnam	<i>Dendrolobium</i> sp.
<i>Bruchidius mulunguensis</i> (Decelle, 1951)	BRU.GK21	Kenya	<i>Neonotonia wightii</i>
<i>Bruchidius mulunguensis</i> (Decelle, 1951)	BRU.GK167	Kenya	<i>Neonotonia wightii</i>
<i>Bruchidius pardellus</i> Delobel 2012	BRU.GK389	Kenya	<i>Neonotonia wightii</i>
<i>Bruchidius pardellus</i> Delobel 2012	BRU.GK390	Kenya	<i>Neonotonia wightii</i>
<i>Bruchidius securiger</i> Delobel & Anton 2003	BRU.GK451	Senegal	<i>Dichrostachys cinerea</i>
<i>Bruchidius securiger</i> Delobel & Anton 2003	BRU.Sb21	Tanzania	<i>Dichrostachys cinerea</i>
<i>Callosobruchus chinensis</i> (Linnaeus, 1758)	BRU.Xm11	Egypt	<i>Cajanus cajan</i>
<i>Callosobruchus maculatus</i> (Fabricius, 1775)	BRU.Xe11	Vietnam	<i>Vigna unguiculata</i>
<i>Callosobruchus subinnotatus</i> (Pic, 1914)	BRU.Xf11	Senegal	<i>Vigna subterranea</i>
<i>Conicobruchus lineatopygus</i> (Pic, 1924)	BRU.L21	Senegal	<i>Indigofera tinctoria</i>
<i>Conicobruchus rubricollis</i> (Pic, 1903)	BRU.GK196	Kenya	N/A
<i>Conicobruchus strangulatus</i> (Fåhraeus, 1839)	BRU.Xh11	Senegal	<i>Crotalaria podocarpa</i>
<i>Kingsolverius malaccanus</i> (Pic, 1913)	BRU.GK150	Vietnam	<i>Pueraria phaseoloides</i>
<i>Kingsolverius malaccanus</i> (Pic, 1913)	BRU.Xw11	Vietnam	N/A
<i>Crioceris duodecimpunctata</i> (Linnaeus, 1758)	CRI.CrioDuo	N/A	N/A
<i>Pachymerus cardo</i> (Fåhraeus, 1839)	BRU.Xj14	Fr. Guiana	<i>Elaeis guineensis</i>

**TABLE 2.** Results of PartitionFinder analyses: selected models and partitions based on the AICc are figured on the left whereas selected models and partitions based on the BIC are figured on the right.

Partitions (AICc)	Models (AICc)	Partitions (BIC)	Models (BIC)
#1: 12S	GTR+G+I	#1: 12S	GTR+G+I
#2: 16S	GTR+G	#2: 16S	GTR+G
#3: Cytb pos1	GTR+G+I	#3: Cytb pos2, COI pos2	HKY+G+I
#4: Cytb pos2	GTR+G+I	#4: Cytb pos3	HKY+G+I
#5: Cytb pos3	GTR+G+I	#5: Cytb pos1/COI pos1	GTR+G+I
#6: COI pos1	GTR+G+I	#6: COI pos3	HKY+G
#3: COI pos2	GTR+G+I	#7: 28S-D2D3/28S-D6D7	GTR+G
#3: COI pos3	GTR+G+I	#8: 28SD4D5/18S	SYM+G
#9: 28S-D2D3	GTR+G		
#10: 28S-D4D5/18S	GTR+G		
#11: 28S-D6D7	GTR+G		

## Results

### Host-plant data and morphological studies

New diagnoses and host-plant data are provided for 10 species belonging to the *Bruchidius albosparsus* species group: *B. albosparsus* (Fåhraeus), *Bruchidius aurivillii* (Blanc), *B. centromaculatus* (Allard), *B. elnairensis* (Pic), *B. grandemaculatus* (Pic), *B. ishwaensis* (Decelle), *B. meridionalis* Anton & Delobel, *B. raddianae* Anton & Delobel, *B. tanaensis* (Pic) and *B. uberatus* (Fåhraeus). For these 10 species bibliographic references corresponding to original descriptions, synonymies and new combinations are also provided. Four new species are also described: *B. eminingensis* **sp. nov.**, *B. gerrardiicola* **sp. nov.**, *B. glomeratus* **sp. nov.** and *B. haladai* **sp. nov.** Morphological traits that enable discrimination between the species in the group are outlined in the following paragraphs. All host-plant names account for the recent nomenclatural changes in the taxonomy of acacias (Kyalangalilwa *et al.* 2013).

### *Bruchidius albosparsus* (Fåhraeus, 1839)

*Bruchus albosparsus* Fåhraeus, 1839:52.

*Bruchus spadiceus* Fåhraeus, 1839:54, **syn. nov.**

*Bruchus advena* Wollaston, 1870:26 (synonymy in Decelle 1972:236)

*Tuberculobruchus albosparsus* (Fåhraeus): Decelle, 1951:180

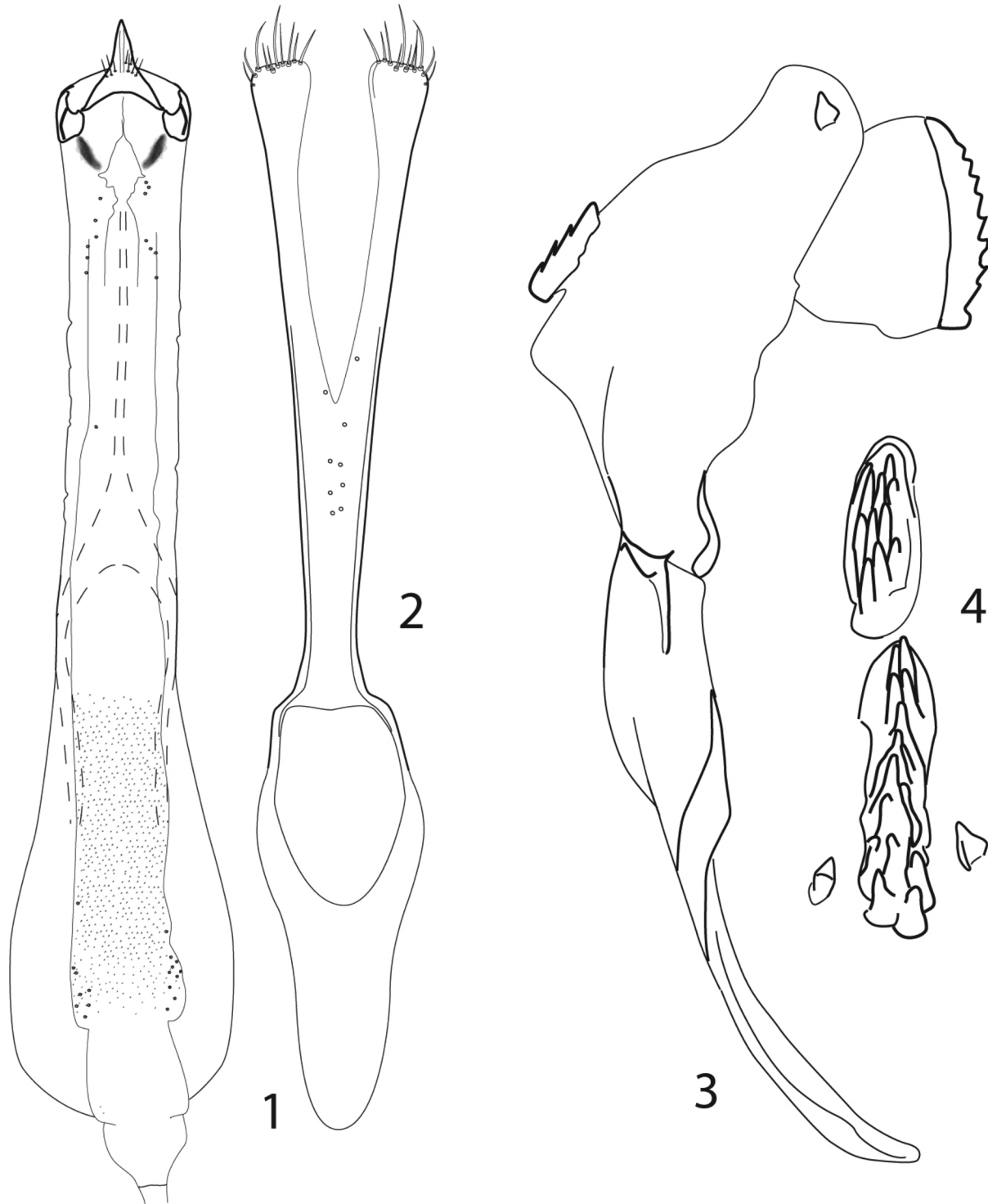
*Bruchidius albosparsus* (Fåhraeus): Vayssièrè, 1961:244

*Bruchidius spadiceus* (Fåhraeus): Decelle, 1972:236

**Material examined.** Type (female) of *Bruchus albosparsus*: Republic of South Africa: “Typus” “Terra Caffrorum / Ecklon & Zeyher” “459 / 64” “111 / 73” [NHRS]; specimen in poor condition, both elytra detached from body, left one glued to abdomen, both posterior legs missing, last abdominal tergite lifted, genitalia missing. Type (female) of *Bruchus spadiceus*: Republic of South Africa: “Typus” “Br: spadiceus / Dej. / Prope b. sp.:Drège” “464 / 64” “112 / 73” [NHRS]; specimen with last abdominal tergite lifted, genitalia missing, antennae and legs complete.

**Other material:** Democratic Republic of Congo: 5♂, 4♀, Isangi Port, 00°46'52"N, 24°16'25"E, 383m, 03.v.2010, ex acacia seeds [2♂ 01610, 01710, specimen GK360 used for DNA extraction] (B. Le Ru) [CBGP, MNHN]. Kenya: 19♂ 31♀, Machakos, 01°50'09"S, 37°26'24"E, 1665m, 23.i.2008, ex *Vachellia seyal seyal* seeds [4♂ 02311, 02411, 02511, 08508, 2♀ 03511, 03611, specimen GK397 used for DNA extraction] (B. Le Ru) [CBGP, MNHN]; 13♂, 10♀, Nairobi, Icipe Campus, 01°13'13"S, 36°53'38"E, 1619m, 11.i.2008, ex *Vachellia xanthophloea* seeds [1♂ 07608, specimens GK398 and GK399 used for DNA extraction] (B. Le Ru) [CBGP, MNHN]; 3♂, 1♀, Gilgil, 00°23'45"S, 36°18'45"E, 2036m, 29.x.2007, ex *Vachellia gerrardii* seeds [1♀ 03011] (B. Le Ru) [MNHN]; 12♂, 12♀, Isinya, 01°40'23"S, 36°51'07"E, 1827m, ii.2002, ex *Vachellia nilotica* seeds [2♂ 03202, 03502, specimen Kg11=KE06 used for DNA extraction] (B. Le Ru) [CBGP, MNHN]; 1♂, 1♀, Magadi, 01°29'49"S, 36°37'15"E, 1748m, 06.i.2007, ex *Vachellia seyal seyal* seeds [1♂ 09307, specimen GK58 used for DNA extraction] (B. Le Ru) [CBGP, MNHN].

A small to medium-sized (1.7–2.7 mm) species, with a short ovate body, integument of lighter specimens yellowish red with brown markings, darker specimens mostly black, with yellowish red areas. Elytral base darkened, especially in humeral area, elytra with a common black spot beyond middle, not reaching apex, antennae (except central segments darkened in darker specimens), fore and middle legs yellowish red, hind legs reddish brown, with black coxae. Thoracic sternites and ventrites more or less extensively blackened medially. Last visible tergite yellowish red to reddish-brown with disc more or less darkened in female. Vestiture mainly whitish or yellowish, not completely covering integument, recumbent; areas of denser white hair: on pronotum, a longitudinal strip opposite scutellum, reaching to the first third of pronotum length, two very small spots about middle of disc, and sides, white; scutellum white; on elytra, white linear spots on interstriae 3, 5, 7, 9, and at mid-length on intervals 5, 7, 8, 9, separated by strips of blackish setae. On remaining interstriae, setation mainly yellowish. A black spot on suture between basal third and apical fourth. Upper parts of thoracic sternites with dense white setae. Last visible tergite with dense and uniform vestiture of whitish setae. Elytra with shallow protuberance bearing two small teeth at base of striae 3 and 4. Ventrite 1 with large basal circular area of thin, semi-erect setae.



**FIGURES 1–4.** *Bruchidius albosparsus* (male): 1—median lobe (ventral view); 2—lateral lobes (ventral view); *Bruchidius aurivillii* (male): 3—median lobe with internal sac evaginated (lateral view); 4—sclerites of the internal sac (ventral view).

Genitalia (Figs. 1–2). Median lobe slender, subcylindrical ( $w/l = 0.12$ ), ventral valve subtriangular, moderately sclerotized, with acute tip, bearing on each side 2 to 4 (usually 3) setae; hinge sclerites linear, hardly sclerotized, or absent; internal sac proximally with a few sensilla, saccus almost smooth, with only a few minute and translucent spines. Basal strut without keel. Lateral lobes cleft to about half their length; apex of parameres with numerous long setae. Female genital tract without dorsal sclerite at entrance of bursa copulatrix, in some specimens one or a few minute spines are visible under phase contrast.



**Biology.** Material from Kenya was reared from seeds of a number of Mimosoideae: *Vachellia gerrardii* (Benth.) P.J.H. Hurter, *V. nilotica* (L.) P.J.H. Hurter & Mabb., *V. seyal* (Del.) P.J.H. Hurter, *V. xanthophloea* (Benth.) P.J.H. Hurter; material from Democratic Republic of Congo from an unidentified species of acacia. Reported in *Senegalia senegal* (L.) Britton and *V. nilotica* (as *Acacia arabica*) seeds in Sudan (Peake 1952). *Bruchidius albosparsus* was also reported (as *B. spadiceus*) from *V. tortilis tortilis* (Forssk.) Galasso & Banfi in Botswana (Ernst *et al.* 1989), from *V. tortilis spirocarpa* (Hochst. ex A. Rich.) Kyal. & Boatwr. and *V. tortilis tortilis* seeds in Israel (Vayssière 1961; Halevy, 1974), from *S. cinerea* (Schinz) Kyal. & Boatwr., *V. davyi* (N.E.Br.) Kyal. & Boatwr., *V. karroo* (Hayne) Banfi & Galasso and *V. luederitzii* (Engl.) Kyal. & Boatwr. in Republic of South Africa and Zimbabwe (Van Tonder 1985), and from *V. tortilis raddiana* (Savi) Kyal. & Boatwr. and *V. tortilis spirocarpa* seeds in Tanzania (Lamprey *et al.* 1974; Pellew & Southgate 1984).

**Discussion.** Color differences between the types of *B. spadiceus* (body globally lighter, antennae entirely testaceous) and *B. albosparsus* (body darker, especially underside, antennae slightly darkened medially) fall well within the range of individual variation commonly observed in the genus. Hence the synonymy *B. spadiceus* = *B. albosparsus*.

