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A new species of *Mermiglossa* from Kenya, with comments on the arrangement of Old World Panurginae (Hymenoptera: Andrenidae)

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Abstract. A new species of the panurgine bee genus *Mermiglossa* Friese (Panurginae) is described and figured from females captured near Voi in the southern part of the former Coast Province, Kenya, a historical type locality for several bee species. *Mermiglossa voicola* Ascher & Engel, new species, is distinguished from the only other species of the genus, *M. rufa* Friese from central Namibia. The new species is readily identified due to its black rather than red metasoma and compound eyes slightly convergent above rather than parallel-sided. The new species raises the total number of described bee species for Kenya to 343, extends the known distribution of its genus and subtribe from the Namib Desert of southwestern Africa to the western edge of the Nviri Desert of East Africa, and provides further evidence of extensive biogeographic connections between these disjunct xeric areas. Recent changes in the family-group classification of Old World Panurginae are discussed in relation to recognition of *Mermiglossina* as a valid subtribe within an expanded tribe Panurgini also including the New World perditines.

INTRODUCTION

The Old World panurgine genera *Mermiglossa* Friese from Namibia and *Plesio-panurgus* Cameron from xeric regions of the Palearctic in Morocco and from eastern Turkey to western Pakistan, share several strong apomorphies including absence of facial foveae in females (Ruz, 1986; Patiny, 1999; Michener, 2007), and have been considered to be rare and enigmatic bees. The first to be discovered was *Plesio-panurgus cinerarius* Cameron in the deserts around Quetta, Balochistan in eastern Pakistan (Cameron, 1907). Its describer misinterpreted some of its remarkable apomorphies as

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plesiomorphic resulting in an inapt name. Soon after, Friese (1912) described *Mermiglossa* and its type species, *Mermiglossa rufa* Friese, from central Namibia. *Mermiglossa* remained obscure until it was redescribed by Eardley (1991), with photographs and illustrations of the male and female, in a review of the southern African Panurginae that also treated *Melitturga* Latreille and *Meliturgula* Friese.

Among African Panurginae, *Mermiglossa* can be recognized by the strong medial concavity of the clypeus in which the medial length of the clypeus is shorter than that of the medial length of the labrum, the absence of yellow maculations, the presence of only two submarginal cells in the forewing (as opposed to three in sympatric *Melitturga* and *Meliturgula*), and the structure of the first metasomal tergum and tergal graduli. The genus is closely related to *Plesiopanurgus*, the latter comprising four species with modified male antennae distributed in northern Africa from Morocco east to Pakistan (Baker, 1972, 1997). Keys to the genera of southern Africa Panurginae by Eardley (1991) and keys to tribe Melitturgini by Michener (2007) will readily permit recognition of the genus. Unfortunately, little is known of the biology of *Mermiglossa* other than a published association with *Merremia* Dennst. ex Endl. (Convolvulaceae) (Eardley, 1991). Nest and immature stages remain unknown for *Mermiglossa*, as well as the related *Plesiopanurgus*.

Herein we provide the description of the first *Mermiglossa* discovered in Kenya, thereby extending the range of the genus from central Namibia to central East Africa. By documenting this species we hope to encourage melittologists in the region to seek these bees on their potential host plants (in family Convolvulaceae), so as to discover the unknown males, locate nests, and otherwise obtain information on their life history. In addition, we provide systematic details for the subtribe Mermiglossina and its constituent genera, and discuss briefly the classification of Old World panurgines.

MATERIAL AND METHODS

Morphological terminology follows that of Engel (2001) and Michener (2007). Measurements were made using an ocular micrometer on an Olympus SZX-12 stereomicroscope and are provided for the holotype, with those of the paratype in parentheses. Photomicrographs were taken using a Canon 7D digital camera attached to an Infinity K-2 long-distance microscope lens. Material is deposited in the Department of Entomology, California Academy of Sciences, San Francisco, California (Wojciech Pulawski, curator), and the Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas (M.S.E., curator).

SYSTEMATICS

Tribe Panurgini Leach

Subtribe Mermiglossina Patiny

Mermiglossini Patiny, 1999a: 270. Type genus: *Mermiglossa* Friese, 1912.

