Redefinition and Systematic Revision of the East African Scorpion Genus Pandinoides (Scorpiones: Scorpionidae) With Critique of the Taxonomy of Pandinus, Sensu Lato

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Source: Bulletin of the American Museum of Natural History, 2016(407) : 1-66

Published By: American Museum of Natural History

URL: https://doi.org/10.1206/0003-0090-407.1.1

REDEFINITION AND SYSTEMATIC REVISION OF THE EAST AFRICAN SCORPION GENUS *PANDINOIDES* (SCORPIONES: SCORPIONIDAE) WITH CRITIQUE OF THE TAXONOMY OF *PANDINUS*, SENSU LATO

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BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY
Number 407, 66 pp., 23 figures, 6 tables
Issued September 21, 2016

ISSN 0003-0090

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ABSTRACT

The scorpion fauna of East Africa, encompassing Burundi, Kenya, Tanzania, Rwanda, and Uganda, is more diverse than those of West and Central Africa, but a systematic survey has never been conducted and the distributions of its species remain poorly understood. A recent opportunity to examine two extensive collections of East African, and predominantly Kenyan, scorpions and new material acquired by the author permitted a reassessment of the fauna of the region. The present contribution, the first of several emanating from this research, comprises two parts. The first part presents a redefinition and revision of the scorpionid genus *Pandinoides* Fet, 1997, with a redescription of the type species, *Pandinoides cavimanus* (Pocock, 1888), a revalidation and redescription of *Pandinoides militaris* (Pocock, 1900), and a description of *Pandinoides duffmackayi*, sp. nov. Pending reassessment of the genera and subgenera of *Pandinus*, sensu lato, based on quantitative phylogenetic analysis, *Pandinoides* is restricted to the three species with a marked concave depression in the retrodorsal surface of the pedipalp chela manus of the adult male, and *Pandinus platycheles* Werner, 1916, transferred to *Pandinus* subgenus *Pandinoriens* Rossi, 2015, creating a new combination: *Pandinus* (*Pandinoriens*) *platycheles* (Werner, 1916), comb. nov. The availability of large series comprising both sexes and all stages of the three *Pandinoides* species covered herein revealed considerable variation in counts of pedipalp trichobothria, spiniform macrosetae of the leg telotarsi, and pectinal teeth, among and even within individual conspecifics, calling into question the widespread practice of defining species and supraspecific taxa almost exclusively on trivial meristic differences between small samples of material (often singletons, female or immature). Furthermore, whereas neobothriotaxic patterns with low counts may provide appropriate diagnostic characters for genera and species, in combination with other characters, this is generally inadvisable when trichobothrial counts are high, due to the greater instability of the patterns.

The second part of this contribution assesses the validity of several putative species of *Pandinus*, sensu lato, recently described or revalidated, in light of data presented in the first part, and presents 10 new synonyms: *Heterometrus roeseli* Simon, 1872 = *Pandinus* (*P.*) *imperator* (C.L. Koch, 1841), syn. nov.; *Pandinus* (*P.*) *camerounensis* Lourenço, 2014 = *Pandinus* (*P.*) *imperator* (C.L. Koch, 1841), syn. nov.; *Pandinurus* (*P.*) *prendinii* Rossi, 2015 = *Pandinurus* (*P.*) *sudanicus* (Hirst, 1911), syn. nov.; *Pandinurus* (*Pandicaporiaccous*) Rossi, 2015 = *Pandinurus* (*Pandiborellius*) Rossi, 2015, syn. nov.; *Pandinurus* (*Pandicaporiaccous*) *janae* Rossi, 2015 = *Pandinurus* (*Pandiborellius*) *percivali* (Pocock, 1902), syn. nov.; *Pandinurus* (*Pandipalpus*) *bartolozii* Rossi, 2015 = *Pandinurus* (*Pandipalpus*) *viatoris* (Pocock, 1890), syn. nov.; *Pandinurus* (*Pandipalpus*) *flagellicauda* Rossi, 2015 = *Pandinurus* (*Pandipalpus*) *viatoris* (Pocock, 1890), syn. nov.; *Pandinurus* (*Pandipalpus*) *lorenzoi* Rossi, 2015 = *Pandinurus* (*Pandipalpus*) *viatoris* (Pocock, 1890), syn. nov.; *Pandinurus* (*Pandipalpus*) *pantinii* Rossi, 2015 = *Pandinurus* (*Pandipalpus*) *viatoris* (Pocock, 1890), syn. nov.; *Pandinurus* (*Pandipalpus*) *pygmaeus* Rossi, 2015 = *Pandinurus* (*Pandipalpus*) *viatoris* (Pocock, 1890), syn. nov.

INTRODUCTION

The scorpion fauna of East Africa, defined here in accordance with Spawls et al. (2004) as the area encompassing the countries of Burundi, Kenya, Tanzania, Rwanda, and Uganda, is more diverse than those of West and Central Africa, presumably because of greater topographical and climatic complexity associated with the Great Rift Valley. The fauna is also comparatively better studied, due to early contributions by Pocock (1888, 1890, 1896, 1897a, 1897b, 1898a, 1898b, 1900a, 1900b), Kraepelin (1913), Birula (1915a, 1915b), Loveridge (1925), and more recent contributions by Probst (1973), Kovařík (2011, 2013a) and Kovařík et al. (2016). In spite of these contributions, a systematic survey of the fauna has never been conducted, and the distributions of the species occurring in the region remain poorly understood.

A recent opportunity to examine two extensive collections of East African, and predominantly Kenyan, scorpions, deposited in the National Museums of Kenya, Nairobi, and the Natal Museum, Pietermaritzburg, South Africa, augmented by other collections, and new material acquired by the author, permitted a reassessment of the fauna of the region.

The present contribution, the first of several emanating from this research, comprises two parts. The first part presents a redefinition and revision of the scorpionid genus *Pandinoides* Fet, 1997, with a redescription of the type species, *Pandinoides cavimanus* (Pocock, 1888), a revalidation and redescription of *Pandinoides militaris* (Pocock, 1900), synonymized without justification by Kovařík (2002), and a description of *Pandinoides duffmackayi*, sp. nov. The overwhelming morphological evidence for three range-restricted species (figs. 1, 2), rather than a single widespread species, presented herein, is independently supported by ongoing genetic research, which has revealed high levels of genetic divergence among them (L. Prendini, in prep.).

Pandinoides was originally proposed as a subgenus of *Pandinus* Thorell, 1876, by Vachon (1974), who neglected to designate a type species, resulting in a nomen nudum. Upon rectification of this omission, *Pandinoides* took Fet's (1997) name as author. Recently, Rossi (2015a) elevated the historical subgenera of *Pandinus*, including *Pandinoides*, to the rank of genera, without testing their monophyly and despite doubts about their validity raised by Prendini et al. (2003; also see Kovařík, 2009), who tested and confirmed the monophyly of *Pandinus* in a phylogenetic analysis of morphology and DNA sequence data, and presented a comprehensive diagnosis for the genus. Pending a detailed reassessment of the genera and subgenera of *Pandinus*, sensu lato, based on quantitative phylogenetic analysis, *Pandinoides* is hereby restricted to the three species with a marked concave depression in the retrodorsal surface of the pedipalp chela manus of the adult male.

The availability of large series comprising both sexes and all stages of the three *Pandinoides* species covered herein revealed considerable variation in counts of pedipalp trichobothria, spiniform macrosetae of the leg telotarsi, and pectinal teeth, both within and among conspecific populations, and even from left to right on a single individual, calling into question the widespread practice of defining species and supraspecific taxa almost exclusively on the basis of minor meristic differences between small samples of material examined (often singletons, and often female or immature). Furthermore, whereas neobothriotaxic patterns with low counts may provide appropriate diagnostic characters for genera and species, in combination with other characters, this is generally inadvisable when trichobothrial counts are high, due to the greater instability of the patterns. In light of these data, the second part of this contribution assesses the validity of several putative species of *Pandinus*, sensu lato, recently described or revalidated, and presents 10 new synonyms.