**Distribution.** Botswana, Democratic Republic of Congo, Egypt (Shaumar 1963), Israel, Kenya, Namibia (Zacher 1936), Tanzania, Republic of South Africa, Saint Helena (Wollaston 1870), Sudan, and Zimbabwe.

### ***Bruchidius aurivillii* (Blanc, 1889)**

*Bruchus mimus* Gyllenhal, 1833:43 (preoccupied)

*Mylabris aurivillii* Blanc, 1889:42

*Bruchidius aurivillii* (Blanc): Schilsky, 1905:36

*Bruchus senegalensis* Pic, 1912: Anton, 2010:341

**Material examined.** Type (male) of *Mylabris aurivillii*: Tunisia: “Bled Thala / ex *Acacia tortilis* (Bonnet) / éclos en aout”, “Type”, “M. / aurivillii / E. Blanc / types” “Museum Paris / 1922 / Coll. L. Bedel”, “lectotype / J. Decelle des., 1972”; paratypes: 2♂, 6♀, same data as lectotype [MNHN].

Other material: Kenya: 5♂, 2♀, Nguruman, 01°45'50"S, 36°3'59"E, 712m, vi.2002, ex *Vachellia tortilis spirocarpa* [2♂ 11202, 14802, specimen Sp11 used for DNA extraction] (B. Le Ru) [CBAD, CBGP]; 2♂, 5♀, Magadi, 01°52'25"S, 36°18'20"E, 666m, 19.i.2013, ex *V. t. raddiana* (B. Le Ru) [CBAD, CBGP]; 1♂, Marigat, 00°25'56"N, 35°57'42"E, 1152m, 17.v.2007, ex *V. tortilis*, [specimen GK95 used for DNA extraction] (B. Le Ru) [CBGP]. Senegal: 1♂, Fleuve, Boké Namadi, 30.i.1999, ex *V. tortilis* [specimen Ac11 used for DNA extraction] (M. Sembène) [CBGP]; 1♂, 5♀, Khatali (between Dara and Déali), 29.iv.1995, ex *V. t. raddiana* [1♂ 11595, 3♀ 12895, 12995, 13095] (H. & A. Delobel) [CBAD]; 4♂, 1♀, Ndiengue Diaw, 16.iii.1996, ex *V. t. raddiana* (H. & A. Delobel) [CBAD]; 1♂, 3♀, 21 km N. Déali, 25.iii.1995, ex *V. t. raddiana* (H. & A. Delobel) [CBAD]; 3♂, Rao, 20.v.1995, ex *V. t. raddiana* [3♂ 10995, 11095, 11195] (H. & A. Delobel) [CBAD]; Lamsar, 16.iii.1999, ex *V. t. raddiana* (M.T. Gueye) [CBAD, CBGP].

A medium-sized (2.1–3.0 mm) species with yellowish to reddish brown integument and various darker areas, antennae and 4 anterior legs light testaceous, posterior legs slightly darker. Vestiture generally pale, with more or less extended brown patches: pronotum mostly brown, with median longitudinal line and basal lobes, white or yellowish; usually elytra with three irregular transversal rows of dots and apex, often more or less extended circular or rhomboid sutural spot, brown; last visible tergite light coloured, with base and median line more densely setose, and often a brown elongated spot on each side. Other major morphological traits are as follows: two minute teeth at base of striae 3 and 4; last visible tergite of female moderately bulging in apical one-third, without foveae; base of ventrite 1 of male with large patch of short yellowish erect setae.

Genitalia (Figs. 3–4): median lobe short, stout ( $w/l = 0.20$ ), apically widened, dorsal valve braced by strongly sclerotized ring, ventral valve acutely subtriangular, with two groups of 5 setae, internal sac lined with transparent tubercles, in proximal part a short dentate sclerite that lays in dorsal position when evaginated, followed by a long sclerite composed of 15–20 fused teeth, and a pair of short lateral teeth; apically a pair of leaf-like, lightly sclerotized plates. Tegminal strut with large carina, parameres short and apically truncated, cleft to 63% their length and with about 10 setae.

**Biology.** Reared from seeds of *Vachellia tortilis*, *V. t. raddiana* and *V. t. spirocarpa*.

**Discussion.** *Bruchidius senegalensis* was a replacement name for *B. mimus* Gyllenhal from Senegal. Subsequently the name *senegalensis* was erroneously used by authors for several other species (*B. centromaculatus*, *B. cretaceus* and *B. meridionalis*); the identity of *B. senegalensis* was established by Anton & Delobel (2003).

**Distribution.** Algeria (de Luca 1962), Burkina Faso (Nongonierma 1978), Chad (Hoffman 1965), Kenya, Mali (Nongonierma 1978), Mauritania (Nongonierma 1978), Morocco (de Peyerimhoff 1926), Saudi Arabia (Anton pers. com.), Senegal, Tunisia, and Yemen (Anton pers. com.).

### ***Bruchidius centromaculatus* (Allard, 1868)**

*Bruchus centromaculatus* Allard, 1868:20

*Bruchidius centromaculatus* Anton & Delobel, 2003:161

*Bruchus lanceolatus* Motschulsky, 1874:211 (synonymy in Anton & Delobel, 2003:161)

*Bruchidius sahlbergi* Schilsky, 1905:no. 94 (synonymy in Anton & Delobel, 2003:161)

*Bruchus albonotatus* Pic, 1930:13 (synonymy in Anton & Delobel, 2003:161)

**Material examined.** Egypt: 3♂, Bahareya, 18.xii.2002, ex *Vachellia nilotica* [1♂ 00403, specimen Cf41 used for DNA extraction] (G. Fédière) [CBAD, CBGP]; 2♂, Bahareya, 3.xii.2002, ex *V. farnesiana* [2♂ 00703, 00803] (G. Fédière) [CBAD]; 1♂, Giza, 12.xii.2002, ex *Dichrostachys cinerea* (G. Fédière) [CBAD]; Phylae, 23.iii.–4.iv.1993, ex acacia seeds (G. Couturier) [CBAD]. Kenya: 5♂, 4♀, Mogotio, 1°05'29"S, 35°56'06"E, 1686m, 18.vi.2007, ex *V. gerrardii* [1♂ 09507, specimen GK54 used for DNA extraction] (B. Le Ru) [CBAD, CBGP]; 2♂, 3♀, Suam, 00°29'27"N, 35°50'31"E, 1894m, i.2003, ex *V. sieberiana* [1♂ 03303] (B. Le Ru) [CBAD]. Senegal: 1♂, Lamsar, 18.iii.1999, ex *V. t. raddiana* [1♂ 02600] (M.T. Gueye) [CBAD, CBGP]; Ross-Béthiot, 21.iii.1999, ex *V. nilotica* [specimen Cf41 used for DNA extraction] (M.T. Gueye) [CBAD, CBGP]; 5♂, 1♀, Ngazobil, 2.xii.1995, ex *V. sieberiana* [3♂ 12495, 13595, 02296, 00497, 1♀ 13599] (A. & H. Delobel) [CBAD]; 1♂, Ngazobil, 25.i.1997, ex *V. sieberiana* [1♂ 00297] (A. & H. Delobel) [CBAD]; 1♂, Nianing, 3.vii.1999, *V. sieberiana* (A. & H. Delobel) [CBGP]; 2♂, Diagle, 13.i.1996, ex *Senegalia macrostachya* [2♂ 01796, 00297] (A. & H. Delobel) [CBAD, CBGP]; 1♂, Pout, i.1996, ex *S. polyacantha campylacantha* [1♂ 02796] (A. & H. Delobel) [CBAD]; other material as listed in Anton & Delobel (2003), including specimens from Burkina-Faso, Democratic Republic of Congo, Israel, Mauritania, Saudi Arabia and Sudan.

A medium to large-sized (2.1–3.1 mm) species, from light yellowish to checkered with blackish and whitish spots; elytral intervals 1 and 2 blackened beyond half length, antennae and legs yellowish, apical antennal segments often darker; ventrite 1 with baso-central pear-shaped area with dense, semi-erect thinner setae in male; in female, last visible tergite with pair of oblong, micropunctate foveae that are devoid of shiny margin; Genitalia [see Figs. 1–7, p.163 in Anton & Delobel 2003]. Internal sac slender ( $w/l = 0.12$ ), entirely lined with small broad-based spines or slim based spines, and 19 to 44 large denticles with base twice as long as point; lateral lobes separated to about 80% their length; tegminal strut with very small carina; in female, vagina long and membranous, with dorsal dentate sclerite.

**Biology.** Reared from seeds of *Dichrostachys cinerea* (L.) Wight & Arn., *Senegalia dudgeoni* (Craib ex Holland) Kyal. & Boatwr., *S. polyacantha campylacantha* (Hochst. ex A. Rich.) Kyal. & Boatwr., *S. macrostachya* (Reichenb. ex DC.) Kyal. & Boatwr., *Vachellia farnesiana* (L.) Wight & Arn., *V. gerrardii*, *V. nilotica adstringens* (Schumach. & Thonn.) Kyal. & Boatwr., *V. n. nilotica*, *V. n. tomentosa* (Benth.) Kyal. & Boatwr., *V. sieberiana* (DC.) Kyal. Boatwr., *V. tortilis* and *V. t. raddiana*.

**Discussion.** *Bruchidius centromaculatus* is morphologically related to *B. arabicus* and can be distinguished by having broader apical antennal segments, no or only shallow protuberances at base of elytra, apically broader male last visible tergite, paired foveae at apex of female last visible tergite, distinctly lower number of denticles in internal sac, dentate sclerites in bursa copulatrix [see Figs. 1a–c in Decelle 1979 for habitus and male genitalia of *B. arabicus*].

**Distribution.** Burkina Faso, Democratic Republic of Congo, Egypt, Kenya, Mauritania, Saudi Arabia, Senegal, and Sudan.

## ***Bruchidius elnairensis* (Pic, 1931)**

*Bruchus elnairensis* Pic, 1931:35

*Bruchidius voltaicus* Decelle, nomen nudum: Nongonierma, 1978, Varaigne-Labeyrie & Labeyrie, 1981

*Bruchidius acaciaephilus* Anton, 2000:246 (synonymy in Anton & Delobel, 2003:171)

**Material examined.** Kenya: 13♂, 12♀, Kabarnet, 00°28'14", 35°51'07"E, 1365m, 18.vi.2007, ii.2003, ex *Vachellia dolichocephala* [2♂ 01614, 01714, specimen E11 used for DNA extraction] (B. Le Ru) [CBAD, CBGP]; other material as listed in Anton & Delobel (2003), including specimens from Burkina-Faso, Ghana, Saudi Arabia and Sudan.

A medium-sized (2.0–2.5 mm) species, with brown red integument and darkened areas; basal antennal segments and legs yellowish, apical antennal segments red-brown. Vestiture dense, with denser yellowish to white setae: sides of pronotum, meso- and metasternites, a small triangle at base of last visible tergite; pronotal disc with ill-defined median longitudinal yellowish-whitish band, sometimes with small white spot on each side of it; elytra often with oblong yellowish, whitish and brownish marks, with two irregular transverse whitish bands and striking longitudinal whitish mark in middle of interval 3, sometimes elytra predominantly yellowish with indistinct paler spots; last visible tergite whitish with two basal yellowish spots. Ventrite 1 with small baso-central patch of semi-erect thin setae. In female, last visible tergite with pair of deep foveae with shiny margin and setous central area. Genitalia (Figs. 5–6). Median lobe of moderate length ( $w/l = 0.13$ ); ventral valve subtriangular, with semicircular row of about eight setae in basal half and acute apical tip; internal sac with subapical median longitudinal agglomeration of about twelve large blunt denticles, at mid part with paired oblique, apically combined agglomerations of eight moderate, sharp denticles each, basally followed by paired oval agglomerations of about 20 small needles each (Fig. 5). Lateral lobes simple, cleft to half their length, with about eight setae at apex; tegminal strut moderate, with short median carina. In female, vagina long and membranous, without dorsal sclerite.

**Biology.** Examined material reared from *Vachellia dolichocephala* (Harms) Kyal. & Boatwr. Also recorded from seeds of *V. amythetophylla* (Steud. ex A. Rich.) Kyal. & Boatwr., *V. hockii* (De Wild.) Seigler & Ebinger, *V. flava* (Forssk.) Kyal. & Boatwr., *V. gerrardii*, *V. seyal* and *V. seyal* var. *fistula* (Schweinf.) Kyal. & Boatwr.

**Discussion.** *Bruchidius elnairensis* is distinguished from the closely related *B. aurivillii* by having vestiture predominantly yellowish, last visible tergite broader, paired foveae near apex of female last visible tergite, paired and only apically combined agglomerations of denticles in mid part of internal sac, larger paired agglomeration of higher number of needles in basal part of internal sac, lateral lobes slimmer and less separated.

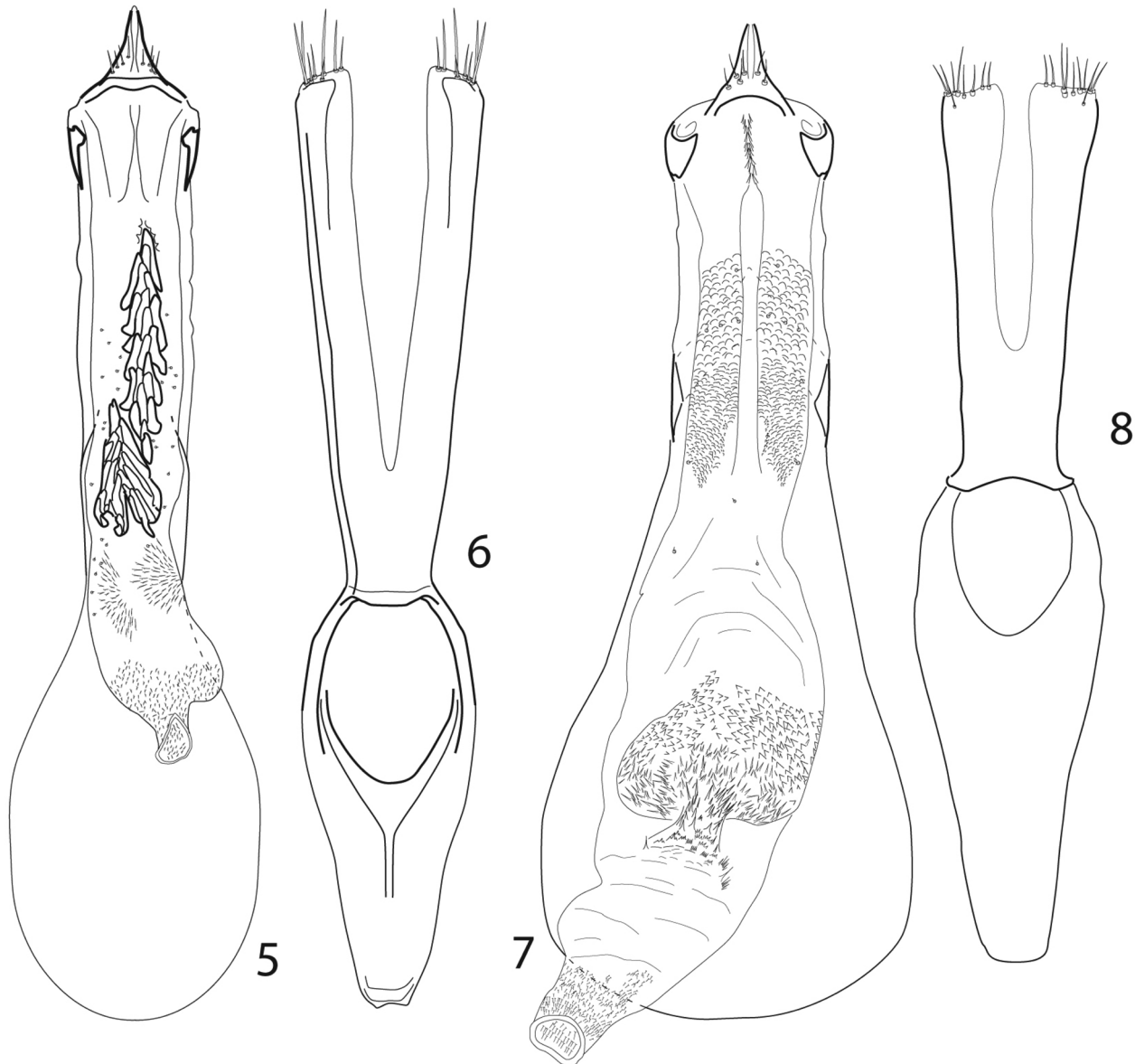
**Distribution.** Burkina Faso, Ghana, Kenya, Saudi Arabia, Senegal (Anton & Delobel 2003), and Sudan (Pic 1931).