DIAGNOSIS: Yellow integumental markings absent. Labial palpomere III about twice as long as IV; mentum elongate, about one-third length of prementum; galeal comb absent. Facial fovea of female absent; clypeus short, strongly concave apically. Labrum of male flat, fully pilose, setae long; of female with basal area glabrous. Man-

dible of male strongly curved, apex attenuate, equipped with strong prebasal tooth on upper margin. Outer subantennal sulcus of male indistinct, represented by a shiny impunctate strip. Forewing with 1rs-m absent. Pretarsal claws of female simple. Metasoma of male wider than mesosoma; metasomal sternum VII with elongate setae arising from medial projection of apicolateral lobes; sternum VIII with broad proximal truncate or emarginate spiculum, widening distally towards lateral arms of sternum.

INCLUDED GENERA: The subtribe includes only *Mermiglossa* and *Plesiopanurgus*. Ruz (1986) redescribed and illustrated both genera and demonstrated many synapomorphies uniting them.

DISTRIBUTION: Six species occur in deserts in central Namibia, coastal Kenya, North Africa (Morocco), and the Middle and Near East.

LIFE HISTORY: Where known, host plants are all in the family Convolvulaceae.

Key to Genera of Mermiglossina

1. Pronotum without strong dorsolateral lamella or protuberance; antenna of male unmodified (male known only for type species) (Namibia, Kenya) *Mermiglossa* Friese
- Pronotum with strong dorsolateral lamella or protuberance; scape and flagellum of male thickened; last flagellomere tapered at apex (Palearctic including North Africa) *Plesiopanurgus* Cameron

Genus *Plesiopanurgus* Cameron

Plesiopanurgus Cameron, 1907: 130. Type species: *Plesiopanurgus cinerarius* Cameron, 1907, monobasic.

Neopanurgus Schwammberger, 1971: 2. Type species: *Neopanurgus richteri* Schwammberger, 1971, by original designation.

Plesiopanurgus (*Zizopanurgus*) Patiny & Rasmont, 1999: 78. Type species: *Panurgus* (*Plesiopanurgus*) *zizus* Warncke, 1985 [1987], by original designation.

DIAGNOSIS: Clypeus strongly protuberant; scape and flagellum of male thickened; distal flagellomere strongly tapered at apex. Pronotum with strong dorsolateral lamella or protuberance. Mesobasitarsus of male longer than metabasitarsus; mesobasitarsus with a patch of small, dense setae apically on inner surface. Pubescence of male elongate, profuse. Metasomal sternum IV of male with distal margin convex, pectinate medially; apical process of sternum VIII with elongate apicolateral projections, base of apical process laterally expanded; base of sternum VIII emarginate.

DISTRIBUTION: Four species are known from deserts of North Africa (Morocco) and the Near East (eastern Turkey, Iran, Balochistan in northwestern Pakistan). The more western species from Morocco [*P. zizus* (Warncke)] and Turkey (*P. ibex* Baker) were placed in *Zizopanurgus* by Patiny & Rasmont (1999).

LIFE HISTORY: Species of *Plesiopanurgus* are known or suspected to be oligoleges of *Convolvulus* L. (Convolvulaceae) and have been collected during April–June (Patiny, 1998a; *vide etiam* Warncke, 1985 [1987]; Baker, 1997; Patiny & Rasmont, 1999).

COMMENTS: Both Baker (1997: who apparently failed to consider Warncke, 1985 [1987]), Patiny (1998a), and Patiny & Rasmont (1999) disputed Warncke's (1983 [1985]) conclusion that *P. ibex* and *P. richteri* (Schwammberger) are subspecies of *P. cinerarius*. Patiny (1998c) recognized *P. hanno* Baker, from Morocco as a junior synonym of *P. zizus*.

Genus *Mermiglossa* Friese

Mermiglossa Friese, 1912: 188. Type species: *Mermiglossa rufa* Friese, 1912, monobasic.