METHODS

Material examined is deposited in the following collections: American Museum of Natural History, New York (AMNH), including the Alexis Harington Collection (AH); Albany Museum, Grahamstown, South Africa (AM); Natural History Museum, London, UK (BMNH); California Academy of Sciences, San Francisco (CAS); Field Museum of Natural History, Chicago (FMNH); Florida State Collection of Arthropods, Gainesville (FSCA); Museum of Comparative Zoology, Harvard University, Cambridge, MA (MCZ); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Musée Royal de l'Afrique Centrale, Tervuren, Belgium (MRAC); Natural History Museum of Zimbabwe, Bulawayo (NHMZ); Naturhistoriska Riksmuseet, Stockholm, Sweden (NHRM), including the Julio Ferrer Collection (JF); KwaZulu-Natal Museum, Pietermaritzburg, South Africa (NM); National Museums of Kenya, Nairobi (NMK); Iziko South African Museum, Cape Town (SAM); Ditsong National Museum of Natural History (former Transvaal Museum), Pretoria, South Africa (TM); United States National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM); Museum für Naturkunde, Humboldt Universität, Berlin, Germany (ZMB); Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany (ZMH); Zoological Museum, University of Copenhagen, Denmark (ZMUC). Tissue samples are stored in the Ambrose Monell Collection for Molecular and Microbial Research (AMCC) at the AMNH. Additional, type material not examined is deposited in the Andrea Rossi Private Collection, Massa, Italy (ARPC), the Hungarian Natural History Museum, Budapest (HNHM), the Museo Civico di Scienze Naturali di Bergamo "E. Caffi," Italy (MSNB), and the Museo Zoologico "La Specola" dell'Università de Firenze, Florence, Italy (MZUF).

Photographs were taken in visible light as well as under long-wave UV light using a Microptics™ ML-1000 digital photomicrography system. Measurements (mm), given as mean and range in the description, were recorded using Mitutoyo® digital calipers (model NTD12–6″C). Morphological terminology follows previous papers on Scorpionidae Latreille, 1802, by the author (e.g., Prendini 2000a, 2001a; Prendini et al., 2003; Tahir and Prendini, 2014), with the terms "external" and "internal" replaced by "retrolateral" and "prolateral" when referring to position on appendages (chelicerae, pedipalps, and legs).

A point locality geographical dataset of collection records from the literature (Pocock, 1888, 1896, 1900b; Kraepelin, 1899, 1913; Birula, 1915a, b; Borelli, 1925a, 1925b; Loveridge, 1925; Werner, 1936; Roewer, 1943; Moriggi, 1941; Lamoral and Reynders, 1975; Kovařík, 2003, 2009) and museum material was created for mapping the distributional ranges of the three species of *Pandinoides*. Records of sufficient accuracy, for which georeferences were not provided, were retroactively georeferenced using the GEOnet Names Server (http://earth-info.nga.mil/gns/html/namefiles.htm), Fuzzy Gazetteer (http://isodp.hof-university.de/fuzzyg/query/) and Google Earth. A distribution map was produced using ArcMap Version 10.1 (Environmental Systems Research Institute, Redlands, CA), by superimposing point locality records on the GTOPO30 global digital elevation model (https://lta.cr.usgs.gov/GTOPO30), obtained from the NASA Spatial Data Access Tool (http://webmap.ornl.gov/wcsdown/wcsdown.jsp?dg_id=10003_1).

SYSTEMATIC REVISION

Family Scorpionidae Latreille, 1802

Genus *Pandinoides* Fet, 1997

Figures 1–16; tables 1–5

Pandinus (*Pandinoides*) Vachon, 1974: 953 (part), nomen nudum (type species not designated).

Pandinus (*Pandinoides*) Fet, 1997: 248, type species: *Pandinus militaris* Pocock, 1900 [= *Pandinoides militaris* (Pocock, 1900)], desig. Fet, 2000: 468 (part); Lamoral and Reynders, 1975: 564 (part); Francke, 1985: 11, 18; Kovařík, 1998: 140 (part); Fet, 2000: 468 (part); Kovařík, 2003: 136, 148, 149, fig. 15, table 1 (part); 2009: 50–52 (part), 58, 59, 114, 115 (part), 129, table 3 (part), figs. 284–293 (part), 403–405; Prendini et al., 2003: 230.

Pandinoides: Rossi, 2015a: 10, 11, 13 (part), 14–16, 43, 50, figs. 8–11.

Diagnosis: Species of *Pandinoides* differ from all other scorpionid genera in the unique shape of the pedipalp chela manus of the adult male, which is characterized by a marked concave depression in the retrodorsal surface, at the base of the fixed finger (figs. 6A, 13A, 20A), and the retroventral carina projecting ventral to the plane of the ventromedian carina (figs. 6B, 13B, 20B).

The following additional characters, in combination, separate *Pandinoides* from all other scorpionid genera. Cheliceral movable finger, prodistal (ventral) and retrodistal (dorsal) teeth unequal, retrodistal tooth considerably smaller than prodistal tooth, aligned longitudinally and not opposable. Carapace interocular and posteromedian surfaces smooth in both sexes (figs. 4, 11, 18); posterior sutures present, connected anteriorly to posterior furcations of interocular suture and extending anteriorly beyond median ocular tubercle. Sternites and metasomal segments I–V, intercarinal surfaces smooth or predominantly so. Sternite VII with paired, costate ventrosubmedian and ventrolateral carinae. Ventrolateral and ventrosubmedian carinae more strongly developed on metasomal segments I and II than on III and IV. Pedipalp chela manus predominantly acarinate except for retroventral and ventromedian carinae (figs. 6, 7, 13, 14, 20, 21); retrodorsal surfaces predominantly smooth proximally with shallow, anastomosing granules and/or reticulation distally. Chela movable finger of adult male without proximal lobe, with median lobe more pronounced than other lobes, and with correspondingly well-developed notch in fixed finger, creating moderate to prominent gap between fingers, when closed (figs. 6A, 13A, 20A). Pedipalp neobothriotaxic major, Type C, with 84 (74–93) trichobothria (tables 1–5; *n* = 90); chela with 4 (3–5) *i* trichobothria and 9 (7–12) *V* trichobothria; patella with 14 (13–15) *e* trichobothria and 31 (22–38) *v* trichobothria. Telotarsi with the following counts of pro- and retroventral spiniform macrosetae (tables 1–5; *n* = 90): I, 3 (1–3), 4 (3–5); II, 3 (2 or 3), 4 (2–5); III, 3 (2–4), 4 (3–5); IV, 3 (2 or 3), 4 (3–5).

Distribution: Ethiopia, Kenya, Somalia, Tanzania, ?Uganda. This genus does not occur in the northeast of the Democratic Republic of Congo (formerly Zaïre) or in Sudan as stated by Kovařík (1998, 2009) and Fet (2000). As discussed under *P. militaris*, the record from Sudan is actually in Uganda (fig. 2), and remains to be confirmed.

Ecology: *Pandinoides* occur in arid savannah and riverine forest, from 240–1770 m elevation. All three species of the genus are fossorial, constructing burrows in compacted clayey to sandy-loam soils using the chelicerae, first two pairs of legs, and metasoma. Burrow entrances are usually situated in open ground. The thickened metasoma (figs. 9, 16, 23), short, robust legs (figs. 8, 15, 22) with stout, spiniform macrosetae distributed retrolaterally and distally on the basitarsi, and curved telotarsal ungues are consistent with the pelophilous ecomorphotype (Prendini, 2001b). Burrows may be single entrance, occupied by a single individual, or composite and multi-entrance, containing multiple related individuals of overlapping generations.

Conservation: All three species of *Pandinoides* are harvested in large numbers for the international trade in exotic pets, judging from their availability on markets in Europe, the United States, and Japan (fig. 1A). The impact of this activity on wild populations is unknown, but several factors suggest it is probably detrimental. Species of *Pandinoides* may be slow to repopulate and hence vulnerable to overharvesting, as with other large-bodied Scorpionidae (Prendini et al., 2003). Female scorpionids typically have gestation periods of up to 12 months and produce fairly small broods (30–35 young) compared with other scorpions. Young are relatively altricial, spending several months in the maternal burrow before dispersing, protracting the period before a female can give birth to her next brood. Age to sexual maturity is 4–7 years, during which period most juveniles experience natural predation (including cannibalism). The fairly restricted distributional ranges of *Pandinoides* species provide further cause for concern, given that wild populations are threatened not only by harvesting but also by continued habitat destruction. *Pandinoides* appear to be equilibrium species, restricted to relatively undisturbed habitat. Species of *Pandinoides* should be CITES-listed as is the case with three West African species, *Pandinopsis dictator* (Pocock, 1888), *Pandinus gambiensis* Pocock, 1899, and *Pandinus imperator* (C.L. Koch, 1841).