## ***Bruchidius eminingensis* Delobel, sp. nov.**

**Material examined.** Holotype (male) of *Bruchidius eminingensis*: Kenya: "Kenya, Emining / *Acacia seyal seyal* / S 00°17'52" E 35°55'17", 1384m, / 18 juin 2007 / B. LeRu coll." "genitalia: lame Delobel 17607" "*Bruchidius eminingensis* n.sp., Delobel des., 2014"[MNHN]. Paratypes: 3♂ 5♀, same data as holotype [1♀, 17507, specimen GK101 used for DNA extraction] [CBGP].

**Other material.** Kenya: 3♂, Machakos, S 01°50'09" E 37°26'24", 1665m, 23.i.2008, ex *Vachellia seyal* [3♂ 08108, 08408, 11208] (B. Le Ru) [CBGP, MNHN].

**Description.** Length (pronotum-last visible tergite): 2.2–2.4 mm; width: 1.0–1.1 mm. Body oval, stout, about half as deep as long, last visible tergite slanted about 10° from vertical, slightly turned under in apical one-fourth. Body yellowish brown to reddish brown, underside and face black; antenna and four anterior legs light testaceous, posterior legs somewhat darker, last tarsal segments black; disc of last visible tergite more or less blackened. Vestiture dense but not completely hiding integument, made of slightly scaly white, yellowish and brown setae; pronotum disc mainly brown, with large white prescutellar spot, scutellum white; elytra mainly yellowish, in holotype with brown oval spot between basal and apical thirds of elytral suture and interstriae 1–3, absent in light specimens; small dark spots in basal fourth of interstria 3, in interstriae 7 and 9, at apex of intervals 2, 4–5, and 7–9; last visible tergite densely and almost uniformly whitish.



**FIGURES 5–8.** *Bruchidius elnairens* (male): 5—median lobe (ventral view); 6—lateral lobes (ventral view); *Bruchidius eminingensis* (male): 7—median lobe (ventral view); 8—lateral lobes (ventral view).

Male. Head short, eyes widely separated, bulging, maximum head width 1.46 times width behind eyes; eyes separated by 0.32 times head width including eyes; face wide, distance between posterior rim of eyes and apex of clypeus / minimum distance between eyes = 2.2; width at bottom of sinus composed of 5–6 ommatidia; interocular carina blunt, ending basally in a bare tubercle. Antenna measuring one-fourth body length; segments 1–4 moniliform, 5 wider than long, following ones transverse, moderately eccentric, 11 rounded apically ( $l/w = 1.1$ ); length of antennomeres: 1.1; 1.0; 1.1; 0.7; 0.8; 0.9; 1.0; 0.9; 1.0; 1.1; 1.8.

Pronotum subcampaniform, wider at base than long ( $w/l = 1.3$ ) its sides slightly convex medially; disc with small, dense punctures.

Elytra oval, regularly widened beyond humerus, widest before middle, 1.1 times longer than combined width; two strong teeth at base of interstria 4; striae thin and sharp, interstriae flat, shining.

Hind femur incrassated, 1.8 times wider than mid femur, mesoventral margin without preapical tooth; hind tibia strongly widened apically, with mucro two thirds width of first tarsomere; lateral denticle about half mucro length, and dorsal denticles about half the latter.

Abdomen with ventrite 5 moderately emarginated, ventrite 4 shorter medially than laterally, base of ventrite 1

with a large circular impression bearing short, dense setae; last visible abdominal tergite shield-shaped, only slightly longer than wide ( $l/w = 1.04$ ).

Genitalia (Figs. 7–8): Median lobe stout (maximum width excluding basal hood/ total length = 0.17), ventral valve subtriangular, moderately sclerotized, with rounded tip, bearing on each side 2–4 setae; basal one-fourth of internal sac densely lined with round denticles, middle of sac smooth, apical part with large dorsal pouch densely lined with short and elongated spines. Basal strut elongated, subtriangular, without keel, lateral lobes as long as basal strut, cleft to 65% their length; apex of parameres with eight long setae.

Female similar to male, last visible tergite reddish with disc black, regularly convex, setation yellowish, denser on basal and apical triangles, also along more or less distinct mid-line; spermatheca comma-shaped, with smooth surface, without visible vaginal sclerite.

**Biology.** Both series were reared from *Vachellia seyal* seeds.

**Discussion.** *Bruchidius eminingensis* is most similar to *B. nongoniermai* Delobel, from which it is separated on the basis of details of aedeagus shape and ornamentation: *B. nongoniermai* (Figs. 9–10) has a more slender median lobe, with saccus devoid of translucent tubercles in anterior part, but completely lined with minute needles. It can be further distinguished by body color and ecology: *B. nongoniermai* is a light yellowish species that feeds in *Vachellia kirkii* (Oliv.) Kyal. & Boatwr. seeds. This species of acacia is restricted to the sahelian zone (Chad, Mali, Sudan) (Delobel 2007). Several undescribed species with similar external morphology exist in the Southeastern part of Africa; they cannot be distinguished from one another without a careful examination of genital morphology.

**Etymology.** Named after the locus typicus, the town of Eming in Kenya.

**Distribution.** Kenya.

### ***Bruchidius gerrardiicola* Delobel, sp. nov.**

**Material examined.** Holotype (male) of *Bruchidius gerrardiicola*: Kenya: “Kenya, Gilgil / *Acacia gerrardii* 2036m / S 00°23'45” E 36°18'45” / 29 octobre 2007 / B. LeRu coll.” “genitalia: lame Delobel 06508” “*Bruchidius gerrardiicola* sp. nov., Delobel des, 2014” [MNHN]. Paratypes: 10♂ 10♀, same data as holotype, [1♀, 07108, specimen GK881 used for DNA extraction] (B. Le Ru) [CBGP].

**Other material:** Kenya: 2♂ 4♀, Eming, S 00°17'52” E 35°55'17”, 1384m, 18.vi;2007, ex *Vachellia seyal* [2♂, 17007, 17407, specimen GK 100 used for DNA extraction] (B. Le Ru) [CBGP, MNHN]; 1♂, SE Kenya, Voi (Tsavo), 11.iv.–14.iv.1997 (M. Halada) [OLML]; 1♂, same data but 23.iii.–4.iv.1997 (M. Halada) [OLML].

Length (pronotum–last visible tergite): 2.2–2.4 mm; width: 1.3–1.4 mm. Body oval, stout, about half as deep as long, last visible tergite slanted about 20° from vertical, humped and turned under in apical one-fourth. Body dark brown, lighter on elytral disc and apex; basal five to seven antennal segments and four anterior legs testaceous, posterior legs reddish-brown with extreme base blackened; last antennal segment black or reddish brown, last tarsal segments black. Vestiture dense but not completely hiding integument, made of slightly scaly white, yellowish and black setae; pronotum disc variegated, with dark and white areas, and a median longitudinal white line; a black oval spot between basal third and apical fourth of elytral suture, on interstriae 1–3; interstriae 4, 6, 8 yellowish, 3, 5, 7, 9 with alternating white and dark spots; a wide strand of dense white setation along side, from behind eye to upper part of ventrites; last visible tergite whitish, with denser setation along midline, especially at base.

Male. Head short, eyes widely separated, bulging, maximum head width about 1.44 times width behind eyes; eyes separated by 0.32 times head width including eyes; face wide, distance between posterior rim of eyes and apex of clypeus / minimum distance between eyes = 2.2; width at bottom of sinus composed of 6–7 ommatidia; interocular carina well defined, disc of clypeus with large, isolated punctures. Antenna measuring one-third body length; segments 1–4 moniliform, 5 as wide as long, following ones transverse, moderately eccentric, 11 rounded apically ( $l/w = 1.2$ ); length of antennomeres: 2.3; 1.0; 1.4; 1.6; 1.8; 1.6; 1.7; 1.6; 1.6; 1.8; 2.8.

Pronotum subcampaniform, wider at base than long ( $w/l = 1.4$ ) its sides slightly convex medially; disc with small, dense punctures.

Elytra oval, regularly widened beyond humerus, widest near middle, about as long as combined width; two small teeth at base of striae 3 and 4; odd interstriae distinctly wider than even interstriae, striae thin and sharp, interstriae flat, shining.

Hind femur incrassated, 2.4 times wider than mid femur, mesoventral margin with minute preapical tooth; hind

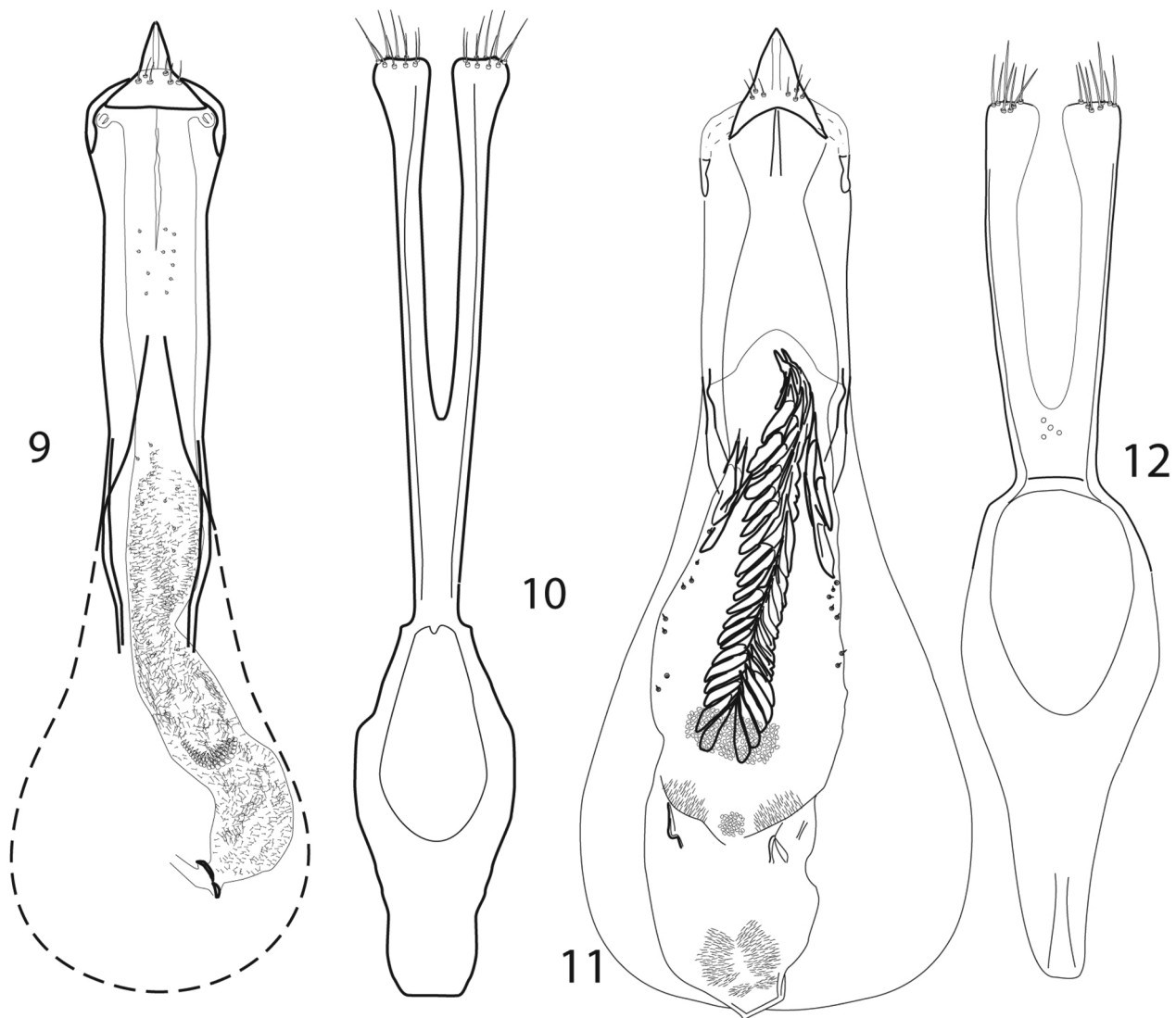
tibia strongly widened apically, with mucro as long as width of first tarsomere; lateral denticle about half mucro length, and dorsal denticles about half the latter.

Abdomen with ventrite 5 slightly emarginated, ventrite 4 about as long medially as laterally, ventrite 1 with a round spot of thin white erect setae at base; last visible abdominal tergite subcircular, only slightly longer than wide ( $l/w = 1.06$ ), disc with large, partly coalescent punctures.

Genitalia (Figs. 11–12). Median lobe moderately stout (maximum width excluding basal hood/ total length = 0.15), ventral valve ogival, well sclerotized, with acute tip, bearing on each side 3–4 setae; basal one-fourth of internal sac smooth, middle of sac with two rows of more than 20 closely packed, slender, thorn-like sclerites and two lateral groups of 3–4 spines, apical part of sac with a small batch of minute translucent granulation. Basal strut without keel, lateral lobes slightly shorter than basal strut, cleft about three-fourths their length; apex of parameres with seven long setae.