DIAGNOSIS: Head conspicuously broader than mesosoma. Glossa extraordinarily elongate, approximately three times as long as prementum; maxillary palpus pentamerous. Metasomal tergum I with dorsal and anterior surfaces nearly right angulate, of male strongly concave anteriorly; terga II and III with gradulus conspicuous, strongly carinate laterally; sterna I–V of female with setae mostly appressed; sternum VII with basal apodemal arms broadly fused to quadrate central disc of sternum.

DISTRIBUTION: The single described species is endemic to central Namibia (Eardley, 1991), whereas the second species described here is from coastal Kenya.

Mermiglossa voicola Ascher & Engel, new species

ZooBank: urn:lsid:zoobank.org:act:FFA3BCA5-C503-444E-A91F-364C1961E15E

(Figs. 1–6)

DIAGNOSIS: The new species can be distinguished from its congener by the overall black to dark brown coloration of the metasoma (versus largely orange to reddish orange in *M. rufa*) and the compound eyes slightly convergent below (parallel-sided in *M. rufa*).

DESCRIPTION: ♀: Total body length 7.75 mm (7.58 mm); forewing length 5.08 mm (5.00 mm). Head wider than long, length 2.17 mm (2.04 mm), width 2.71 mm (2.71 mm), about as wide as, or slightly wider than, mesosoma; upper interorbital distance 1.83 mm (1.79 mm); lower interorbital distance 1.46 mm (1.42 mm). Clypeus strongly concave medioventrally; clypeal medial length 0.50 mm (0.50 mm); labral medial length 0.56 mm (0.52 mm). Mandible long, gently curved, without apical teeth, with small, obtuse, indistinct tooth near base of inner surface. Galea and glossa elongate, extending to metacoxae. Occipital carina present. Medial and parapsidal lines distinct, strongly impressed; intertegular distance 1.88 mm (1.88 mm). Forewing with marginal cell broadly truncate and appendiculate; with two submarginal cells of approximately equal lengths; nine distal hamuli on hind wing. Anterior-facing and dorsal surfaces of first metasomal tergum nearly orthogonal in profile; lateral portions of graduli particularly pronounced, particularly on second through fourth terga.

Clypeus with coarse, shallow punctures, punctures separated by less than a puncture width, although more widely spaced medioapically, integument between smooth; labrum largely impunctate, a few scattered setigerous punctures in lateral quarters, wrinkled basally, medially and apically smooth, medioapically with distinct, semi-circular carina, carina with lateral portions curving back onto labral surface but ending shortly thereafter. Face with contiguous punctures; medial line terminating in impunctate spot at about lower tangent of antennal toruli; vertex with punctures becoming more indistinct and irregular, blending to shallow, larger, faint indications of coarse punctures by occipital region and gena; postgena impunctate and imbricate. Mesoscutum and mesoscutellum with distinct punctures separated by less than a puncture width, integument between smooth; metanotum with coarse, irregular, contiguous punctures; pleura with large, coarse, irregular, contiguous punctures, giving integument a roughened appearance, except metepisternum imbricate with close smaller punctures; propodeum basally as on metanotum, lateral surface as on metepisternum, posterior surface as on lateral surface except medially around pit becoming



Figures 1–3. Female holotype of *Mermiglossa voicola*, new species. 1. Lateral habitus. 2. Dorsal habitus. 3. Facial aspect.

smooth. Metasoma imbricate; anterior-facing surface of first tergum impunctate, dorsal surface with punctures separated by a puncture width or less; punctures of remaining terga contiguous or nearly so; broad brown marginal zones impunctate.

Integument of head, mesosoma, and metasoma largely black to dark brown; antenna, mandible, and labiomaxillary complex dark brown; tegula and legs dark brown; wing venation brown except Sc+R and pterostigmal margins dark brown, membrane hyaline; metasomal terga with broad dark brown margins. Pygidial plate black, with acutely rounded apex.

Pubescence typical for genus; generally white to silvery except somewhat tawny on labral apex, apical half of ventral margin of mandible, margins of basitarsi, apices of tibiae and metafemur (overhanging base of basimetatibial plate); pygidial fimbria and apical fimbria of fifth tergum rufous and composed of dense, plumose setae.

♂: *Latet.*



Figures 4–6. Female holotype of *Mermiglossa voicola*, new species. 4. Dorsal view of vertex, mesoscutum, and mesoscutellum. 5. Dorsal view of metanotum and propodeum. 6. Dorsal view of metasoma.