Included Species: *Pandinoides cavimanus* (Pocock, 1888); *Pandinoides duffmackayi*, sp. nov.; *Pandinoides militaris* (Pocock, 1900).

Vachon (1974) assigned *Pandinus platycheles* Werner, 1916, to subgenus *Pandinoides*, based solely on the count of trichobothria in the *i* series of the pedipalp chela. Lamoral and Reynders (1975), Fet (2000), and Kovařík (2003, 2009) adopted Vachon's (1974) placement of *P. platycheles* in *Pandinoides*, as did Rossi (2015a) when elevating the historical subgenera to the rank of genera.

Kovařík (2009: 50) suggested that knowing the adult male of *P. platycheles* "is crucial to deciphering its relationship to *P.* (*Pandinoides*) *cavimanus*,

FIGURE 1. *Pandinoides* Fet, 1997, habitus in life. **A, B.** *Pandinoides cavimanus* (Pocock, 1888) adults seized from shipment for exotic pet trade by U.S. Fish and Wildlife Service (**A**); ♀ (AMNH), imported to the United States from Tanzania (**B**). **C.** *Pandinoides duffmackayi*, sp. nov., paratype ♂ (AMNH), imported to U.S. from Tanzania. **D.** *Pandinoides militaris* (Pocock, 1900), ♂, Tsavo, Kenya. Photos courtesy Randy Mercurio (B, C) and Corwin Trent (D).

a species that has yet another unusual expression of sexual dimorphism." On the contrary, several obvious differences between the female of *P. platycheles*, illustrated by Kovařík (2009: 115, figs. 291–293), and the females of *P. cavimanus* and *P. militaris*, notably the shape and surface granulation of the carapace and pedipalp chela, clearly ally *P. platycheles* with the species of *Pandinus* and *Pandinurus* occurring in eastern Africa, rather than with *Pandinoides*.

Pending a detailed reassessment of the genera and subgenera of *Pandinus*, sensu lato, based on quantitative phylogenetic analysis, *Pandinoides* is restricted to the three species with a marked concave depression in the retrodorsal surface of the pedipalp chela manus of the adult male, and *P. platycheles* transferred to *Pandinus* subgenus *Pandinoriens* Rossi, 2015: *Pandinus* (*Pandinoriens*) *platycheles* (Werner, 1916), comb. nov.

REMARKS: As published by Vachon (1974), the name *Pandinus* (*Pandinoides*) was a nomen nudum and therefore unavailable. Fet (1997: 248) designated the type species as *Scorpio exitialis* Pocock, 1888, in error. Fet (2000) corrected that to *Pandinus militaris* Pocock, 1900.

Key to Identification of the Species of *Pandinoides* Fet, 1997

1. Total adult body length 60–78 mm, carapace length 10–13 mm, chela length 14–19 mm; pedipalp with 74–82 trichobothria: patella with 39–45 trichobothria, including 22–28 *v* trichobothria; chela fixed finger (adult ♂), proximal lobe present, similar in size to medial lobe; little to no gap proximally between fixed and movable fingers, when closed (adult ♂); pectinal tooth count, 11–13, usually 12 (♂), 10–12, usually 11 (♀); basitarsi III, prolateral *t* and *st* macrosetae setiform, IV, prolateral *t* setiform, *st* spiniform ....*P. duffmackayi*, sp. nov.

– Total adult body length 87–123 mm, carapace length 15–19 mm, chela length 21–32 mm; pedipalp with 83–93 trichobothria: patella with 47–55 trichobothria, including 30–38 *v* trichobothria; chela fixed finger (adult ♂), proximal lobe slightly to markedly smaller than medial lobe, or absent, moderate to prominent gap proximally between fixed and movable fingers, when closed; pectinal tooth count, 13–16, usually 14 (♂), 12–15, usually 13 or 14 (♀); basitarsi III and IV, prolateral *t* and *st* macrosetae spiniform................................2

2. Color in life, usually brownish black; median ocular tubercle, distance from anterior carapace margin 51%–56% of carapace length; metasoma 52%–56% (♂), 49%–53% (♀) of total length, segments IV and V, summed lengths 115%–130% (♂), 107%–120% (♀) of carapace length; carapace interocular and circumocular surfaces granular anterior to median ocular tubercle, along median longitudinal sulcus, and on frontal lobes; metasomal segment IV, ventrosubmedian carinae costate; chela manus height 59%–73% (♂), 66%–76% (♀) of width, length along retroventral carina 56%–63% (♂), 58%–67% (♀) of width; chela fixed finger (adult ♂), proximal lobe present but slightly smaller than medial lobe, moderate gap proximally between fixed and movable fingers, when closed ……………………..….*P. cavimanus*

– Color in life, yellowish brown or reddish brown; median ocular tubercle, distance from anterior carapace margin 46%–52% of carapace length; metasoma 46%–52% (♂), 42%–50% (♀) of total length, segments IV and V, summed lengths 98%–117% (♂), 87%–105% (♀) of carapace length; carapace interocular and circumocular surfaces smooth or with few granules anterior to ocular tubercle; metasomal segment IV, ventrosubmedian carinae granular; chela manus height 49%–68% (♂), 64%–73% (♀) of width, length along retroventral carina 64%–76% (♂), 62%–72% (♀) of width; chela fixed finger (adult ♂), proximal lobe vestigial, much smaller than medial lobe, or absent, prominent gap proximally between fixed and movable fingers, when closed........*P. militaris*

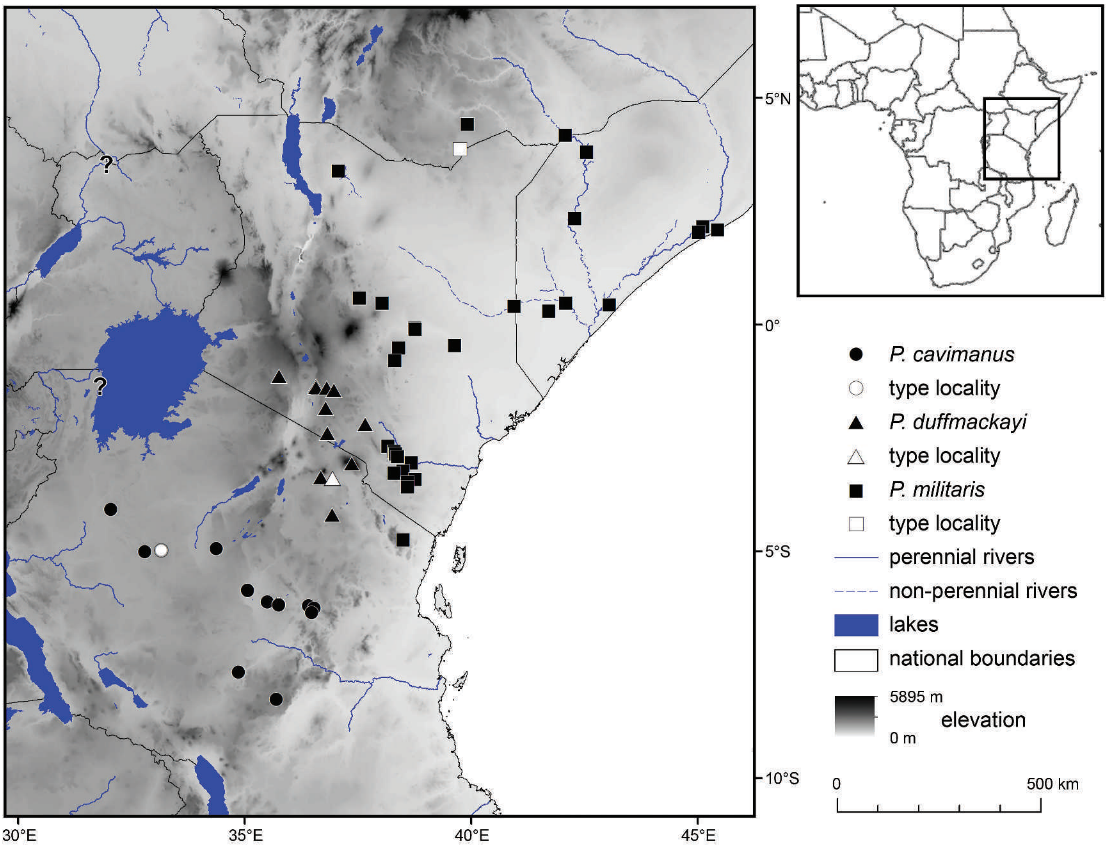


FIGURE 2. Map plotting known distributions of *Pandinoides cavimanus* (Pocock, 1888) (circles), *Pandinoides duffmackayi*, sp. nov. (triangles), and *Pandinoides militaris* (Pocock, 1900) (squares) based on data from the literature and the present contribution. White symbols denote type localities. Question marks denote unconfirmed, dubious records.