**Biology.** Larvae were reared from seeds of two *Vachellia* species: *V. gerrardii* and *V. seyal*.

**Discussion.** *Bruchidius gerrardiicola* is most similar to *B. glomeratus* n. sp., from which it is separated on the basis of aedeagus ornamentation: in addition to the median strand of densely packed spines, *B. glomeratus* shows a few slender spines in distal position; these additional spines are also present here, but are more numerous and in medial position. The saccus of *B. gerrardiicola* also lacks the sclerotized plates present in *B. glomeratus*. In females, the last visible tergite is less markedly bulging than in *B. glomeratus*.



**FIGURES 9–12.** *Bruchidius nongoniermai* (male): 9—median lobe (ventral view); 10—lateral lobes (ventral view); *Bruchidius gerrardiicola* (male): 11—median lobe (ventral view); 12—lateral lobes (ventral view).

**Etymology.** From the name of one of the identified host plant, *Vachellia gerrardii*.

**Distribution.** Kenya.

***Bruchidius glomeratus* Delobel, sp. nov.**

*Bruchidius* sp. KE05: Kergoat *et al.*, 2005, 2007, 2008

**Material examined.** Holotype (male) of *Bruchidius glomeratus*: Kenya: “Kenya, Kangonoi / 1°06'20”S 37°41'51”E, 1850m / i.2002, ex grains *Acacia etbaica* / B. Le Ru coll.”, “*Bruchidius glomeratus* sp. nov. / A. Delobel des. 2014”, “Holotype”. Paratypes, 3♂, 8♀, same data as holotype [1♂, slide 02502, two females dissected, genitalia in glycerin, specimen Kc11 used for DNA extraction] [CBGP, MNHN].

**Description.** Length (pronotum-last visible tergite): 2.1–2.2 mm; width: 1.3 mm.

Body stout, last visible tergite slanted about 10° from vertical, humped and turned under in apical one-fourth. Body reddish-brown, except center of sternites and claws, darker; antennal base and four anterior legs testaceous, posterior legs reddish-brown; antennae progressively blackened from segment 5 or 6, segment 11 lighter than preceding ones. Vestiture not completely hiding integument, made of short and thin, dull white setae, almost uniform, except for large dark rhomboid spot along posterior part of elytral suture and interstriae 2–3; additional more or less inconspicuous brownish spots at basal fourth of interstria 3 and middle of interstriae 9–10; a wide strand of dense white setation along side, from behind eye to upper part of ventrites; last visible tergite whitish, with denser setation along midline, especially at base.

Male. Head short, eyes widely separated, bulging, maximum head width about 1.36 times width behind eyes; eyes separated by 0.29 times head width including eyes; face wide, distance between posterior rim of eyes and apex of clypeus / minimum distance between eyes = 2.1; width at bottom of sinus composed of 6–7 ommatidia; no interocular carina, but a small shining bulge. Antenna about one fourth body length; segments 1–4 moniliform, 5 as wide as long, following ones transverse, almost symmetrical, 11 rounded apically (l/w = 1.0); length of antennomeres: 1.4; 1.0; 0.9; 0.9; 1.1; 1.0; 1.0; 1.0; 1.0; 1.1; 1.6.

Pronotum subcampaniform, wider at base than long (w/l = 1.3) its sides slightly convex medially; disc with small, dense punctures.

Elytra not wider at base than pronotum, but regularly widened beyond humerus, widest near middle, 1.1 times longer than combined width; two small teeth at base of interstria 4; striae on disc thin and sharp, interstriae flat, shining.

Hind femora moderately incrassated, mesoventral margin with minute preapical tooth; hind tibia strongly widened apically, with mucro shorter than width of first tarsomere; lateral denticle about 2/3 mucro length, and dorsal denticles about half the latter.

Abdomen with ventrite 5 deeply emarginated, ventrite 4 very short medially, ventrite 1 with a small round spot of erect setae at basal 0.4 of segment; last visible abdominal subcircular, only slightly longer than wide, disc with large, partly coalescent punctures.

Genitalia (Figs. 13–14). Median lobe moderately stout (maximum width excluding basal hood/ total length = 0.14), ventral valve ogival, moderately sclerotized, with acute tip, bearing on each side 4 setae; basal one-fourth of internal sac smooth, middle of sac with two rows of about 17 closely packed, slender, thorn-like sclerites, saccus with four slender spines and a pair of lightly sclerotized structures. Basal strut elongated, slender, with inconspicuous keel, lateral lobes shorter than basal strut, cleft to about three-fourths their length; apex of parameres with four long setae and three shorter ones.

Female. Similar to male, but antennae shorter, last visible tergite not turned under, reddish brown, with sharp apical bulge surrounded by black, flattened circular area, base of tergite with white triangle; sternite 5 about twice longer than sternite 4.

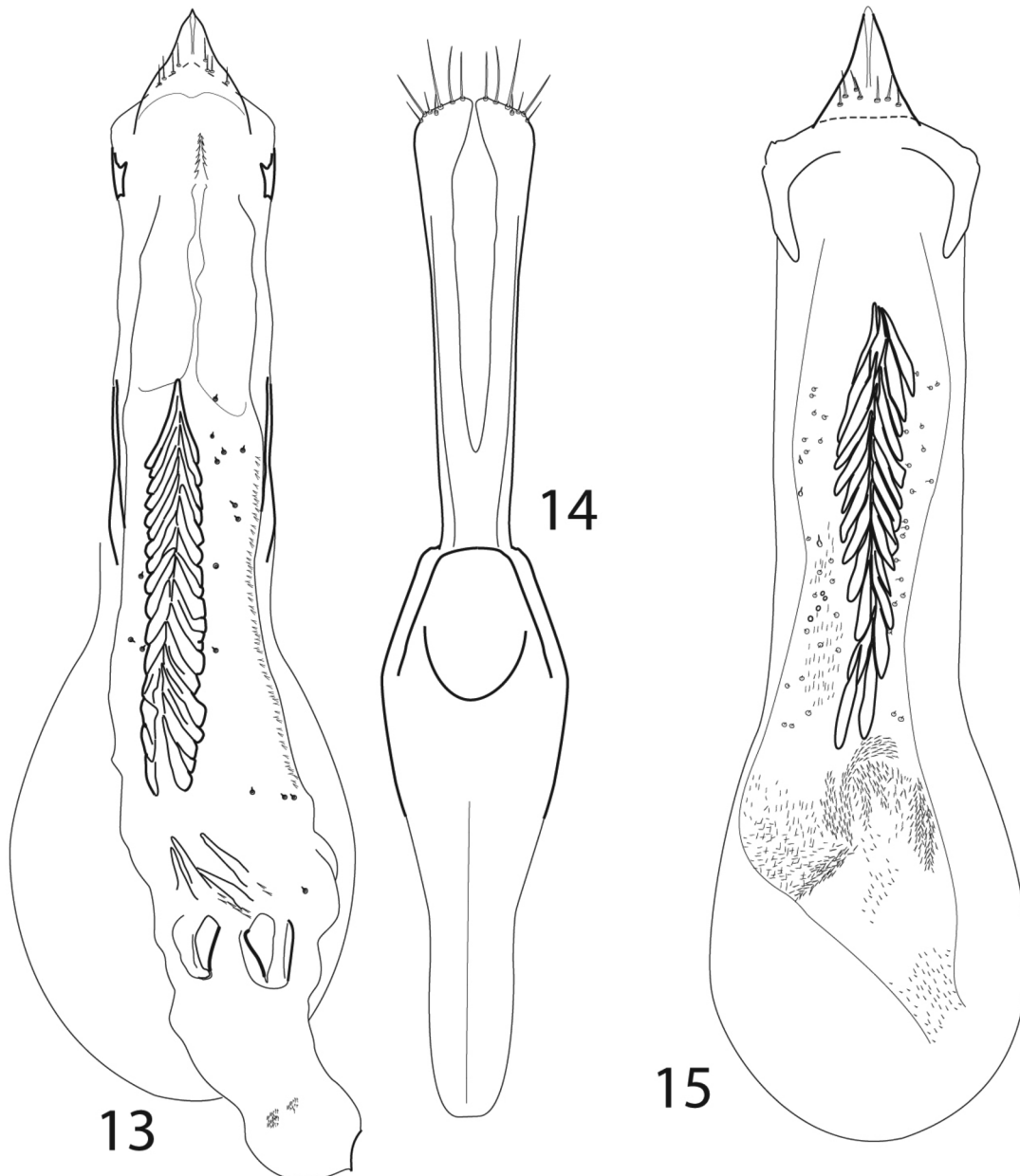
**Biology.** Larvae were reared from seeds of *Vachellia etbaica* (Schweinf.) Kyal. & Boatwr., an East-African species restricted to Somali-Masai woodland (ILDIS, 2014).

**Discussion.** *Bruchidius glomeratus* is morphologically most similar to *B. basilewskyi* (Decelle) and *B. gerrardiicola* n. sp. In *B. basilewskyi*, the pronotum is more transverse and strongly bulging laterally, its posterior legs are almost entirely black, as is its last visible tergite; the arrangement of large spines in the internal sac (Fig.

15) is quite similar with that of *B. glomeratus* (Fig. 13), but it lacks the four additional elongated spines in the posterior area. *Bruchidius glomeratus* can be also separated from *B. gerrardiicola* by the shape of the black elytral spot (rhomboid in *B. glomeratus*, subcircular in *B. gerrardiicola*). It has also close morphological affinities with *B. grandemaculatus* (Pic), a usually larger species with body colour darker and antenna light brown. Male genitalia of the three species show a very close relationship, with an arrangement of spines that is also met in species with “eyed” female last visible tergite (Anton & Delobel, 2003), particularly in *B. elnairensis*; male genitalia in *B. grandemaculatus* are of a quite different type. In female, last visible tergite is less bulging than in *B. grandemaculatus*, but more than in *B. gerrardiicola*.

**Etymology.** Past participle (masculine) of Latin verb *glomerare*, “to group”, referring to the dense longitudinal grouping of spines in the median part of the internal sac.

**Distribution.** Kenya.



**FIGURES 13–15.** *Bruchidius glomeratus* (male): 13—median lobe (ventral view); 14—lateral lobes (ventral view); *Bruchidius basilewskyi* (male, paratype, MNHN): 15—median lobe (ventral view).



## ***Bruchidius grandemaculatus* (Pic, 1933)**

*Bruchus grandemaculatus* Pic, 1933:20.

*Bruchidius grandemaculatus* (Pic): Zampetti, 1988:102.

**Material examined.** Type (male) of *Bruchidius grandemaculatus*: Kenya: “Lamu I. / Kenya Colony” “April–May 1911 / H.J.A. Turner” “Museum Paris / coll. Pic” “Type” [MNHN].

**Other material:** Kenya: 2♂, 2♀, Tsavo, Mackinnon, 3°43'54"S 39°02'07"E, 379m vii.2001, ex *Vachellia nilotica* seeds [1♂ 05501, 2♀ 05401, 05601, specimen G11 used for DNA extraction] (B. Le Ru) [CBGP, MNHN]; 8♂, 13♀, Kerio 00°32'26"N 35°31'31"E, 1282m, 17.vii.2007, ex *V. tortilis spirocarpa* seeds [1♂ 09707] (B. Le Ru) [CBGP, MNHN]; 2♂, 1♀, Marigat, 00°28'13"N 35°54'30"E, 1265m, 18.vi.2007, ex *Senegalia senegal* seeds [1♂ 06708] (B. Le Ru) [MNHN]; 3♂, Marigat, 00°20'49"N 35°56'00"E, 1322m, 17.v.2007, ex *S. senegal* seeds (B. Le Ru) [CBGP, MNHN]; 10♂, 16♀, Malindi, 03°08'03"S 40°08'05"E, 33m, 31.xii.2007, ex *V. nilotica* seeds [specimen GK210 used for DNA extraction] (B. Le Ru) [CBGP, MNHN]; 1♀, Tsavo (Voi), 22.xi–2.xii.1996 (M. Snizek) [OLML]; 1♂, Tsavo, 23.iii–4.iv.1997 (M. Halada) [OLML].

A medium to large-sized (2.6–4.4 mm) species, body color variable, darker specimens with elytra largely black, with disc brownish, and lighter specimens mostly tawny, with black markings only in apical fourth of elytra; female darker than male, elytra largely black with elongated spots of light setae in interstriae; anterior legs and antennae testaceous, posterior legs reddish brown with base often black; last visible tergite brown, with a median and two lateral lines of white setae. Other distinctive morphological traits: antenna short, submoniliform; elytra with wide protuberance bearing two large blunt teeth at base of striae 3 and 4; ventrite 1 with small basal ovoid area of thin, semi-erect setae; last visible tergite strongly turned under apically in male; in female, with two large and shallow apical impressions surrounding a narrow median bulge.

Genitalia (Figs. 16–17). Median lobe elongated, slightly widened apically ( $w/l = 0.13$ ), basal hood moderately widened; ventral valve small, subtriangular, folded in middle, with two lateral groups of 2–3 setae; basal third of internal sac densely lined with strands of tubercles that are strongly sclerotized anteriorly, and become translucent posteriorly; posterior part of internal sac with various spinules and setae, and a complex structure composed of lightly sclerotized plates with dense setation and a pair of small lateral pockets; gonopore wide, sclerotized; basal strut narrow, with small keel; lateral lobes cleft to about 80% their length; apex bearing 6 setae. In female, vagina short, no dorsal sclerite at entrance of bursa copulatrix.

**Biology.** Examined material was reared from seeds of three Mimosoideae collected in Kenya: *Senegalia senegal*, *Vachellia nilotica* and *V. tortilis spirocarpa*.

**Discussion.** As underlined beforehand, *B. grandemaculatus* is morphologically similar to *B. glomeratus*. It differs by is larger size, darker coloration and the color of its antennae. In female, the last visible tergite is also more bulging than in *B. glomeratus*. Male genitalia of both species are also quite distinctive (see Figs. 16–17 for *B. grandemaculatus* and Figs. 13–14 for *B. glomeratus*).

**Distribution.** Burundi (Pic 1933), Democratic Republic of Congo (Pic 1933), Kenya, and Somalia (Zampetti 1988).

## ***Bruchidius haladai* Delobel, sp. nov.**

**Type material.** Holotype (male) of *Bruchidius haladai*: Kenya: “Kenya, Malindi / ex *Acacia nilotica* 33m / S 03°08.054' E40°08.098' / 31 décembre 2007, B. Le Ru coll.” “Genitalia: lame Delobel 00814” “Holotype” “*Bruchidius / haladai* sp. nov. / Delobel des., 2014” [MNHN]. Paratypes: 8♂, 12♀, same data as holotype [2♂ 07809, 07909, 1♀ 00410] [MNHN].