HOLOTYPE: ♀, Kenya: [Taita-Taveta County], Coast Province [former], 2 km S. Voi, 3°24.7'S, 38°32.3'E, 16 December 2002, M. [Michael] A. Prentice; deposited in the Department of Entomology, California Academy of Sciences, San Francisco, California, USA (CAS).

PARATYPES: 1♀, same data as holotype; deposited in the Division of Entomology, University of Kansas Natural History Museum, Lawrence, Kansas, USA (SEMC).

ETYMOLOGY: The specific epithet pertains to Voi, the largest town in Taiti-Taveta County of the former Coast Province, located at the western edge of the Nviri (or Taru) Desert southwest of Tsavo East National Park in the rain shadow of Mount Kilimanjaro.

Key to Species of *Mermiglossa*

- 1. Metasomal terga largely orange to reddish orange; inner margins of compound eyes parallel (central Namibia) *M. rufa* Friese
- Metasoma terga entirely black to dark brown; inner margins of compound eyes slightly convergent ventrally (southern Kenya) *M. voicola*, n. sp.

DISCUSSION

The new *Mermiglossa* is one of several bee species described recently from Kenya that further document its richness in bees, delimit endemic areas for these, and establish biogeographic connections between East and southwestern Africa. The total of described bee species from Kenya now stands at 343 (Eardley & Urban, 2010; Ascher & Pickering, 2017), and almost identical to totals for Tanzania (354, including records from Zanzibar), but far higher than totals for the neighboring countries of Uganda (only 209 species reliably recorded; much higher reported totals are unreliable), Ethiopia (approximately 205 species; the precise total is uncertain as some historical records may pertain to modern Eritrea), Sudan (141 species, most that can be traced precisely are from North Sudan; two species are known from types collected at Gabal Elba in the Hala'ib Triangle, a disputed area controlled by Egypt), or Somalia (69 species). Totals for known endemic species likewise are highest for Kenya (73 species) and Tanzania (88 species, of which nine are known only from Zanzibar) and also relatively high for Ethiopia (59 species). Near endemic taxa are also represented, with six species shared between Kenya and Tanzania and two species shared between Kenya and Ethiopia. Endemic species from Sudan (26), Uganda (23), and Somalia (nine) are lower, reflecting in part more limited study of these faunas, especially in recent decades. Although totals of described and endemic bee species for Kenya (and Tanzania) are impressive as compared with those of other East and West African countries and those of the Sahel, they are far lower than the 1152 species (including 628 endemics) recorded from South Africa, an area of exceptional bee diversity and home to the region's leading taxonomic specialist.

The geographic area covered by these countries and the collecting effort expended within each are not equivalent, nor are the range of habitats uniform or proportionally represented among them, leading to differences in diversity across latitudes (*e.g.*, a vast area of uniform habitat may be less diverse than a smaller geographic region of more varied topography, vegetation, &c.). For example, South Africa covers approximately 1.2 million km² and is not directly comparable to a country like Somalia with an area of 637,657 km². Similarly, the range of vegetative habitats across Sudan is less than that of South Africa, despite more comparable areas (nearly 1.9 million km² for the former, versus the approximately 1.2 million km² of the latter). In the long term, it will be vital to ascertain the numbers of bee species by vegetative habitats and area, in order to gain a refined understanding of bee diversity, biogeography, and evolution throughout Africa.

The type locality of the new *Mermiglossa* is close to Voi, from which other interesting bee species have been described recently; *i.e.*, *Lipotriches (Armatriches) voiensis* Pauly, *Hylaeus (Deranchylaeus) venustus* Dathe, and *Cellariella inexpectata* Pesenko & Pauly (Pesenko & Pauly, 2005; Pauly, 2014; Dathe, 2014); and historically, *e.g.*, *Megachile (Pseudomegachile) voiensis* Cockerell (Cockerell, 1937). In all, at least six valid bee species (including the new species here described) and three additional names now in synonymy have been described from Voi or its immediate vicinity, and at least two additional valid and five invalid names were described from Taita-Taveta County [the type locality of *Coelioxys lepidospila* Cockerell, cited by its author as "Kenya Colony: Luni (sic) River, Taveta" (Cockerell, 1933), is from the Lumi River]. In all, the new *Mermiglossa* brings the total number of currently valid bee species described from Kenya to 109, and 63 additional names now in synonymy have also been described from the country, making it an important and ongoing center of species discovery. In addition