Pandinoides cavimanus (Pocock, 1888)

Figures 1A, B, 2, 3–9; table 1

Scorpio cavimanus Pocock, 1888: 247–249 (part); Pocock, 1896: 431, 432 (part), pl. XVIII, fig. 2, 2a.

Pandinus cavimanus: Kraepelin, 1899: 121, 122 (part); 1908: 191, fig. 17; 1913: 183 (part); Birula 1915a: 51; Birula, 1915b: 26, 27 (part); Loveridge, 1925: 304, 305; Birula, 1927: 87, 88; Werner, 1934: 152, 278, fig. 116g; Werner, 1936: 185, 186 (part); Moriggi, 1941: 94 (part); Belfield, 1956: 43, 45; Probst, 1973: 327 (part); Kovařík, 1992: 186; 1998: 140 (part).

Pandinus cavimnus: Kraepelin, 1901: 270.

Pandinus (*Pandinoides*) *cavimanus*: Vachon, 1974: 953; Lamoral and Reynders, 1975: 564 (part); El-Hennawy, 1992: 100, 136; Kovařík, 1997: 183; Fet, 2000: 468; Kovařík, 2002: 1, 18, 20 (part); 2003: 136, 148, 149, fig. 15, table 1 (part); 2009: 50–52 (part), 58, 59, 129 (part), table 3 (part), pl. K (fig. 2), figs. 403, 405.

Pandinoides cavimanus: Rossi, 2015a: 13 (part), 50, figs. 8–10.

Type Material: Holotype ♂ (BMNH 1863.66) [examined], **TANZANIA: Tabora Prov.:** *Uyui Distr.*: Central Africa, between the center and Umyamuezi [04°59′S 033°10′E] and 5° to 7°S latitude, Captain Speke.

Fet (2000: 468) mistakenly listed two syntypes and Kovařík (2003: 149) erroneously designated one, BMNH 1863.66 from Umyamuezi, the lectotype (also see Kovařík, 2009: 58). Despite mentioning two specimens in the original description of *Scorpio cavimanus*, Pocock (1888: 249) explicitly designated one as the type: "I have seen two specimens … one (dried) brought from Kilima-Njaro by Mr. M. J. Jackson; the other, which, being preserved in spirit of wine, I have selected as the type, brought by Capt. Speke from Umyamuezi."

Diagnosis: *Pandinoides cavimanus* may be separated from *P. duffmackayi*, sp. nov., and *P. militaris*, as follows. *Pandinoides cavimanus* is usually brownish black (fig. 1A, B), rarely reddish brown, in color whereas *P. duffmackayi*, sp. nov., is reddish brown to reddish black (fig. 1C) and *P. militaris*, yellowish brown (fig. 1D) to reddish brown. The interocular and circumocular surfaces of the carapace are sparsely and finely granular anterior to the median ocular tubercle, along the median longitudinal sulcus, and often on the frontal lobes in *P. cavimanus* (fig. 4A, C), but smooth, or nearly so, in *P. duffmackayi*, sp. nov. (fig. 11A, C), and smooth or with a few granules anterior to the ocular tubercle in *P. militaris* (fig. 18A, C). The metasoma of *P. cavimanus* is 52%–56% (♂) and 49%–53% (♀) of total length, the summed lengths of segments IV and V, 115%–130% (♂), 107%–120% (♀) of carapace length (table 1), whereas the metasoma of *P. duffmackayi*, sp. nov., is 49%–53% (♂) and 46%–49% (♀) of total length, the summed lengths of segments IV and V, 105%–116% (♂) and 91%–110% (♀) of carapace length (tables 2, 3), and the metasoma of *P. militaris* is 46%–52% (♂) and 42%–50% (♀) of total body length, the summed lengths of segments IV and V, 98%–117% (♂) and 87%–105% (♀) of carapace length (tables 4, 5). The dorsal surfaces of metasomal segments I–IV in the male are finely and sparsely granular in *P. cavimanus* (fig. 9A) but smooth in *P. duffmackayi*, sp. nov. (fig. 16A), and *P. militaris* (fig. 23A). The ventral surface of the telson vesicle of the male bears obsolete carinae, each comprising isolated spiniform granules, restricted to the anterior half or third, in *P. cavimanus* (fig. 9B, C), whereas the vesicle is smooth or nearly so in *P. duffmackayi*, sp. nov. (fig. 16B, C), and bears distinct carinae, each comprising prominent spiniform granules, extending its entire length, in *P. militaris* (fig. 23B, C). The proximal lobe on the pedipalp chela fixed finger of the adult male is slightly smaller than the medial lobe, creating a moderate gap proximally between the fixed and movable fingers, when closed in *P. cavimanus* (fig. 6A), whereas the proximal lobe is similar in size to the medial lobe, creating little to no gap proximally between the fingers, when closed in *P. duffmackayi*, sp. nov. (fig. 13A), and it is vestigial, much smaller than the medial lobe, or absent, creating a prominent gap proximally between the fingers, when closed in *P. militaris* (fig. 20A).

Based on unpublished genetic data, *P. cavimanus* is most closely related to *P. duffmackayi*, sp. nov., from which it may be further separated as follows. *Pandinoides cavimanus* is larger, with total adult body length 87–111 mm, carapace length 15–18 mm and pedipalp chela length 21–29 mm (table 1), than *P. duffmackayi*, sp. nov., with total adult body length 60–78 mm, carapace length 10–13 mm and chela length 14–19 mm (tables 2, 3). *Pandinoides cavimanus* bears 83–91 trichobothria on the pedipalp, with 48–55 trichobothria on the patella, including 31–37 in the *v* series, whereas *P. duffmackayi*, sp. nov., bears 74–82 trichobothria on the pedipalp, with 39–45 trichobothria on the patella, including 22–28 in the *v* series. The pectinal tooth count of *P. cavimanus*, with 14 or 15, usually 14 (♂) and 13 or 14, usually 13 (♀), is higher than that of *P. duffmackayi*, sp. nov., with 11–13, usually 12 (♂) and 10–12, usually 11 (♀). The prolateral *t* and *st* macrosetae of basitarsi III and IV are spiniform in *P. cavimanus* (fig. 8C, D), whereas *t* and *st* are setiform on III, and *t* setiform and *st* spiniform on IV in *P. duffmackayi*, sp. nov. (fig. 15C, D).

Pandinoides cavimanus has often been confused with *P. militaris* due to their similar size and high trichobothrial counts, but may be separated