**Other material:** Kenya: 7♂, Voi (Tsavo), 11–14.iv.1997 [1♂ 13607, specimen GK245 used for DNA extraction] (M. Halada) [OLML]; 1♂, Tsavo, Voi, 22.xi–2.xii.1996 [1♂ 06909] (M. Halada) [OLML]; 1♂, 1♀, Tsavo, Voi, 22.xi–2.xii.1996 (M. Snizek) [OLML]; 1♂, Voi, 13–17.xii.1997 (M. Snizek) [OLML]; 2♀, Voi, 8–18.xi.1996 (M. Snizek) [OLML]; 1♂, 1♀, Tsavo, Voi, 23.iii–4.iv.1997 (M. Snizek) [OLML]. Zimbabwe, 1♂, 50km NW Chipinge, 25.i.1998 (M. Halada) [OLML].

**Description.** Length (pronotum–last visible tergite): 2.9 mm; width: 1.7 mm.

Body stout, last visible tergite vertical. Integument dark brown to black, antennomeres 1–4(5) reddish brown,

(5)6–10 black, 11 reddish brown apically; mouthparts and vertex reddish; anterior legs yellowish brown with femora partly blackened and last 2 or 3 tarsomeres black; posterior legs dark brown to black; base of last visible tergite lighter coloured.

Vestiture made of long, moderately dense white, yellowish, brown and black setae; pronotum with black setae anteriorly, disc with diffuse brown spots; basal lobe with long white or yellowish setae; on elytra, black dots arranged in two transversal stripes on interstriae 3, 5, 7 and 9; a wide longitudinal stripe along suture (except in basal fourth), on interstriae 1 and 2, and 3 in posterior third; apex black with 4–5 small brown dots; last visible tergite with two dark basal dots and small irregular black areas.

Male. Head short, with eyes strongly bulging, maximum head width 1.7 times width behind eyes; eyes separated by 0.17 times head width including eyes; face long and very narrow, with distance between posterior rim of eyes and apex of clypeus / distance between eyes = 4.1; eye cleft only to middle, width at bottom of sinus composed of 12 ommatidia; carina on frons not defined, interocular tubercle distinct, flattened, dull.

Punctuation of face irregular, apex of clypeus straight, alutaceous. Antenna measuring 0.85 times body length; antennal segments 2–3 moniliform, of equal length, together shorter than 4, 5–10 widened apically, serrate, strongly eccentric, 4 as wide as long, 5–10 much wider than long, 8 1.3 times wider than long, 11 oval ( $l/w = 2.2$ ). Length of antennomeres: 2.4; 1.0; 1.0; 2.7; 2.8; 2.8; 3.1; 2.9; 3.2; 3.5; 5.1.

Pronotum subtrapezoidal, with greatest width at base ( $w/l = 1.33$ ), its sides bulging near middle, not expanded behind eyes; its surface irregular, with two oblique impressions, on sides of basal lobe and near middle. Disc with punctures strong, coalescent and ocellate.

Elytra 1.12 times longer than combined width, their sides convex, maximum width beyond middle; two strong teeth at base of interstria 4. Striae on disc shallow and narrow, with punctures small; interstriae shining, with strong microsculptures and rows of large punctures.

Hind femora moderately incrassated, mesoventral margin with strong preapical denticle; hind tibiae apically strongly widened, with dorsomesal and ventral carinae complete, lateral reaching base, and a ventro-lateral carina not reaching apex; apex of tibia with mucro about as long as width of tarsomere 1 at base; lateral denticle about 1/3 mucro length, and dorsal denticles about half as long as lateral denticle. First tarsomere ventrally with small denticle.

Abdomen with ventrite 5 deeply emarginate; ventrite 1 basally with small patch of white setae. Last visible abdominal tergite subtriangular, 1.1 times longer than wide at base, with apex not turned under, in female without foveae.

Genitalia (Figs. 18–19). Median lobe of moderate length, stout (maximum width excluding basal hood/ total length = 0.16), not apically widened; basal hood large and wide, not emarginate; ventral valve acutely triangular, bearing two lateral groups of 5 setae; dorsal valve braced by a wide sclerotized ring; no hinge sclerites; basal part of internal sac with 18 strongly sclerotized spines; saccus lined with minute pointed tubercles, and with two small thorn-like sclerites; distal tube with long, dense needles. Basal strut with large keel; lateral lobes cleft to 80% their length, pubescent; apex of parameres with about 15 short setae.

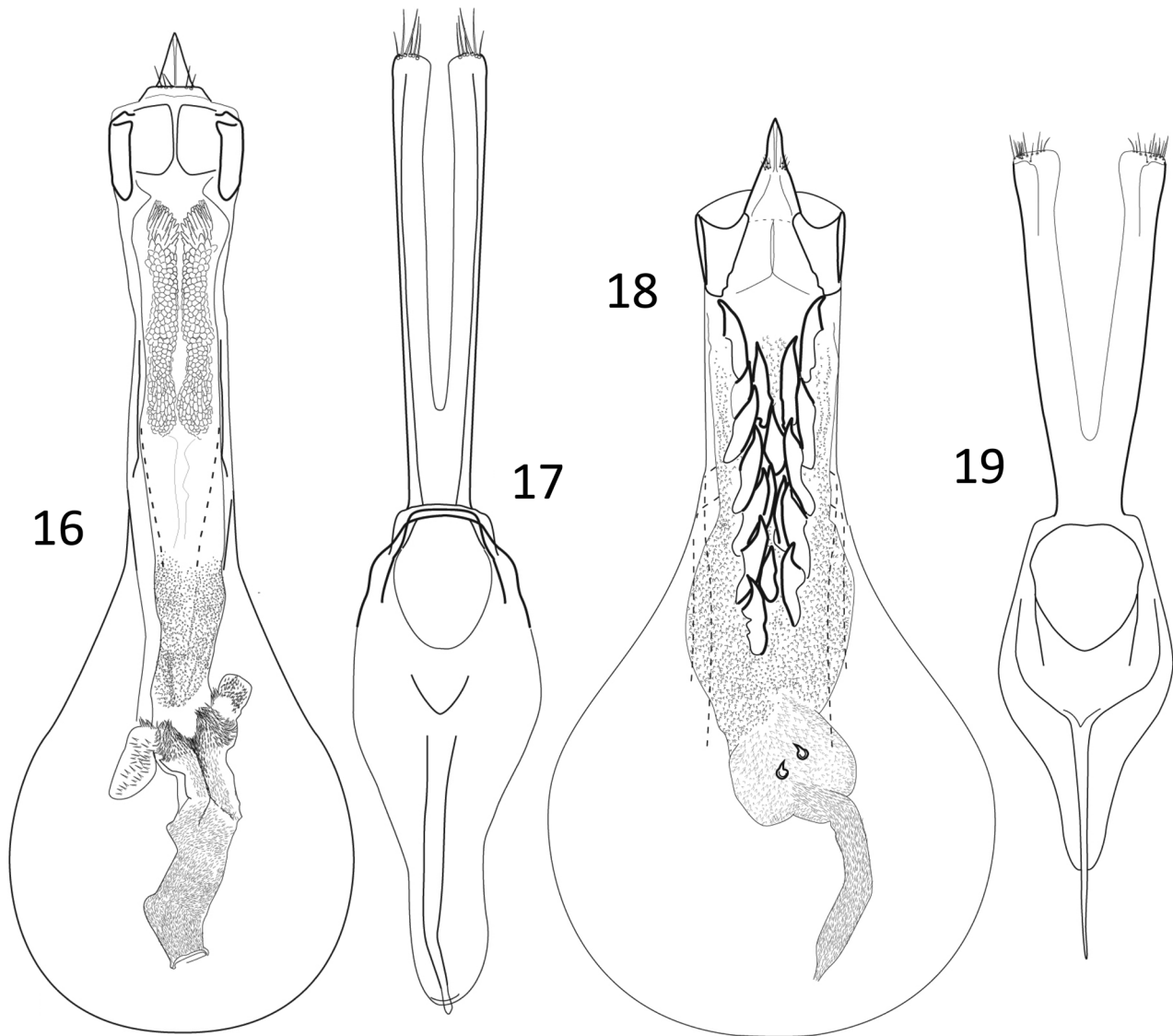
Female. Similar to male, but antennae shorter, segments 1–4 moniliform, 5–10 more or less darkened, sometimes whole antenna reddish brown. Vagina long and membranous, with a small thorn-like sclerite in dorsal position at entrance of bursa copulatrix.

**Biology.** Reared from *Vachellia nilotica* seeds.

**Discussion.** *Bruchidius haladai* compares most closely with *B. uberatus*, from which it differs mainly in a very distinctive arrangement of large sclerotized teeth in the internal sac (Fig. 18; see Fig. 25 for *B. uberatus*). *Bruchidius uberatus* has a wide distribution in Africa (from Mauritania and North Africa to Republic of South Africa and Namibia, also present in the Arabic Peninsula, Iran and India, whereas *B. haladai* seems restricted to East Africa. A stout median lobe, pointed ventral valve, numerous large spines in the internal sac, basal strut with large dorsal keel, are also met in a species that belong to a phylogenetically distant lineage (Delobel *et al.* 2013); *B. hinnulus* (Fähræus). *Bruchidius haladai* however differs from *B. hinnulus* in the smaller number and larger size of spines in the internal sac.

**Etymology.** Species dedicated to Marek Halada, who collected several specimens in the Tsavo National Park.

**Distribution.** Kenya and Zimbabwe.



**FIGURES 16–19.** *Bruchidius grandemaculatus* (male): 16—median lobe (ventral view); 17—lateral lobes (ventral view); *Bruchidius haladai*: 18—median lobe (ventral view); 19—lateral lobes (ventral view).

***Bruchidius ishwaensis* (Decelle, 1958)**

*Bruchus ishwaensis* Decelle, 1958:82

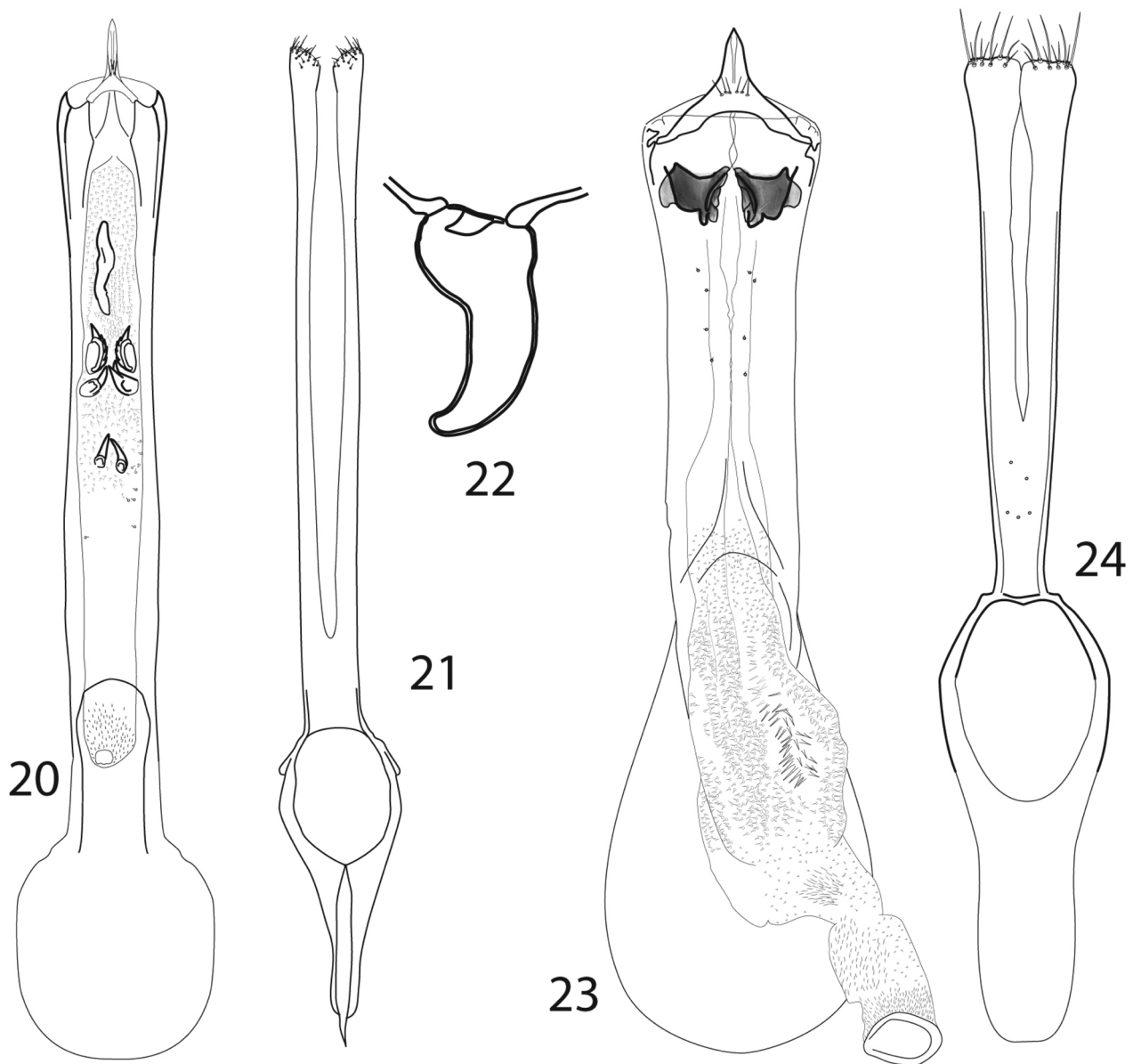
*Bruchidius ishwaensis* (Decelle): Decelle, 1979:82

**Material examined:** Holotype (male) of *Bruchus ishwaensis*: Democratic Republic of Congo: “Holotypus”, “Genit ♂ / Br.57”, “Coll. Mus. Congo / Pl. d’Ishwa (Mahagi) / iii-1942 / J. Vrydagh”, “*Bruchus* / *ishwaensis* n. sp. / det. J. Decelle 1958” [MRAC].

**Other material:** Kenya: 9♂, 7♀, Garissa, 00°28’39”S 39°33’00”E, 292m, i.2002, ex *Vachellia etbaica* [1♂ 04903] (B. Le Ru) [CBAD]; 1♂, 2♀, same data, ex *V. reficiens* [1♂ 02102, 1♀ 02202, specimen Ki11 used for DNA extraction] (B. Le Ru) [CBAD, CBGP]; 16♂, 14♀, same data, ex *V. zanzibarica* [♂ 04602, 04702] (B. Le Ru) [CBAD, CBGP]; 3♂, 2♀, Baringo, 00°35’10”N 36°00’55”E, 1084m, 18.vi.2007, ex *V. reficiens* (B. Le Ru) [CBAD, CBGP]; 1♂, Kabarak, 00°10’26”S 35°58’21”E, 1910m, 18.vi.2007, ex *V. seyal* (B. Le Ru) [CBAD, CBGP]; 3♂, 1♀, Voi (Tsavo), 11.iv.–14.iv.1997 (M. Halada) [OLML]; 4♂, Voi (Tsavo), 23.iii. – 4.iv.1997, (M. Snizek) [OLML]; 2♂, 1♀, same data, (M. Halada) [OLML]; 1♂, Voi (Tsavo), 8 – 18.vi.1996, (M. Snizek) [OLML]; 1♂, Tsavo W., Kitani Lodge, v. 2002 (A. Vojnits) [HNHM].