to the described fauna, many undescribed species have recently been discovered in Kenya (pers. obs.), some of which have been photographed in life (e.g., Martins, 2012), or are represented in the BOLD systems molecular diagnostic and image database (L. Packer, pers. comm.). Ongoing studies are also advancing knowledge of pollinator diversity, function, and conservation in Kenya and disseminating practical information to the public (Martins, 2014).

Mermiglossa, a genus previously thought strictly endemic to the Namib desert, is now known to extend to East Africa. Other recently described bees have strengthened this biogeographic connection, such as *Samba* (*Samba*) *ascheri* Michez & Patiny and *S.* (*S.*) *turkana* Packer, Kenyan species belonging to a group best known from xeric areas of southwestern Africa (Michez *et al.*, 2010; Packer & Martins, 2015). Most species of another primarily southern African group, the Scraptrini (genus *Scrapter* Lepeletier de Saint Fargeau & Audinet-Serville), are known from South Africa (39 of 42 species; the other three are Namibian endemics), but remarkably one of these, *Scrapter nitidus* (Friese), extends to Kenya. Distributions of bee taxa that span Kenya and southern Africa are now increasingly well known, through ongoing revisionary studies including description of species such as the Kenyan *Systropha* (*Austrosystropha*) *oti* Patiny, Baldock, & Michez (Patiny *et al.*, 2013). It is now clear that what might be assumed to be quite distinct bee faunas, those of East Africa and southwestern Africa, actually share a large number of genera and even species. Remarkably, no fewer than 82 species are shared between Namibia and Kenya.

Comments on the Classification of Old World Panurginae

The Old World Panurginae include genera with two submarginal cells; *i.e.*, *Panurgus* Panzer, *Panurginus* Nylander, *Camptopoeum* Spinola; which have been traditionally placed in tribe Panurgini, and also *Melitturga* with three submarginal cells, which has been placed in a separate tribe Melitturgini along with *Meliturgula*, and which is best known from Africa. Of these “Old World” panurgine genera, only *Panurginus* also occurs in the New World. Warncke (1972, 1983, 1985) described additional subspecies, species, and subgenera thereby expanding the known diversity of Old World panurgines, but this was somewhat obscured by the low ranks he gave to his new taxa. Patiny (1999a, 1999b) elevated most of Warncke’s taxa in rank, treating the latter’s subspecies as species and his subgenera as genera. Patiny also described many species as new, the genera *Gasparinhala* Patiny and *Borgatomelissa* Patiny (the latter of which had been labeled in collections previously as a new genus by the late D.B. Baker), and additional subgenera of *Panurgus* (e.g., Patiny, 1998b, 1999c, 2000, 2001). He also partitioned the traditional Panurgini and Melitturgini into multiple tribes to accommodate these new taxa and bring the system into accordance with his own phylogenetic results which contradicted the traditional two-tribe system (Table 1). Four of Patiny’s tribes were established as new at that time: Paramelitturgini, Camptopoeumini (sic), Mermiglossini, and Panurginini. The name Paramelitturgini was unavailable since it was not based on an available genus-group name, so Engel (2001) proposed the name Meliturgulini for this group. Engel placed Patiny’s Mermiglossini in synonymy with Melitturgini and the other tribes in synonymy with Panurginini, an arrangement followed by Michener (2007), who maintained the traditional two-tribe system (Michener, 2007; *vide* Table 1), but noted that the phylogenetic position of the sister genera *Mermiglossa* and *Plesiopanurgus*, *i.e.*, of the Mermiglossina, was uncertain and that, “Recognition of subtribes may be appropriate.”