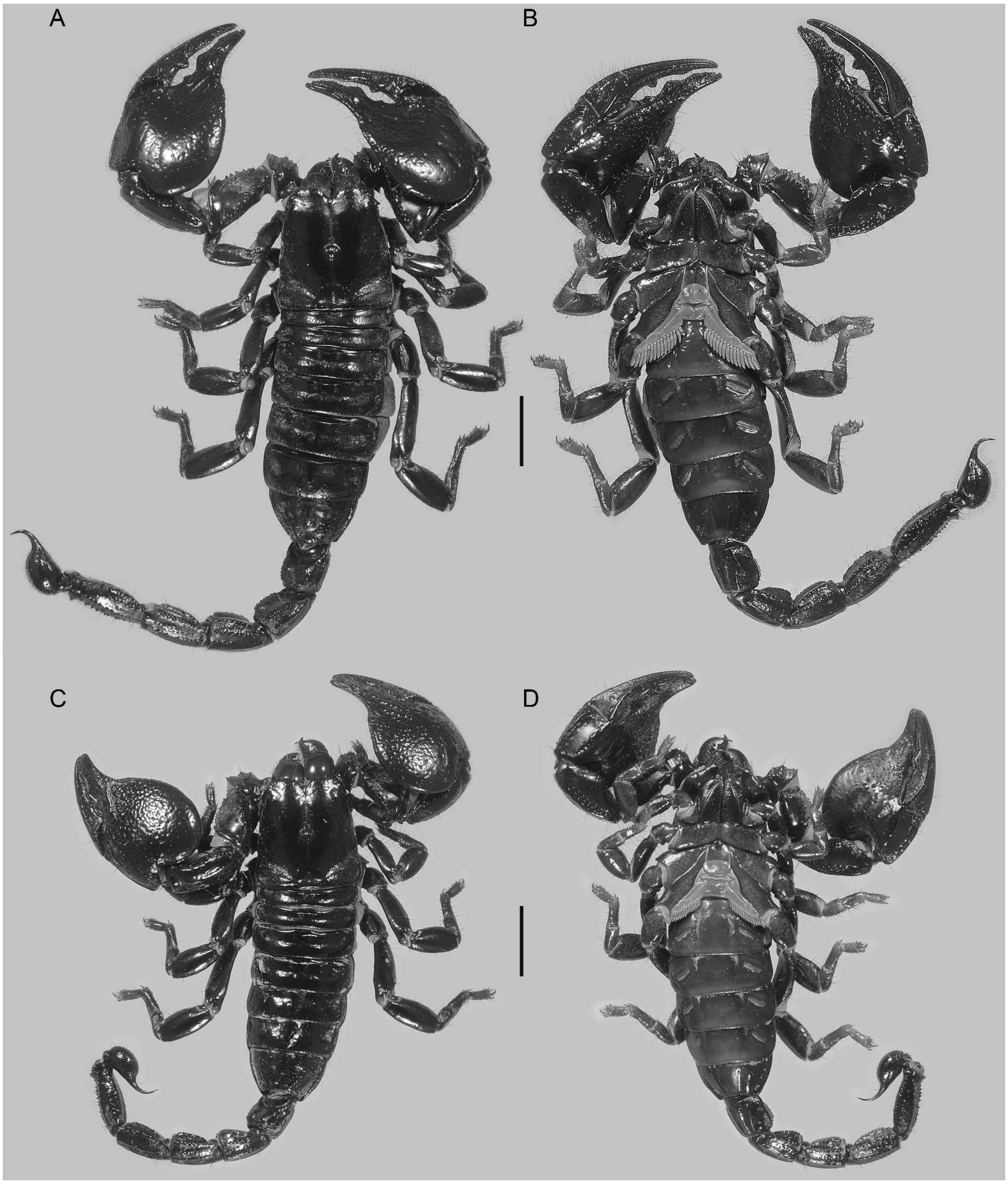


FIGURE 3. *Pandinoides cavimanus* (Pocock, 1888), habitus, dorsal (**A, C**) and ventral (**B, D**) aspects. **A, B.** ♂ (AMNH), **C, D.** ♀ (AMNH), Mapinduzi, Tanzania. Scale bars = 10 mm.

TABLE 1

Meristic data for adult specimens of *Pandinoides cavimanus* (Pocock, 1888) from Mapinduzi, Tanzania, in the American Museum of Natural History, New York.

Measurements (mm) follow Prendini (2000): [1]sum of carapace, tergites I–VII, metasomal segments I–V, and telson; [2]distance from anterior carapace margin; [3]sum of metasomal segments I–V and telson; [4]distance from base of condyle to tip of fixed finger. Counts of pectinal teeth, spiniform macrosetae of telotarsi and pedipalp trichobothria reflect sinistral (s) and dextral (d) sides. Setal counts include areolar cups (sockets), if setae broken.

Specimen	Sex	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀	♀
Total length[1]		107.5	104.0	110.9	103.5	105.3	102.3	91.0	99.5	86.9	90.9	91.6
Carapace	anterior width	11.9	12.2	12.6	12.6	11.7	11.3	11.2	11.5	10.7	10.2	9.9
	posterior width	16.5	17.8	17.2	17.2	16.4	17.3	14.7	15.7	15.6	14.9	13.7
	length	16.9	17.7	17.2	17.4	17.5	17.3	14.8	15.9	14.9	15.3	15.0
	median ocelli[2]	8.8	9.8	9.6	9.4	9.7	9.6	8.2	8.3	7.6	8.1	8.1
Tergite I	length	2.3	1.8	2.4	1.9	2.3	2.4	2.2	2.4	1.7	2.2	2.0
Tergite II	length	2.8	2.8	3.0	2.2	3.2	2.9	2.6	2.6	1.9	2.6	2.5
Tergite III	length	4.4	3.8	4.1	4.1	4.0	4.4	3.8	3.3	2.7	3.9	3.8
Tergite IV	length	5.0	3.9	5.3	4.2	4.6	4.6	4.9	5.0	3.8	4.7	4.5
Tergite V	length	5.9	4.2	6.3	4.3	5.6	4.8	5.0	5.5	4.4	4.8	5.1
Tergite VI	length	6.9	4.7	6.4	5.0	6.6	5.0	5.6	6.5	4.5	5.3	6.0
Tergite VII	length	7.1	6.6	7.8	6.5	8.6	6.6	7.2	7.3	6.5	6.4	7.3
Sternite VII	length	7.0	6.1	7.8	6.2	8.3	6.4	7.1	5.7	6.1	6.5	5.5
	width	12.9	13.8	13.9	12.0	12.0	13.2	10.9	12.2	12.0	11.0	10.9
Mesosoma	total length (tergites)	34.4	27.7	35.3	28.3	34.8	30.6	31.4	32.5	25.5	29.8	31.1
Metasoma I	length	7.8	7.9	8.0	7.6	7.4	7.8	6.3	6.8	6.2	6.6	6.7
	width	7.0	7.5	7.4	7.3	6.8	7.2	5.7	6.1	5.8	6.1	6.0
Metasoma II	length	8.5	8.5	9.1	8.3	7.6	7.9	6.5	7.4	6.6	6.8	6.8
	width	6.6	6.8	6.8	6.7	6.6	6.7	5.0	5.6	5.1	5.5	5.2
Metasoma III	length	9.3	9.4	9.5	8.6	8.2	8.5	6.8	8.2	7.1	6.9	7.2
	width	6.1	6.3	6.4	6.3	6.1	6.0	4.8	4.9	4.8	5.3	4.7
Metasoma IV	length	9.5	10.2	9.6	10.5	8.7	9.5	7.2	9.0	7.6	7.2	7.5
	width	5.3	5.6	5.5	5.5	5.3	5.3	4.2	4.7	4.5	4.7	4.3
Metasoma V	length	10.0	11.5	11.1	12.1	10.8	11.2	8.6	10.0	9.0	9.3	8.7
	width	4.8	4.8	4.9	4.7	4.6	4.6	3.8	4.0	3.9	3.9	3.9
Telson	vesicle length	7.7	7.4	7.5	7.5	6.4	6.3	5.9	6.0	5.9	5.7	5.5
	vesicle width	5.3	5.6	5.1	5.2	4.5	5.0	3.6	3.9	3.9	3.9	3.4
	vesicle height	4.4	4.9	4.8	4.5	4.1	4.1	3.4	3.7	3.7	3.4	3.4
	aculeus length	3.5	3.8	3.8	3.3	3.8	3.2	3.6	3.7	3.9	3.4	3.1
	total length	11.1	11.1	11.3	10.8	10.1	9.5	9.5	9.7	9.9	9.1	8.6
Metasoma	total length[3]	56.2	58.6	58.5	57.9	53.0	54.4	44.9	51.2	46.4	45.8	45.5
Femur	length	11.3	11.8	12.4	11.7	9.6	12.2	9.1	10.1	9.1	10.2	9.1
	width	6.0	6.2	6.5	6.2	5.8	5.8	5.7	5.7	5.2	5.3	5.6
Patella	length	13.7	13.9	14.4	14.0	12.9	13.5	11.3	12.1	11.5	11.9	11.6
	width	6.1	6.5	6.0	6.3	5.4	6.3	5.0	5.6	5.4	5.0	4.9
Chela	length[4]	27.3	27.1	28.6	27.0	25.3	25.0	21.7	22.7	22.3	22.2	20.9
	width	16.7	16.9	16.3	17.1	16.5	16.1	13.7	15.3	13.3	14.1	12.7
	height	9.8	10.8	11.9	11.6	11.4	11.4	9.9	10.0	10.1	9.7	8.9
	length retroventral carina	10.5	10.5	10.3	9.6	9.9	9.9	8.4	8.8	9.0	8.7	8.3
	length movable finger	18.5	19.9	20.5	19.3	16.5	17.2	14.7	16.6	15.2	15.1	15.1
Pectines	total length	9.1	9.0	9.3	8.6	6.9	7.2	6.4	6.7	6.6	6.1	6.8
	length dentate margin	7.6	7.7	7.2	6.6	5.2	5.8	5.2	4.7	4.6	4.4	5.7
	tooth count (s/d)	15/15	15/14	14/14	13/14	14/14	12/12	13/13	12/12	13/13	13/13	14/14
Telotarsi I	prolateral row (s/d)	3/3	3/3	3/3	3/3	3/3	3/3	-/-	3/3	3/3	3/3	3/3
	retrolateral row (s/d)	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3
Telotarsi II	prolateral row (s/d)	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	-/3	3/3	3/3
	retrolateral row (s/d)	3/3	3/3	3/3	3/3	3/-	3/3	3/3	-/3	-/3	3/3	3/3
Telotarsi III	prolateral row (s/d)	4/4	4/4	4/4	4/4	4/4	4/4	-/-	4/4	4/4	4/4	4/4
	retrolateral row (s/d)	4/5	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4
Telotarsi IV	prolateral row (s/d)	5/5	4/4	4/4	4/4	4/4	4/4	4/4	5/4	-/4	4/4	4/5
	retrolateral row (s/d)	5/5	4/4	4/4	4/4	4/-	5/4	4/4	-/4	-/5	4/4	4/4
Trichobothria	patella *e* (s/d)	14/14	15/15	14/14	14/14	14/14	14/14	15/15	14/14	15/15	15/15	14/14
	patella *v* (s/d)	37/36	35/35	31/34	34/34	33/33	33/33	35/37	32/35	34/35	35/36	32/33
	patella total (s/d)	54/53	53/53	48/51	51/51	50/50	50/50	53/55	49/52	52/53	53/54	49/50
	chela manus *V* (s/d)	8/9	9/9	9/8	8/9	9/9	9/9	9/9	7/7	10/10	9/9	9/9
	chela manus total (s/d)	20/21	21/21	21/20	20/21	21/21	21/21	21/21	19/19	22/22	21/21	21/21
	chela finger *i* (s/d)	4/3	4/4	4/3	3/4	4/4	4/4	4/4	4/4	4/5	5/4	4/4
	chela finger total (s/d)	12/11	12/12	12/11	11/12	12/12	12/12	12/12	12/12	12/13	13/12	12/12
	chela total (s/d)	32/32	33/33	33/31	31/33	33/33	33/33	31/33	33/31	34/35	34/33	33/33
	pedipalp total (s/d)	89/88	89/89	84/85	85/87	86/86	86/86	83/91	89/86	89/91	90/90	85/86