A small to medium-sized (1.4–2.5 mm) brown and reddish species, with white, yellow and brown setation; antennae usually testaceous in male, or with median segments more or less darkened; female usually with antennal segments 6 (7, 8)–10 blackened, shorter and less eccentric than in male; on pronotum, basal lobes, median line and two lateral spots white, narrow apical stripe and postero-lateral impressions yellow; on elytra, dark specimens with brown heart-shaped sutural spot, absent in lighter specimens; usually 4 lines of brown spots: at base, first fourth (interstriae 3, 7, 9), middle (interstriae 5, 7, 8, 9), and apex almost entirely. Other distinctive morphological traits: antenna strongly serrate and eccentric in male, shorter and less eccentric in female; mucro of posterior tibia strong and elongated; absence of particular arrangement of setae on first ventrite in male, in female last visible tergite without impression or foveae.

Genitalia (Figs. 20–21). Median lobe elongated, slender ( $w/l = 0.10\text{--}0.12$ ), basal lobe small and circular, ventral valve narrow, acutely triangular; internal sac with 3 series of sclerites: a large, elongated, roof-like, dented sclerite, with blunt apex, followed by four globular and dentate sclerites (anterior pair with 2 to 4 teeth, posterior pair usually with single tooth), then a group of 1 to 4 slender spines; tegminal strut with large carina, parameres narrow and elongated, cleft to about 84% their length. In female, vagina short, without dorsal sclerite, spermathecal body pear-shaped (Fig. 22).



**FIGURES 20–24.** *Bruchidius ishwaensis* (male): 20—median lobe (ventral view); 21—lateral lobes (ventral view); *Bruchidius ishwaensis* (female): 22—spermatheca (lateral view); *Bruchidius tanaensis* (male): 23—median lobe (ventral view); 24—lateral lobes (ventral view).

**Biology.** Examined material reared from seeds of *Vachellia etbaica*, *V. reficiens* (Wawra) Kyal. & Boatwr., *V. seyal* and *V. zanzibarica* (S. Moore) Kyal. & Boatwr. Also reared from seeds of *Vachellia drepanolobium* (Harms ex Y. Sjöstedt) P.J.H. Hurter (as *Acacia lathouwersi*) in the Democratic Republic of Congo by Decelle (1958), together with *B. basilewskyi*.

**Discussion.** Very closely related with *B. saudicus* Decelle from Saudi Arabia and Yemen (Anton 2010); the two species differ in the shape of the large sclerite of the median lobe, and in the number of smaller sclerites, but both characters are highly variable in *B. ishwaensis*; antennae are also shorter and stouter in *B. ishwaensis*. Differs from *B. aurivillii* in its longer and more serrate antenna.

**Distribution.** Democratic Republic of Congo, Kenya, and Somalia (Decelle 1979).

### ***Bruchidius meridionalis* Anton & Delobel, 2003**

*Bruchidius meridionalis* Anton & Delobel, 2003:174

**Material examined.** Kenya: 13 ♂, 18 ♀, Mogotio, 00°05'29''S 35°56'06''E, 1686m, 18.vi.2007, ex *Vachellia gerrardii* [1♂ 17397, specimen GK 112 used for DNA extraction] (B. Le Ru) [CBGP]; other material as listed in Anton & Delobel (2003), including specimens from Angola, Burundi, Central African Republic, Republic of South Africa, Rwanda and Zambia.

A small (1.8–2.7 mm), yellowish to reddish-brown species with darker and paler spots in elytral interstriae; elytra with double-toothed protuberance at base of interstriae 3–4; in male, a large pear-shaped area with short erect setae in basal angle of first ventrite; in female, last visible tergite with a pair of flat, unmarginated, micropunctate foveae.

Genitalia [see Figs. 19–23, p.176 in Anton & Delobel 2003]: Median lobe moderately elongated (maximum width excluding basal hood/ total length = 0.14), basal hood little widened; ventral valve large, subtriangular, with two lateral groups of 3–5 setae each; no hinge sclerite; internal sac densely lined with thin spines of various sizes; its median area with two rows of 10–17 denticles having point as long as base; gonopore wide, sclerotized; tegminal strut narrow, with obsolete keel; lateral lobes cleft to about 4/5 their length; apex not modified, bearing 8–11 setae; in female, vagina long and membranous, a dorsal ovoid dentate sclerite at entrance of bursa copulatrix.

**Biology.** Reared from seeds of *Vachellia gerrardii*, *V. sieberiana* and other unidentified *Vachellia* species.

**Discussion.** *Bruchidius meridionalis* can be distinguished from the morphologically closely related *B. centromaculatus* by having a wider eye separation, protuberances always present at base of elytra, smaller teeth at base of elytral striae 2–4, shorter median lobe, lower number of denticles in internal sac, basal denticles as large as remaining ones, and smaller ratio of base to point of denticles.

**Distribution.** Angola, Burundi, Central African Republic, Democratic Republic of Congo (Anton & Delobel 2003), Kenya, Republic of South Africa, Rwanda, and Zambia.

### ***Bruchidius raddiana* Anton & Delobel, 2003**

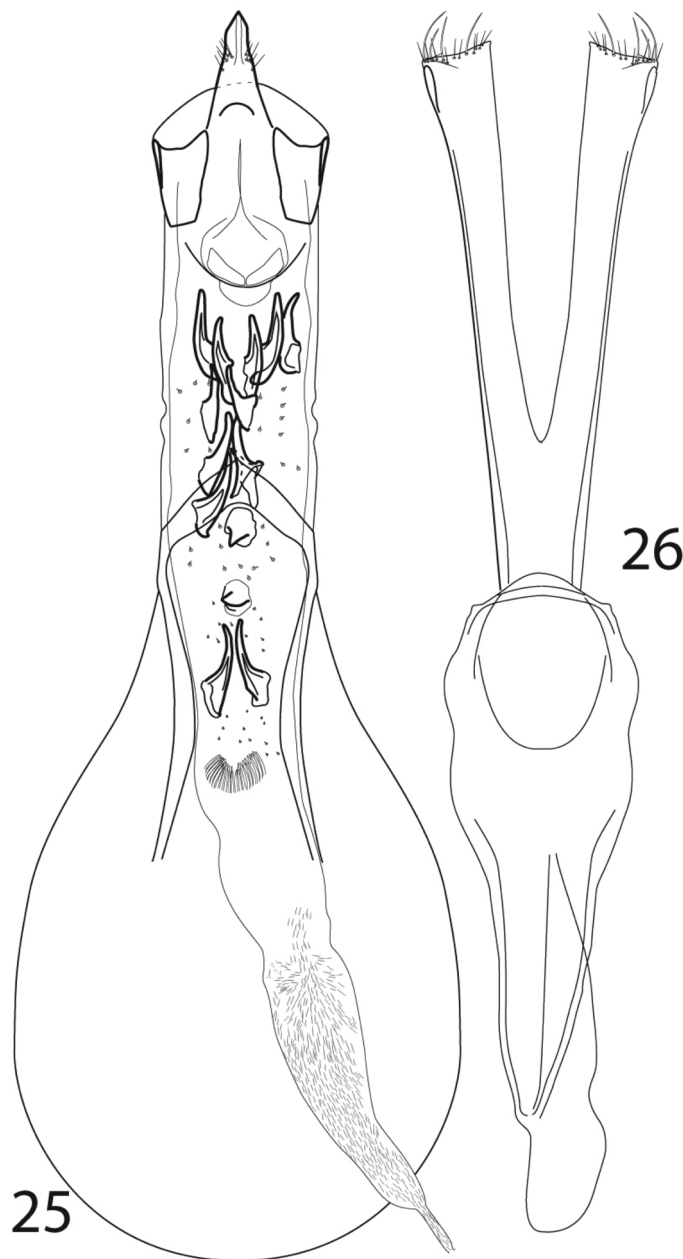
*Bruchidius sahelicus* Decelle, 1979 (nomen nudum)

*Bruchidius raddiana* Anton & Delobel, 2003:178

**Material examined.** Egypt: 1♂, 2♀, Ras Mohamed, 25.iv.2001, ex *Vachellia tortilis raddiana* [1♀ 02301] (G. Fédière) [CBAD, CBGP]; 2♂, Aïn Sukna, 15.vi.2001, ex *V. t. raddiana* [2♂ 03701, 00503] (G. Fédière) [CBAD]; 3♂, 3♀, Karhur Tall, 7.ii.2003, ex *V. ehrenbergiana* [1♀ 02203] (G. Fédière) [CBAD]; 1♂, 1♀, Assuan, 3.vii.2002, ex *V. tortilis* (G. Fédière) [CBAD]. Iran: 1♂, Bushehr, ex *V. farnesiana* [1♂ 00611, specimen GK335 used for DNA extraction] (L. Abbaszadeh) [CBGP]; 1♂, 1♀, Bushehr, 30.v.2012, ex *Hydnocarpus* sp. [1♂ 05713] (N. Farrar) [CBAD]. Israel: 1♂, Negev, vi.1996, ex *V. t. raddiana* [specimen Bd11 used for DNA extraction] (D. Ward) [CBGP]; 1♂, 1♀, Wadi Bitaron, vi.1998, ex *V. t. raddiana* (K. Or.) [CBAD]; 5♂, 5♀, Wadi Saif, vii.1998, ex *V. t. raddiana*, (K. Or.) [CBAD]. Morocco: 1♀, Vallée du Agdz, 24.v.2003 (A. Jaeger) [CBAD]. Senegal: 4♂, 2♀, Khatali, 29.iv.1995, ex *V. t. raddiana* [4♂ 11295, 12602, 12702, 12802, 2♀ 11695, 12695] (A. & H. Delobel) [CBAD]; Dahra, v.1998, ex *V. t. raddiana* [2♀ 02700, 02800] (A. & H. Delobel) [CBAD]; 1♂, 1♀, Boké Namadi,

30.i.1999, ex *V. t. raddiana* [specimen R11 used for DNA extraction] (M. Sembène) [CBGP]. United Arab Republic: 1♂, Wadi Safad, 31.i.–21.ii.2006, light trap [1♂ 05308] (A. Van Harten) [CBAD]; 1♂, 1♀, Wadi Madaq, 21.xii.2005–2.iii.2006, light trap (A. Van Harten) [CBAD]; 2♀, same data, 14–25.i.2006 (A. Van Harten) [CBAD]; 1♂, 2♀, Al-Ajban, 22.x.–9.xi.2005, Malaise trap (A. Van Harten) [CBAD]; 1♂, 1♀, 27.v.–26.vi.2006, light trap (A. Van Harten) [CBAD]; 1♂, 1♀, Khor-Al-Kwair, 24.iv.–2.v.2007, light trap (A. Van Harten) [CBAD]; 1♂, Hatta, 4.–11.iv.2006, light trap (A. Van Harten) [CBAD]; 1♂, Mahafiz, 19–26.iv.2006, water trap (A. Van Harten) [CBAD]. Other material as listed in Anton & Delobel (2003), including specimens from Algeria, Burkina-Faso, India, Jordan, Lybia, Mali, Niger, Oman, Sri Lanka, Sudan and Tunisia.

A small to medium-sized (1.4–2.7 mm) species, from light yellowish to checkered with blackish and whitish spots, elytra with double-toothed protuberance at base of striae 3–4, and a sharp isolated tooth at stria 2. Other distinctive morphological traits: in male, a large circular spot of short erect setae in basal angle of first ventrite; last visible tergite of female with pair of small foveae with shiny margin.



**FIGURES 25–26.** *Bruchidius uberatus* (male): 25—median lobe (ventral view); 26—lateral lobes (ventral view).

Genitalia [see Figs. 25–28, p.189 in Anton & Delobel 2003]: Internal sac entirely lined with small broad or slim based spines, and 3–6 large denticles with base as long as point; lateral lobes separated to about 80% their length; tegminal strut with very small carina. In female, vagina long, no dorsal sclerite at entrance of bursa copulatrix.

**Biology.** Reared from seeds of *Vachellia farnesiana*, *V. flava*, *V. gerrardii negevensis* (Zohary) Ragup. et al., *V. hockii*, *V. nilotica tomentosa*, *V. seyal*, *V. tortilis*, *V. tortilis raddiana*, and an unidentified species of *Hydnocarpus* (Achariaceae). *Dichrostachys cinerea*, *Senegalia senegal* and *V. sieberiana* are other possible hosts.

**Distribution.** Algeria, Burkina Faso, Egypt, India, Iran, Israel, Jordan, Libya, Mali, Mauritania, Morocco, Niger, Oman, Saudi Arabia, Senegal, Sri Lanka, Sudan, Tunisia, United Arab Emirates, and Yemen (Anton & Delobel 2003).

### ***Bruchidius tanaensis* (Pic) comb. nov.**

*Bruchus tanaensis* Pic, 1921

**Material examined.** Holotype (male) of *Bruchus tanaensis*: Kenya: "TYPE" [red], "type" [Pic's handwriting], "Tana River / B.E.A.", "G. Babault / juin 1915" "Genit. ♂ / Br. Pic.55 (not recovered)" "Bruchus tanaensis Pic" [unidentified handwriting], "Muséum Paris / Coll. M. Pic", "Bruchus / tanaensis Pic" [Decelle's handwriting]; this specimen lacks right elytron and hind femur [MNHN]. Allotype (female): Kenya: "Tana River / B.E.A.", "G. Babault / mai 1915", "Muséum Paris / 1930 / Coll. G. Babault", "TYPE" [red], *Bruchus / tanaensis / n. sp.* [Pic's handwriting], "Muséum Paris / Coll. M. Pic", "Bruchus / tanaensis Pic" [Decelle's handwriting] [MNHN].