Table 1. A comparison of tribal and subtribal treatments for three recent panurgine classifications. Michener's (2007) classification is based in large part on that of Ruz (1986, 1991), and although acknowledging the potential utility of some elements of Patiny's (1999a) arrangement, held on to the two-tribe system. Patiny (1999a) regarded *Avpanurgus* Warncke, *Simpanurgus* Warncke, and *Flavipanurgus* Patiny as *incertae sedis* within Panurginae (these were included in Panurgini by Michener, 2007). In the present arrangement *Flavipanurgus* would be placed in Panurgina, *Avpanurgus* in Camptopoeina, and *Simpanurgus* as *incertae sedis* within Panurgini.

Michener (2007)	Patiny (1999a)	Herein (# of species)
Nolanomelissini	then undescribed	Nolanomelissini (1)
Calliopsini	Calliopsini	Calliopsini (138)
Protandrenini, <i>partim</i>	Protandrenini	Protandrenini (411)
Protandrenini, <i>partim</i>	not treated	Neffapini (1)
Panurgini, <i>partim</i>	Panurgini	Panurgini: Panurgina (41)
Panurgini, <i>partim</i>	Camptopoeumini (sic)	Panurgini: Camptopoeina (32)
Panurgini, <i>partim</i>	Panurginini	Panurgini: Panurginina (64)
Melitturgini, <i>partim</i>	Melitturgini	Panurgini: Melitturgina (19)
Melitturgini, <i>partim</i>	"Paramelitturgini", <i>nomen invalidum</i>	Panurgini: Meliturgulina (20)
Melitturgini, <i>partim</i>	Mermiglossini	Panurgini: Mermiglossina (6)
Protomelitturgini	not treated	Protomelitturgini (2)
Perditini	Perditini	Panurgini: Perditina (672)

Ascher (2004) found Patiny's tribes to be useful taxa but did not endorse his conclusions about their phylogenetic relationships due in part to problematic character coding, weighting, and choice of outgroups. He therefore reduced them in rank to subtribes within an expanded tribe Panurgini, also including the New World perditines (*Perdita* Smith and *Macrotera* Smith) as a subtribe. This revised classification, outlined here, was based on lack of substantial evidence for reciprocal monophyly of the two traditional tribes and strong evidence from the nuclear gene EF-1 α that *Perdita* s.l., traditionally classified as tribe Perditini and thought to be closely related to the New World Calliopsini (Ruz, 1986, 1991), was instead sister to the Old World genus *Panurgus* Panzer. Thus, perditines are a New World member of this assemblage, with calliopsines comprising the sister group of all other panurgines excepting *Nolanomelissa* Rozen (Ascher, 2003). This novel placement for perditines results in a revised interpretation of biogeographic affinities for the largest single diversification known among bees. Classification of Perditina as a subtribe of Panurgini has not been fully documented, but does appear in some published works (e.g., Scott *et al.*, 2011), and is consistent with subsequent phylogenetic results (Hedtke *et al.*, 2013; Ramos, 2011).

Although the family-group taxa now recognized for Old World Panurginae (Table 1) are believed to be monophyletic if the well-known genera are considered, the placement of *Avpanurgus* Warncke and *Simpanurgus* Warncke remains somewhat uncertain due to inadequate material available for study. In addition, more work is needed to resolve phylogenetic relationships among the constituent lineages of Panurgini.