from the latter as follows. The carapace is less compressed, dorsoventrally, in *P. cavimanus* (fig. 4A, C) than in *P. militaris* (fig. 18A, C). The median ocular tubercle is posteromedial, its distance from the anterior carapace margin 51%–56% of the carapace length in *P. cavimanus* (table 1), but medial, its distance from the anterior carapace margin 46%–52% of the carapace length, in *P. militaris* (tables 4, 5). The ventrosubmedian carinae on metasomal segment IV are distinct, costate in *P. cavimanus* (fig. 9C), but obsolete, granular in *P. militaris* (fig. 23C). The chela manus of *P. cavimanus* is broader, the length along the retroventral carina 56%–63% (♂) and 58%–67% (♀) of the width, and more convex, the height 59%–73% (♂) and 66%–76% (♀) of the width, than the manus of *P. militaris*, in which the length along the retroventral carina is 64%–76% (♂) and 62%–72% (♀) of the width, and the height 49%–68% (♂) and 64%–73% (♀) of the width. The chela fixed finger of *P. cavimanus* arises abruptly from the manus and is wider proximally (figs. 6A, 7) than that of *P. militaris*, which arises more gradually from the manus (figs. 20A, 21). The chela fingers and distal surfaces of the manus are moderately (♂) to sparsely (♀) setose in *P. cavimanus* (fig. 1B), but densely (♂) to moderately (♀) setose in *P. militaris* (fig. 1D). *Pandinoides cavimanus* bears 31–35 trichobothria on the pedipalp chela, including 7–10 in the *V* series, whereas *P. militaris* bears 33–36 trichobothria on the chela, including 9–12 in the *V* series. The angle of the first proximal median lamella (scape) of the pecten is smaller (more acute), especially in the female, of *P. cavimanus* (fig. 4B, D), compared with *P. militaris* (fig. 18B, D).

Redescription: The following redescription supplements the original description by Pocock (1888) and is based on the material examined.

Total Length: Adult medium, maximum length, measured from anterior margin of carapace to tip of aculeus, 106 mm (104–111 mm, *n* = 4) (♂), 95 mm (87–105 mm, *n* = 7) (♀) (table 1).

Color: Chelicerae, dorsal surfaces bicolored, proximal three-quarters of manus dorsal surface sparsely infuscate, paler than carapace and densely infuscate distal quarter of manus dorsal surface and fingers. Carapace, tergites, metasoma, telson, pedipalp trochanter, femur, patella pro- and retrolateral surfaces, chela fingers, and legs dorsal and retrolateral surfaces entirely infuscate, uniformly dark brownish black; pedipalp patella ventral surface and chela manus dorsal, lateral, and ventral surfaces entirely infuscate but slightly paler, dark maroon. Coxosternal region, sternites, and legs, prolateral and ventral surfaces predominantly infuscate, paler, dark olive-brown with maxillary lobes darker, and leg tibia, basitarsus, and telotarsus paler than femur and patella. Genital opercula and pectines, immaculate, uniformly pale cream.

Chelicerae: Movable finger, prodistal (ventral) and retrodistal (dorsal) teeth unequal, retrodistal tooth considerably smaller than prodistal tooth, aligned longitudinally and not opposable. Fingers and manus, proventral surfaces, with long, dense vestiture of macrosetae. Coxae, prodorsal surfaces without stridulatory setae (scaphotrix); promedian surfaces without chemoreceptive lamelliform setae (trichocopae).

Carapace: Anterior width of posterior width, 72% (69%–73%, *n* = 4) (♂), 71% (66%–76%, *n* = 7) (♀); posterior width of length, 99% (97%–101%, *n* = 4) (♂), 98% (91%–104%, *n* = 7) (♀) (table 1). Three pairs of lateral ocelli, anterior pairs larger, facing anteriorly, separated by distance equal to width of ocellus from smaller posterior pair, facing posteriorly. Median ocelli slightly larger than anterior pairs of lateral ocelli, distance between ocelli equal to or greater than width of ocellus; median ocular tubercle situated posteromedially, distance from anterior carapace margin 54% (52%–56%, *n* = 4) (♂), 54% (51%–56%, *n* = 7) (♀) of carapace length (table 1). Anterior carapace margin with deep median notch (fig. 4A, C); with small median projection (epistome); without median depression; rostrolateral margin without distinct notch next to posterior lateral ocelli. Median longitudinal sulcus narrow, suturiform; continuous from median notch to interocular sulcus; with obsolete anterior furcation; without anterocular depression. Median ocular tubercle