**Other material:** Kenya: 4♂ 12♀, Kabarak, 00°10'26"S 35°58'21"E, 1910m, 18.vi.juin 2007, ex *Vachellia seyal* [1♂ 17207, specimen GK104 used for DNA extraction] (B. Le Ru) [CBAD, CBGP]; 1♂ 5♀, Kapenguria, 01°18'44"S 35°13'07"E, 1894m, vii.2002, ex *V. hockii* [♂ 04203, ♀ 02514, specimen GK357 used for DNA extraction] (B. Le Ru) [CBAD, CBGP]; 2♂ 4♀, Machakos, 01°13'13"S 37°26'24"E, 1665m, 23.i.2008, ex *V. seyal* [2♂ 08308, 02211, specimen GK385 used for DNA extraction] (B. Le Ru) [CBAD, CBGP]; 4♂ 5♀, Masii, 01°24'27"S 37°29'53"E, 1319m, vi.2002, ex *V. hockii* [1♂ 05503, specimen K213 used for DNA extraction] (B. Le Ru) [CBAD, CBGP]; Oltepesi, 01°32'30"S 36°33'07"E, 1665m, v.2002, ex *V. nubica* [specimen K313 used for DNA extraction] (B. Le Ru) [CBGP]; Rongai, 00°11'56"S 35°50'06"E, 2104m, ix.2002, ex *Senegalia mellifera mellifera* [1♂ 14902] (B. Le Ru) [CBAD]. Republic of South Africa: 1♂, Natal, Weenen (2840 ft), viii–ix.1823 [1♂ 06209] (H.P. Thomasset) [MNHN], 1♀, same data but i–ii.1826, with label "*Bruchus spadiceus* / J. Decelle det. 1965" (H.P. Thomasset) [MNHN].

A medium-sized (2.7–2.8 mm) species with body short and ovate, integument reddish-brown, antennae (except central segments), fore and middle legs yellowish red. A black spot on frons, antennal segments 7–10 brownish-black, apical segment usually markedly lighter than preceding ones, thoracic sternites partly black. On elytra, posterior 2/3 of 1<sup>st</sup> and 2<sup>nd</sup> interstriae darkened (sometimes dark area extended into an oval spot), humeral callus black. Last visible tergite reddish-brown with disc more or less blackened in females. Vestiture mainly white and yellowish, not completely covering integument, recumbent; on pronotum, a longitudinal strip opposite scutellum, reaching to 1<sup>st</sup> third of pronotum length, two very small spots about middle of disc, and sides, white; scutellum white; on elytra, white linear spots on interstriae 3, 5, 7, 9, separated by strips of blackish setae. On remaining interstriae, vestiture mainly yellowish. A black spot on suture between basal third and apical fourth. Upper parts of thoracic sternites with dense white setation. Elytra with shallow protuberance bearing two small teeth at base of striae 3 and 4. Ventrite 1 with large basal circular area of thin, semi-erect setae. Female last visible tergite with disc black, slightly heart-shaped, about as long as wide, strongly convex medially in apical 2/3.

Genitalia (Figs. 23–24). Median lobe moderately stout ( $w/l = 0.17$ ); ventral valve subtriangular, moderately sclerotized, with acute tip, bearing numerous sensilla and on each side a row of 3 to 4 setae; hinge sclerites large, subrectangular to subtriangular, strongly sclerotized; internal sac proximally with a few sensilla, saccus densely lined with setae and spicules and a group of small translucent spines. Basal strut without keel. Lateral lobes cleft to about two thirds of their length; apex of parameres with numerous long setae. In female, vagina long and membranous, no sclerite at entrance of bursa copulatrix.

**Biology.** Material from Kenya was reared from seeds of several species of Mimosoideae: *Senegalia mellifera mellifera* (Vahl) Seigler & Ebinger, *V. hockii*, *V. nubica* (Benth.) Kyal. & Boatwr. and *V. seyal*.

**Discussion.** The genitalia of the male holotype are presumed lost. The identity of types is assumed mainly on the basis of antennal color, with segments 7–10 markedly blackened as in specimens listed here, strongly sclerotized hinge sclerites, and saccus with moderately strong spines.

**Distribution.** Democratic Republic of Congo (Decelle 1951, 1958), Kenya, and Republic of South Africa.

### ***Bruchidius uberatus* (Fåhraeus, 1839)**

*Bruchus uberatus* Fåhraeus, 1839:40

*Bruchus baudoni* Caillol, 1908:8 (synonymy in Decelle, 1966:111)

*Bruchidius baudoni* (Caillol): Pic, 1913:17

*Bruchidius uberatus* (Fåhraeus): Decelle, 1966:110

**Material examined.** Egypt: 1♂ Philae, 8.v.2002, ex *Vachellia nilotica* (G. Fédère) [CBAD, CBGP]; 3♂, 1♀, Bahareya, 21.xii.2000, ex *V. n. tomentosa* [1♂ 00201, 1♀ 02614] (G. Fédère) [CBAD]; 1♂, Bahareya, 19.ii.2003, ex *V. nilotica* [1♂ 06303] (G. Fédère) [CBAD, CBGP]; 1♂, Maadi, 22.xii.2000, ex *V. n. tomentosa* [1♂ 01301] (G. Fédère) [CBAD]. Senegal: 1♀, Dakar-Hann, 16.xii.1994, ex *Senegalia senegal*, (M. Tran) [CBAD]; Richard-Toll, 21.iii.1999, ex *V. n. adansonii* [specimen U41 used for DNA extraction] (M.T. Gueye) [CBGP]; Popenguine, 31.xi.1994, ex *V. nilotica* (H. & A. Delobel) [CBAD]; 3♂, 2♀, M'Bour, 21.xii.1994, ex *V. nilotica* (H. & A. Delobel) [CBAD]; M'Bour, 18.i.1995, ex *V. n. adansonii* (H. & A. Delobel) [CBAD]; Bandia, 18.i.1995, ex *V. n.* (H. & A. Delobel) [CBAD]; Ross-Bethiot, 20.v.1995, ex *V. n. tomentosa* (H. & A. Delobel) [CBAD]. United Arab Emirates: 1♂, Hatta, 4-11.iv.2006, light trap [1♂ 03810] (A. van Harten) [CBGP].

A medium to large-sized (2.6–4.7 mm) species, body light to dark brown, antennae and four anterior legs testaceous, often darkened, posterior legs reddish brown; pronotum with dense white setae on basal lobes and two lateral dots; elytra with white elongated spots separated by brown to black intervals in odd interstriae, even interstriae yellowish to largely dark brown; last visible tergite entirely white or with a median line of white setae, dark spots at base and middle, apex largely dark; female usually darker than male. Other distinctive morphological traits are as follows: antenna short, strongly serrate from segment 4 in male; base of interstria 4 bulging, with two wide teeth; first ventrite with small basal patch of erect setae; last visible tergite strongly turned under apically in male; in female antenna shorter, serrate from segment 5, last visible tergite regularly convex except faint bulge beyond middle, often almost bare, shining, without foveae.

Genitalia (Figs. 25–26): Median lobe elongated, almost cylindrical (maximum width excluding basal hood/total length = 0.14), basal hood moderately widened; ventral valve large, subtriangular, with two lateral groups of 6 setae; no hinge sclerite; basal half of internal sac with 12–16 large thorn-like sclerites with broad base and blunt tip, followed by two median, hooked circular sclerites, then a pair of large thorn-like sclerites; posterior part of internal sac with a cluster of stout spicules; apical third with dense setation, ending in a setose tube; gonopore not sclerotized; basal strut narrow, with large keel; lateral lobes cleft to about 3/4 their length; apex straight, bearing about 18 short and long setae. In female, vagina long, entrance of bursa copulatrix with dorsal ovoid sclerite bearing a strong thorn-like spine oriented posteriorly, its surface lined with minute teeth.

**Biology.** Examined material was reared from the seeds of *Vachellia nilotica* (including *V. n. tomentosa* and *V. n. adansonii*) and *Senegalia senegal*. Also occasionally obtained from seeds of *Vachellia flava*, *V. tortilis*, and *V. sieberiana* in Mali and Senegal (Nongonierma 1978).

**Discussion.** As underlined beforehand *B. uberatus* is morphologically closely related to *B. haladai*.

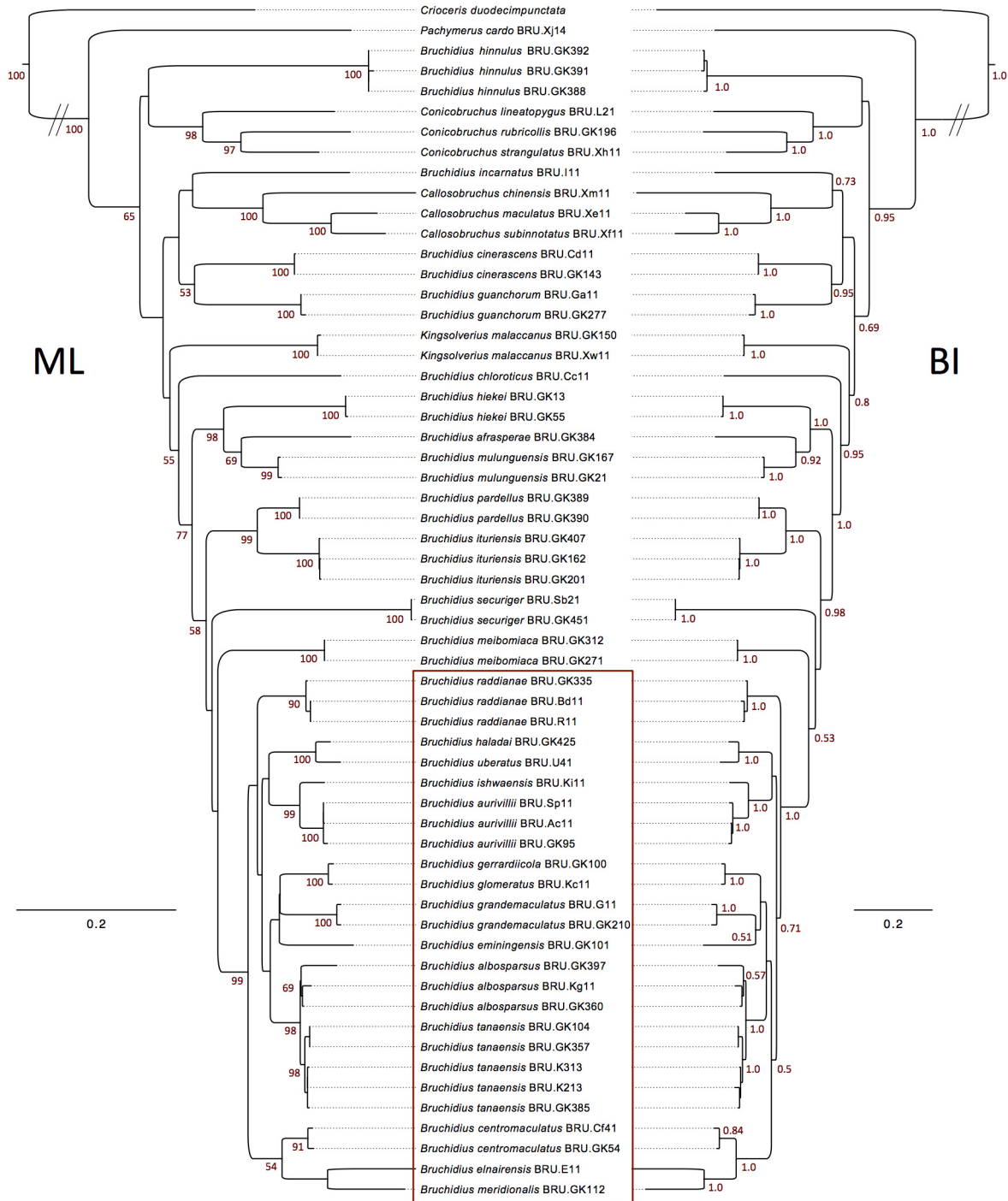
**Distribution.** Angola (Decelle 1975), Burkina Faso (Nongonierma 1978), Egypt, Guinea (Zacher 1936), India (Allard 1895), Ivory Coast (Gillon *et al.* 1992), Mali, Mauritania (Nongonierma 1978), Namibia (Zacher 1936), Republic of South Africa (Van Tonder 1985), Senegal, Sudan (Fåhraeus 1839), and United Arab Emirates.

### **Phylogenetic analyses**

Both ML and BI partitioned analyses generated topologies that are quite similar (see Fig. 27). Clade support is moderate to high on average, with most nodes leading to species supported by high bootstrap or posterior probabilities values. A high support (BV of 99% and PP of 1.0) is recovered for the node leading to the representatives of the *B. albosparsus* group.



Within the *B. albosparsus* species group, ML and BI trees exhibit some distinctive discrepancies such as the position of *B. raddianae* (more basal under BI) or the placement of the clade encompassing *B. centromaculatus*, *B. elnairensis* and *B. meridionalis* (more basal under ML). At least five major lineages are nonetheless consistently recovered: (i) *B. albosparsus* and *B. tanaensis*; (ii) *B. aurivillii*, *B. haladai*, *B. ishwaensis* and *B. uberatus*; (iii) *B. centromaculatus*, *B. elnairensis* and *B. meridionalis*; (iv) *B. eminingensis*, *B. gerrardiicola*, *B. glomeratus* and *B. grandemaculatus*; (v) *B. raddianae*.



**FIGURE 27.** Results of molecular phylogenetic analyses. On the left side the best-fit maximum likelihood (ML) tree is figured. Support values are only provided for nodes leading to species (BV < 50% are not figured). On the right side the majority-rule consensus topology from Bayesian inference (BI) analyses is figured. Support values are only provided for nodes leading to species (PP < 50% are not figured). Representatives of the *Bruchidius albosparsus* species group are highlighted using a red frame.

## Discussion

**Systematics and morphology.** Based on the results of morphological and molecular studies we can assess with more confidence the boundaries of the *Bruchidius albosparsus* species group. The newly defined species group encompasses the 14 species studied here: *Bruchidius albosparsus*, *B. aurivillii*, *B. centromaculatus*, *B. elnairensis*, *B. eminingensis*, *B. gerrardiicola*, *B. glomeratus*, *B. grandemaculatus*, *B. haladai*, *B. ishwaensis*, *B. meridionalis*, *B. raddianae*, *B. tanaensis* and *B. uberatus*. In addition we also include 13 species that exhibit marked genital and external similarities (corresponding to the combination of character states provided in the introduction). Four of these species were previously included in the *Bruchidius centromaculatus* species group (Anton & Delobel, 2003): *B. andrewesi* (Pic), obtained from pods of *Acacia auriculiformis* A. Cunn. ex Benth., *Prosopis africana* (Guill. & Perr.) Taub., *Prosopis cineraria* (L.) Druce, *V. leucophloea* (Roxb.) Maslin et al. and *Vachellia tortilis* in India; *B. arabicus* Decelle, obtained from *Vachellia gerrardii* pods in Djibouti, Israel, Jordan, Kenya, Oman, Qatar, Saudi Arabia, Somalia, United Arab Emirate and Yemen; *B. cretaceus* (Pic), reared from *Vachellia erioloba* (E. Mey.) P.J.H. Hurter, *V. haematoxylon* (Willd.) Seigler & Ebinger, *V. hebeclada* (DC.) Kyal. & Boatwr. and *V. stuhlmannii* (Taub.) Kyal. & Boatwr. in Angola, Botswana, Namibia and Republic of South Africa; and *B. simulans* (Anton & Delobel), strictly associated with *Vachellia tortilis* (*V. t. raddiana* and *V. t. spirocarpa*) in Botswana, Ethiopia, Kenya, Namibia, Republic of South Africa, Tanzania and Zimbabwe. The following six species also belong to the group: *B. asiricus* Decelle from Ethiopia, Saudi Arabia and Yemen and *B. baharicus* Decelle from Saudi Arabia, both with unknown biology; *B. basilewskyi* (Decelle), reared from pods of *Vachellia drepanolobium* in the Democratic Republic of Congo; *B. buettikeri* Decelle from *Vachellia gerrardii* and *V. tortilis raddiana* in Djibouti, Israel, Jordan, Kenya, Saudi Arabia, Somalia, Oman, Qatar, United Arab Emirates and Yemen; *B. nongoniermai*, reared from pods of *Vachellia kirkii* in Chad, Mali and Sudan; and *B. saudicus* Decelle reared from pods of *Vachellia etbaica* and *V. flava* (Forssk.) Kyal. & Boatwr. in Ethiopia, Saudi Arabia and Yemen. Finally, three recently described East African species (Delobel & Le Ru in press) can be added to the list: *B. horridus* (Delobel & Le Ru) reared from *Vachellia horrida* (L.) Kyal. & Boatwr. in Kenya; *B. quadrispinosus* (Delobel & Le Ru) reared from *Vachellia xanthophloea* (Benth.) P.J.H. Hurter in Kenya; and *B. tumidulus* (Delobel & Le Ru) reared from *Vachellia lahai* (Steud. & Hochst. ex Benth.) Kyal. & Boatwr., *V. nilotica*, *V. nilotica subalata* (Vatke) Kyal. & Boatwr. and *V. seyal* in Kenya. Based on these accounts, the *Bruchidius albosparsus* group now comprises 27 species, which are mostly distributed all over Africa (the range of the group also encompasses the western part of the Asian continent, including India).