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REFERENCES

- Ascher, J.S. 2003. Appendix: Evidence for the phylogenetic position of *Nolanomelissa* from nuclear EF-1 α sequence data. In: Melo, G.A.R., & I. Alves dos Santos (Eds.), *Apoidea Neotropica: Homenagem aos 90 Anos de Jesus Santiago Moure*: 107–108. Editora UNESC [Universidade do Extremo Sul Catarinense]; Criciúma, Brazil; xvi+320 pp.
- Ascher, J.S. 2004. *Systematics of the Bee Family Andrenidae (Hymenoptera, Apoidea)*. Doctoral dissertation, Cornell University; Ithaca, NY; 333 pp.
- Ascher, J.S., & J. Pickering. 2017. Discover Life bee species guide and world checklist (Hymenoptera: Apoidea: Anthophila). [http://www.discoverlife.org/mp/20q?guide=Apoidea_species, last accessed 16 November 2017]
- Baker, D.B. 1972. A revision of the genus *Plesiopanurgus* Cameron, with notes on some Arabian and African Panurginae (Hymenoptera: Apoidea). *Journal of Entomology, Series B, Taxonomy and Systematics* 41(1): 35–43.
- Baker, D.B. 1997. A new species of *Plesiopanurgus* Cameron from Morocco (Hymenoptera: Apoidea, Andrenidae). *Entomologist's Gazette* 48(3): 199–203.
- Cameron, P. 1907. On a new genus and some new species of aculeate Hymenoptera collected by Lieut.-Col. C.G. Nurse in Baluchistan. *Journal of the Bombay Natural History Society* 18(1): 130–136.
- Cockerell, T.D.A. 1933. African bees of the genus *Coelioxys*. *Annals and Magazine of Natural History, Tenth Series* 11(65): 547–557.
- Cockerell, T.D.A. 1937. *African Bees of the Genera Ceratina, Halictus and Megachile*. British Museum; London, UK; xvi+254 pp.
- Dathe, H.H. 2014. Studies on the systematics and taxonomy of the genus *Hylaeus* F. (8) Revision of the Afrotropic subgenus *Hylaeus (Deranchylaeus)* Bridwell (Hymenoptera: Anthophila, Colletidae). *Zootaxa* 3874(1): 1–84.
- Eardley, C.D. 1991. The southern African Panurginae (Andrenidae: Hymenoptera). *Phytophylactica* 23: 115–136.
- Eardley, C.D., & R. Urban. 2010. Catalogue of Afrotropical bees (Hymenoptera: Apoidea: Apiformes). *Zootaxa* 2455: 1–548.
- Engel, M.S. 2001. A monograph of the Baltic amber bees and evolution of the Apoidea (Hymenoptera). *Bulletin of the American Museum of Natural History* 259: 1–192.
- Friese, H. 1912. Neue und wenig bekannte Bienen Süd-Afrikas (Hym.). *Archiv für Naturgeschichte, Abteilung A* 78(5): 181–189.
- Hedtke, S.M., S. Patiny, & B.N. Danforth. 2013. The bee tree of life: A supermatrix approach to apoid phylogeny and biogeography. *BMC Evolutionary Biology* 13: 138 [1–13].
- Martins, D.J. 2012. Rare parasitic bee genus discovered in Kenya. *Swara, Journal of the East African Wildlife Society* 33(2): 52–54.
- Martins, D.J. 2014. *Our Friends the Pollinators. A Handbook of Pollinator Diversity and Conservation in East Africa*. Nature Kenya, The East Africa Natural History Society; Nairobi, Kenya; 102 pp.
- Michener, C.D. 2007. *The Bees of the World* [2nd Edition]. Johns Hopkins University Press; Baltimore, MD; xvi+[i]+953 pp., +20 pls.