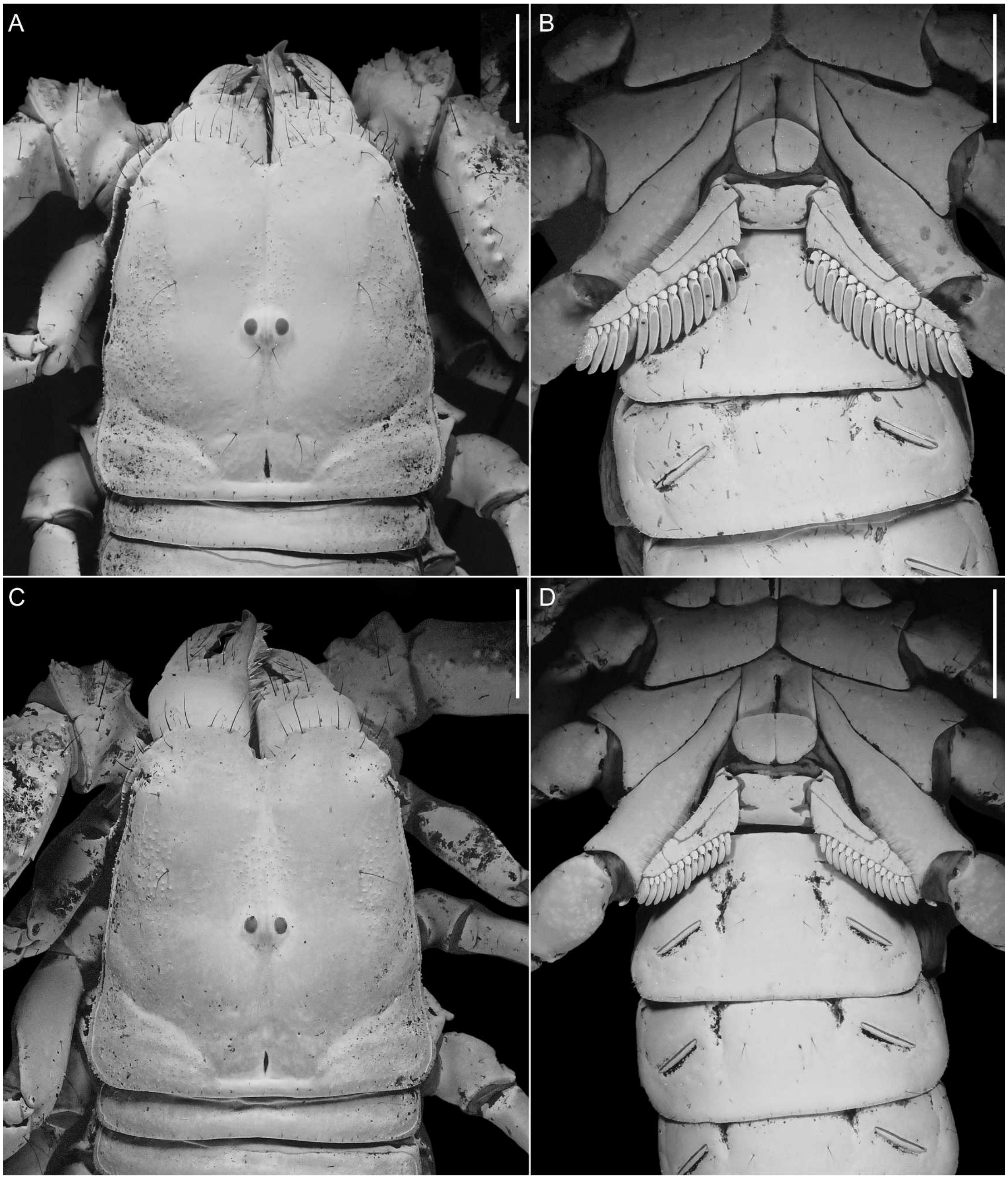


FIGURE 4. *Pandinoides cavimanus* (Pocock, 1888), carapace, dorsal aspect (**A, C**), and sternum, genital opercula, and pectines, ventral aspect (**B, D**). **A, B.** ♂ (AMNH), **C, D.** ♀ (AMNH), Mapinduzi, Tanzania. Scale bars = 5 mm.

raised, superciliary carinae higher than ocelli, not extended anteriorly or posteriorly. Interocular sulcus present. Circumocular depressions completely encircling median ocular tubercle, converging anteriorly. Posteromedian and posteromarginal sulci deep. Paired mediolateral and posterolateral sulci shallow. Circumocular depressions completely encircling median ocular tubercle, converging anteriorly. Posteromedian and posteromarginal sulci deep. Paired mediolateral and posterolateral sulci shallow. Median longitudinal suture continuous from median notch to median ocular tubercle, equally strong along entire length; not extending to anterior margin of carapace, terminating at or posterior to median notch. Anterior furcated sutures obsolete. Anterocular furcated sutures absent. Interocular suture present, slender. Posterior sutures present but less distinct than median longitudinal and interocular sutures, converging on median ocular tubercle; connected anteriorly to posterior furcations of interocular suture and extending anteriorly beyond median ocular tubercle. Interocular and circumocular surfaces sparsely and finely granular anterior to median ocular tubercle, along median longitudinal sulcus, and often on frontal lobes (fig. 4A, B). Anterolateral, mediolateral and posterolateral surfaces uniformly finely granular, more coarsely and densely so in male. Posteromedian surfaces smooth.

Pedipalps: Femur width of length, 53% (52%–53%, *n* = 4) (♂), 57% (48%–62%, *n* = 7) (♀) (table 1). Retrodorsal carina distinct, comprising several spinform granules; more strongly developed than prodorsal carina. Dorsomedian carina vestigial, reduced to prominent granule demarcated by conspicuous macroseta. Dorsal secondary carina absent. Prodorsal carina obsolete, comprising isolated subspiniform granules. Promedian carina distinct, comprising row of spiniform granules (several demarcated by conspicuous macrosetae), oriented diagonally between prodorsal and proventral carinae. Proventral carina distinct, costate-granular, more strongly developed than retroventral carina. Ventromedian, secondary accessory, and retroventral carinae absent. Retromedian carinae absent, indicated only by macrosetal rows. Prodorsal intercarinal surfaces with scattered granules; other intercarinal surfaces smooth. Patella width of length, 45% (42%–47%, *n* = 4) (♂), 44% (42%–47%, *n* = 7) (♀) (table 1). Dorsal surface convex, dorsomedian carina dorsal to plane of retrodorsal carina, obsolete, costate (fig. 5A). Retrodorsal and retromedian carinae absent. Retroventral carina obsolete, costate (fig. 5B). Promedian carina obsolete, costate, demarcated by conspicuous macroseta; anterior process absent. Other carinae absent. Intercarinal surfaces smooth. Chela short, broad, base of fixed finger arising abruptly from manus (figs. 6A, 7); manus, height of width, 66% (59%–73%, *n* = 4) (♂), 61% (56%–63%, *n* = 7) (♀); length along ventroexternal carina of width, 61% (56%–63%, *n* = 4) (♂), 62% (58%–67%, *n* = 7) (♀); length along ventroexternal carina of length movable finger, 52% (50%–57%, *n* = 4) (♂), 57% (53%–60%, *n* = 7) (♀) (table 1). Dorsomedian carina obsolete, except proximal to base of fixed finger, distinct, costate. Dorsal secondary, subdigital, retromedian,

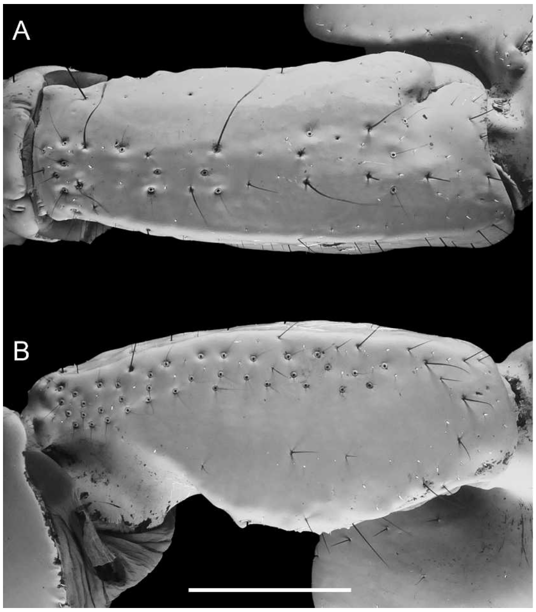


FIGURE 5. *Pandinoides cavimanus* (Pocock, 1888), ♂ (AMNH), Mapinduzi, Tanzania, dextral pedipalp patella, retrolateral (**A**) and ventral (**B**) aspects. Scale bar = 5 mm.

FIGURE 6. *Pandinoides cavimanus* (Pocock, 1888), ♂ (AMNH), Mapinduzi, Tanzania, dextral pedipalp chela, retrolateral (**A**), ventral (**B**), and prolateral (**C**) aspects. Scale bar = 5 mm.