Molecular phylogenetic analyses strongly support the monophyly of this group (BV of 99% and PP of 1.0), and corroborate most studies that have included members of the group (Kergoat *et al.* 2005a, 2005b, 2007; Delobel *et al.* 2013). The only exception is the study of Kergoat *et al.* (2008), in which *B. grandemaculatus* is not grouped with other members of the group. As already highlighted in Kergoat *et al.* (2008), the questionable placement of *B. grandemaculatus* likely corresponds to an artefact that can be accounted for the use of supertrees, which are highly sensitive to sampling biases. As underlined in Delobel *et al.* (2013) a close phylogenetic relationship is suggested between the *Bruchidius albosparsus* species group and *Bruchidius meibomiaca*. Though they share some morphological similarities (especially the shape of the ventral valve or the absence of hinge sclerites), *Bruchidius meibomiaca* differs significantly by several characters such as the shape of antennae (long and sexually dimorphic in *B. meibomiaca*) or the shape of the parameres (fused at to base to 2/3 of their total length in *B. meibomiaca*). This species is also associated with a completely distinct group of legume plants, from tribe Desmodieae (genus *Dendrolobium*) (Arora 1980). Within the group *albosparsus*, the inferred phylogenetic relationships generally echo the groupings that are suggested by the morphological studies. It is especially the case for the following relationships: (i) between *B. gerrardiicola*, *B. glomeratus* and *B. grandemaculatus*; (ii) between *B. haladai* and *B. uberatus*; (iii) between *B. aurivillii* and *B. ishwaensis*; (iv) between *B. centromaculatus* and *B. meridionalis*. The only marked exception is the absence of a close phylogenetic relationships between *B. aurivillii* and *B. elnairensis*, despite that they share lots of morphological similarities.

Members of the *Bruchidius albosparsus* group have a very homogeneous external morphology. Because of their rather small size and short and thick body they can be easily distinguished from representatives of the *Bruchidius submaculatus* (Fåhræus) species group (Delobel 2007), which are associated with the same host plants in Africa and Asia, but have an elongated and depressed body. This morphological homogeneity also implies that most external characters are of little use to precisely identify members of the group. For instance, the coloration of

adults is usually too variable to serve as a reliable diagnostic character; a good illustration of this can be provided by the wide range of color variation in *B. grandemaculatus* (Fig. 28). Size of specimens is also extremely variable and does not constitute a reliable diagnostic character. This variability is usually correlated with environmental factors: unusually small specimens (less than 1.5 mm in length) may emerge from small seeds or from seeds hosting several larvae; that said really large specimens (more than 4 mm in length) should always correspond either to *B. grandemaculatus* or *B. uberatus*. By contrast with other bruchine groups, characters such as the shape of posterior femora or the apical ornamentation of posterior tibiae also do not allow to distinguish among related species from the group. Only three external characters are somewhat useful to discriminate species belonging to the group: (i) the size and shape of basal elytral protuberances; (ii) in male, the size and shape of a basocentral area of thin erect setae localized on the first ventrite; (iii) in female, the presence of a pair of lateral eye-like fovea near the apex of the last visible tergite (for *B. centromaculatus*, *B. cretaceus*, *B. elnairensis*, *B. meridionalis*, *B. raddianae* and *B. simulans*). With reference to the latter it is worth underlining that our phylogenetic analyses suggest that this structure may have appeared twice (or may have secondarily disappeared in all other members of the group) during the course of the evolution of the *Bruchidius albosparsus* group.



**FIGURE 28.** Color variation in *Bruchidius grandemaculatus* adults (a, b—males; c, d—females).

In contrast with external characters, genitalia (essentially male genitalia) are extremely distinctive among members of the group. The general shape of the median lobe is characteristic: in some species the median lobe is elongated and slender (e.g. *B. albosparsus*, *B. ishwaensis*) while it can be of moderate length (e.g. *B. elnairensis*, *B. horridus*, *B. nongoniermai*) or short and enlarged in others (e.g. *B. aurivillii*, *B. haladai*). The shape of the ventral valve is also of particular interest: it can range from extremely acute (e.g. *B. ishwaensis*) to large and ogival in some species (e.g. *B. gerrardiicola*, *B. glomeratus*). Hinge sclerites are only present in three species: *B. albosparsus*, *B. horridus* and *B. tanaensis*, which contrasts with some *Bruchidius* lineages in which hinge sclerites are frequently present (e.g. in the *Bruchidius submaculatus* group). In the internal sac the lack of distinctive spines or sclerites is also characteristic of six species (*B. albosparsus*, *B. eminingensis*, *B. horridus*, *B. grandemaculatus*, *B. nongoniermai*, *B. tanaensis*). In other species distinctive spines are more or less numerous but they are never fused into large dented sclerites; it is the case of the six species with a pair of lateral eye-like foveae near the apex of the last visible tergite of female plus *B. gerrardiicola*, *B. glomeratus*, *B. haladai* and *B. uberatus*. Sclerites may be more or less developed in other species, and of different types, as in the case of *B. ishwaensis* which possesses three distinct types of sclerites (a large roof-like dented sclerite, four globular and dentate sclerites and a group of one to four slender spines). A basal strut with a well-developed keel is also informative as it is only found in six species: large keel in *B. haladai*, *B. tumidulus* and *B. uberatus* and small keel in *B. cretaceus*, *B. grandemaculatus* and *B. ishwaensis*. The shape of the parameres is also potentially informative, varying between short and large in some species (e.g. *B. eminingensis*) to slender and elongated in others (e.g. *B. ishwaensis*). The stability of fine structures lining the internal sac wall (hyaline tubercles, fine needles, small spines, ctenoid scales...) throughout

the species range of the *Bruchidius albosparsus* group is noteworthy; it seems to oppose the somewhat high variability observed in other bruchine groups such as the *Bruchidius ituriensis* species group (Delobel *et al.* 2013), the *Conicobruchus strangulatus* species group (Le Ru *et al.* 2014) or the genus *Caryedon* (Johnson *et al.* 2004). Actually the stability of fine structures in bruchines is only apparent, as both fine and large structures in the internal sac wall do exhibit individual variations; in this particular group of species however, the localization and extension of sections of the internal sac with a precise type of ornamentation, their succession from ventral valve to gonopore, or the complete absence of them in other sections of the internal sac, prove to be quite stable among members of the same species. We therefore consider these to be of a high taxonomic value. In females, the vagina is usually long and slender (but much shorter in *B. ishwaensis*), dorsal dented sclerites at entrance of bursa copulatrix are present in a few species; spermatheca is usually comma-shaped, with a long diverticulum, but the latter is very short in *B. ishwaensis*.

**TABLE 3.** Host plant preferences

species	host-plants
<i>albosparsus</i>	<i>Vachellia davyi</i> , <i>V. gerrardii</i> , <i>V. karroo</i> , <i>V. luederitzii</i> , <i>V. nilotica</i> , <i>V. seyal</i> , <i>V. tortilis raddiana</i> , <i>V. t. spirocarpa</i> , <i>V. t. tortilis</i> , <i>V. xanthophloea</i> , <i>Senegalia cinerea</i> , <i>S. senegal</i>
<i>andrewesi</i>	<i>Acacia auriculiformis</i> , <i>Prosopis africana</i> , <i>P. cineraria</i> , <i>V. leucophloea</i> , <i>V. tortilis</i>
<i>arabicus</i>	<i>Vachellia gerrardii</i>
<i>asiricus</i>	unknown
<i>aurivillii</i>	<i>Vachellia tortilis raddiana</i> , <i>V. t. spirocarpa</i>
<i>baharicus</i>	unknown
<i>basilewskyi</i>	<i>Vachellia drepanolobium</i>
<i>buettikeri</i>	<i>Vachellia gerrardii</i> , <i>V. tortilis raddiana</i>
<i>centromaculatus</i>	<i>Dichrostachys cinerea</i> , <i>S. dudgeoni</i> , <i>S. polyacantha campylacantha</i> , <i>S. macrostachya</i> , <i>V. farnesiana</i> , <i>V. gerrardii</i> , <i>V. nilotica adstringens</i> , <i>V. n. nilotica</i> , <i>V. n. tomentosa</i> , <i>V. sieberiana</i> , <i>V. tortilis</i> , <i>V. t. raddiana</i>
<i>cretaceus</i>	<i>Vachellia erioloba</i> , <i>V. haematoxylon</i> , <i>V. hebeclada</i> , <i>V. stuhlmannii</i>
<i>elnaiensis</i>	<i>Vachellia amythetophylla</i> , <i>V. dolichocephala</i> , <i>V. hockkii</i> , <i>V. flava</i> , <i>V. gerrardii</i> , <i>V. seyal</i> , <i>V. seyal</i> var. <i>fistula</i>
<i>eminingensis</i>	<i>Vachellia seyal</i>
<i>gerrardiicola</i>	<i>Vachellia gerrardii</i> , <i>V. seyal</i>
<i>glomeratus</i>	<i>Vachellia etbaica</i>
<i>grandemaculatus</i>	<i>Senegalia senegal</i> , <i>Vachellia nilotica</i> , <i>V. tortilis spirocarpa</i>
<i>haladai</i>	<i>Vachellia nilotica</i>
<i>horridus</i>	<i>Vachellia horrida</i>
<i>ishwaensis</i>	<i>Vachellia drepanolobium</i> , <i>V. etbaica</i> , <i>V. reficiens</i> , <i>V. seyal</i> , <i>V. zanzibarica</i>
<i>meridionalis</i>	<i>Vachellia gerrardii</i> , <i>V. sieberiana</i>
<i>nongoniermai</i>	<i>Vachellia kirkii</i>
<i>quadriscopinosus</i>	<i>Vachellia xanthophloea</i>
<i>raddiana</i>	<i>Dichrostachys cinerea</i> *, <i>Senegalia senegal</i> *, <i>Vachellia farnesiana</i> , <i>V. flava</i> , <i>V. gerrardii negevensis</i> , <i>V. hockkii</i> , <i>V. nilotica tomentosa</i> , <i>V. seyal</i> , <i>V. sieberiana</i> *, <i>V. tortilis</i> , <i>V. t. raddiana</i>
<i>saudicus</i>	<i>Vachellia etbaica</i> , <i>V. flava</i>
<i>simulans</i>	<i>Vachellia tortilis raddiana</i> , <i>V. t. spirocarpa</i>
<i>tanaensis</i>	<i>Senegalia mellifera mellifera</i> , <i>V. nubica</i> , <i>V. oerfota</i> , <i>V. seyal</i>
<i>tumidulus</i>	<i>Vachellia lahai</i> , <i>V. nilotica</i> , <i>V. n. subulata</i> , <i>V. seyal</i>
<i>uberatus</i>	<i>Senegalia senegal</i> , <i>Vachellia flava</i> , <i>V. nilotica adansonii</i> , <i>V. n. tomentosa</i> , <i>V. tortilis</i> , <i>V. sieberiana</i>

\* unconfirmed possible hosts

**Host plant preferences.** Collectively species in the *B. albosparsus* group are known to develop on 38 mimosoid species (Table 3): 28 *Vachellia* spp., six *Senegalia* spp., two *Prosopis* spp., one *Acacia* and one *Dichrostachys*. The host record of *B. raddiana*e on *Hydnocarpus* in Iran is somewhat questionable because Achariaceae have never been recorded as valid hosts for seed beetles. In addition, because members of *B. albosparsus* group are only known to feed on mimosoids, a shift toward a plant from a distinct family seems quite unlikely. Nonetheless this case is worth investigating because shifts toward unrelated plants have been documented in seed beetles, as in the case of a unique specimen of *B. emarginatus* Allard that has been reared from *Tribulus terrestris* Linnaeus (Zygophyllaceae) instead of a regular legume host (Delobel & Delobel 2005). Regarding the level of specialization of species from the group, nine species appear strictly monophagous (Table 3). Because most of them are not commonly sampled (e.g. *B. arabicus*, *B. basilewskyi*) we cannot exclude the possibility that additional hosts may be discovered in the future; however in the case of the abundant *B. aurivillii* the strict association with *Vachellia tortilis* seems real. Other species in the group have between two and 10 distinct host plant species (10 for *B. albosparsus*). All species but six are exclusively associated with *Vachellia* species, which are well characterized by the sequestration in their seeds of the nonprotein amino acid N-acetyldjenkolic acid (Seigler 2003; Or & Ward 2004). Only a few species are able to develop on *Vachellia* and on plants with distinct toxic secondary compounds, such as *Senegalia* spp. which rely on the nonprotein amino acid albizziine as their main toxic compounds (Evans *et al.* 1977, 1979; Bisby *et al.* 1994; Seigler 2003) or *Dichrostachys* spp. which rely on dichrostachinic acid (Bisby *et al.* 1994). This high level of specialization can be likely explained by the fact that multiple detoxification abilities (e.g. Bleiler & Rosenthal 1988; Rosenthal 1990; Zhu-Salzman *et al.* 2003; Moon *et al.* 2004) are required for species that are more generalist. The latter likely involves major evolutionary trade-offs (*sensu* Cornell and Hawkins 2003) that constrain most seed-beetle species to feed on restricted set of plants that share similar toxic metabolites (Kergoat *et al.* 2005a, 2007b, 2008).

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