- Michez, D., C. Eardley, M. Kuhlmann, K. Timmermann, & S. Patiny. 2010. The bee genera *Haplolmelitta* and *Samba* (Hymenoptera: Anthophila: Melittidae): Phylogeny, biogeography and host plants. *Invertebrate Systematics* 24(4): 327–347.
- Packer, L., & D.J. Martins. 2015. A new species of *Samba* s. str. (Hymenoptera: Melittidae) from the Turkana Basin, Kenya with observations on the function of the metatibial spur in females. *Zootaxa* 3918(2): 261–272.
- Patiny, S. 1998a. Mise en synonymie de l'espèce récemment décrite, *Plesiopanurgus hanno* Baker, 1997 et considérations sur la position subgénérique des *Plesiopanurgus* Cameron, 1907 (Hymenoptera: Andrenidae). *Bulletin et Annales de la Société Royale belge d'Entomologie* 134(3): 247–252.
- Patiny, S. 1998b. Description d'un sous-genre nouveau de *Melitturga* Latreille, 1809 (Hymenoptera, Apoidea, Andrenidae). *Bembix* 10: 29–33.
- Patiny, S. 1999a. Etude phylogénétique des Panurginae de l'ancien monde (Hymenoptera, Andrenidae). *Linzer Biologische Beiträge* 31(1): 249–275.
- Patiny, S. 1999b. Révision des Panurginae ouest-paléarctiques n'appartenant pas à la tribu des Melitturgini Michener, 1944. Partie 1: *Panurgus* Panzer, 1806 et *Camptopoeum* Spinola, 1843 (Hymenoptera, Andrenidae). *Entomofauna* 20(19): 309–328.
- Patiny, S. 1999c. Description d'une nouvelle espèce de *Flavipanurgus* Warncke, 1972 (Hymenoptera, Andrenidae, Panurginae). *Notes Fauniques de Gembloux* 37: 57–61.
- Patiny, S. 2000. Description d'un genre nouveau de Panurginae: *Borgatomelissa* g. nov. (Hymenoptera, Andrenidae). *Notes Fauniques de Gembloux* 41: 101–104.
- Patiny, S. 2001. A new Panurginae genus from Iran: *Gasparinahla* g. nov. described on base of a new species: *Gasparinahla megapalpa* sp. nov. (Hymenoptera: Apidae: Panurginae). *Linzer Biologische Beiträge* 33(1): 309–313.
- Patiny, S., & P. Rasmont. 1999. Description d'un nouveau sous-genre de *Plesiopanurgus* Cameron, 1907 (Hymenoptera, Andrenidae, Panurginae). *Notes Fauniques de Gembloux* 37: 77–80.
- Patiny, S., D. Baldock, & D. Michez. 2013. Systematics of the bee subgenus *Systropha* (*Austrosystropha*) (Hymenoptera: Halictidae): Description of a new species and proposal of a new sex association. *Zootaxa* 3647: 577–584.
- Pauly, A. 2014. Les abeilles de Graminées ou *Lipotriches* Gerstaecker, 1858, *sensu stricto* (Hymenoptera: Apoidea: Halictidae: Nomiinae) de l'Afrique subsaharienne. *Belgian Journal of Entomology* 20: 1–393.
- Pesenko, Y.A., & A. Pauly. 2005. Monograph of the bees of the subfamily Nomioidinae (Hymenoptera: Halictidae) of Africa (excluding Madagascar). *Annales de la Société Entomologique de France* 41(2): 129–236.
- Ramos, K.S. 2011. *Relações Filogenéticas entre as Abelhas da Subfamília Andreninae com Ênfase nas Tribos Calliopsini, Protandrenini e Protomelitturgini* (Hymenoptera, Apidae). Doctoral dissertation, Universidade Federal do Paraná; Curitiba, Brazil; xiv+156 pp.
- Ruz, L. 1986. *Classification and phylogenetic relationships of the panurgine bees* (Hymenoptera - Andrenidae). Doctoral dissertation, University of Kansas; Lawrence, KS; iii+312 pp.
- Ruz, L. 1991. Classification and phylogenetic relationships of the panurgine bees: The Calliopsini and allies (Hymenoptera: Andrenidae). *University of Kansas Science Bulletin* 54(7): 209–256.
- Schwammberger, K.-H. 1971. Zwei neue Bienen-Arten aus Iran (Hymenoptera Apoidea). *Stuttgarter Beiträge zur Naturkunde* 225: 1–4.
- Scott, V.L., J.S. Ascher, T.L. Griswold, & C.R. Nufio. 2011. The bees of Colorado (Hymenoptera: Apoidea: Anthophila). *Natural History Inventory of Colorado* 23: i–vi, 1–100.
- Warncke, K. 1972. Westpaläarktische Bienen der Unterfamilie Panurginae (Hym., Apidae). *Polkskie Pismo Entomologiczne* 42(1): 53–108.
- Warncke, K. 1983 [1985]. Beiträge zur Bienenfauna des Iran 19.–20. Die Gattungen *Panurgus* Pz. und *Melitturga* Fr. (Hymenoptera, Apidae). *Bollettino del Museo Civico di Storia Naturale di Venezia* 34: 221–235.
- Warncke, K. 1985 [1987]. Ergänzende Untersuchungen an Bienen der Gattungen *Panurgus* und *Melitturga* / Andreninae, Apidae, vor allem aus dem türkischen Raum. *Bollettino del Museo Civico di Storia naturale di Venezia* 36: 75–107.



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