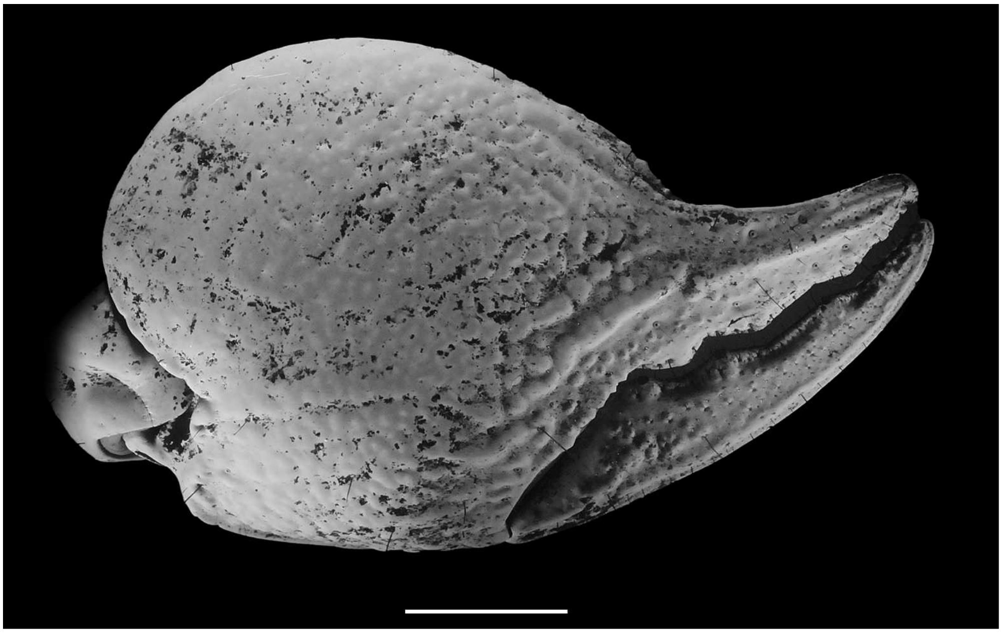


FIGURE 7. *Pandinoides cavimanus* (Pocock, 1888), ♀ (AMNH), Mapinduzi, Tanzania, dextral pedipalp chela, retrolateral aspect. Scale bar = 5 mm.

retrolateral secondary and secondary accessory carinae absent. Digital carina absent, except proximal to base of fixed finger, obsolete costate. Retroventral and ventromedian carinae distinct, costate; retroventral carina more pronounced and projecting ventral to plane of ventromedian carina (fig. 6B). Proventral and promedian carinae obsolete, granular, each indicated by prominent macroseta. Prodorsal carina absent, but indicated by prominent macroseta. Chela moderately (♂) to sparsely (♀) setose on fingers and distally on manus. Manus, retrodorsal surface with (adult ♂) or without (♀, immature stages) marked concave depression at base of fixed finger (figs. 6A, 7), predominantly smooth proximally with shallow, anastomosing granules distally; retrolateral surfaces shallowly granular; ventral intercarinal surface smooth; prolateral intercarinal surfaces predominantly smooth, with scattered spiniform granules dorsally and distally. Fixed and movable fingers, prolateral intercarinal surfaces finely granular, retrolateral intercarinal surfaces predominantly smooth (♂) or finely granular (♀); median denticle rows each with six enlarged retrolateral denticles (including terminal denticle), proximal three retrolateral denticles on fixed finger, and proximal three (♀) or second and third most proximal (♂) retrolateral denticles on movable finger situated on lobes; fixed finger with proximal lobe, similar in size (♀, immatures) or slightly smaller than medial lobe (adult ♂); movable finger (adult ♂) without proximal lobe, with median lobe markedly more pronounced than other lobes, and with correspondingly well-developed notch in fixed finger; moderate gap proximally between fingers, when closed (adult ♂); terminal denticles of fingers interlocking unevenly when closed, movable finger displaced to exterior; distinct notch near tip of fixed finger to accommodate terminal denticle of movable finger.

Trichobothria: Neobothriotaxic major, Type C, with the following segment totals (n = 25; table 1): femur, 3 (1 d, 1 i, 1 e); patella, 52 (48–55): 2 d, 1 i, 34 (31–37) v, 14 (14 or 15) e, usually comprising 3 et, 2 est, 2 em, 2 esb, 5 eb; chela, 33 (31–35), manus, 21 (19–22), comprising 2 D, 10 E, 9 (7–10) V; fixed finger, 12 (11–13), comprising 4 d, 4 e, 4 (3–5) i (figs. 5–7). Total count of trichobothria per pedipalp: 87 (83–91). Femur, i situated on dorsal surface. Patella, d_2 situated on

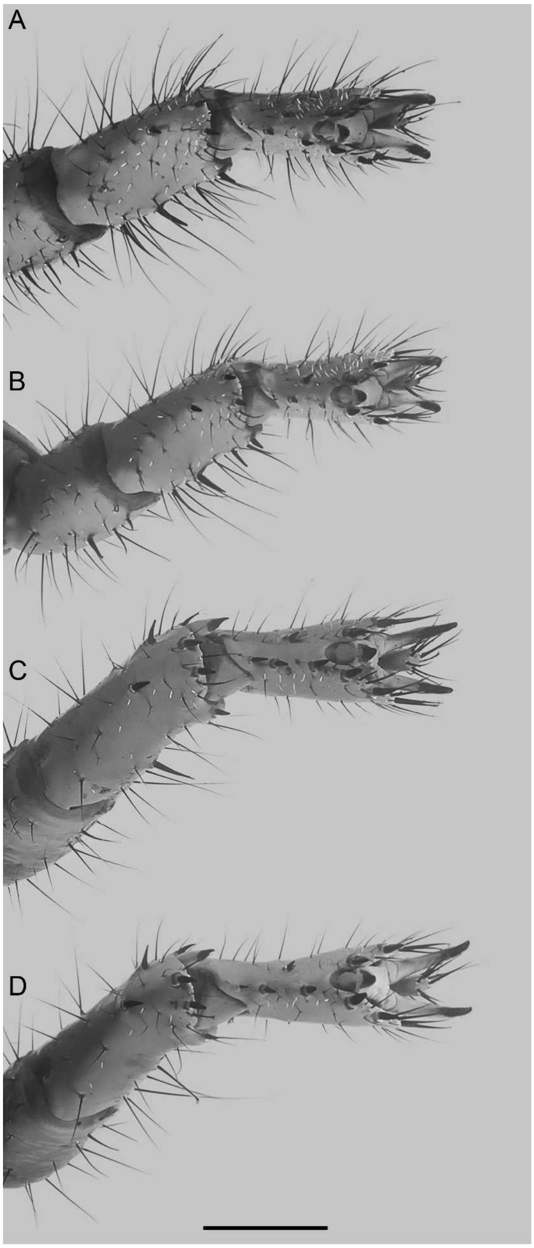


FIGURE 8. *Pandinoides cavimanus* (Pocock, 1888), ♂ (AMNH), Mapinduzi, Tanzania, legs I–IV, tibiae, basitarsi and telotarsi, ventral aspect (**A–D**). Scale bar = 2.5 mm.

dorsomedian carina, slightly closer to *d*1 than to *i*. Chela, distance *et–est* ca. half distance *est–esb*; distance *est–esb* greater than half distance *esb–eb*; *est* aligned with *dst*.

Legs: First pair of maxillary lobes (coxapophyses) tapering anteriorly, longer than and encircling second pair. Stridulatory organs, comprising "rasp" (granular tubercles) and "scraper" (stridulatory setae or scaphotrix), present on opposing surfaces of coxae of pedipalps and first pair of legs, respectively. Legs acarinate. Femora, patellae, and tibiae, pro- and retrolateral surfaces each with scattered setiform macrosetae. Tibiae, prolateral surfaces, without spiniform macrosetae; I and II, retrolateral surfaces, usually each with two spiniform (*t*, *st*) macrosetae; III and IV, retrolateral surfaces, without spiniform macrosetae. Basitarsi I–IV, prolateral pedal spurs present (fig. 8); retrolateral pedal spurs absent; retrolateral margins similar, unmodified, rounded; I and II, dorsoventrally compressed, retrolateral margin produced into bladelike edge, III and IV terete, retrolateral margin unmodified, rounded. Basitarsi, pro- and retrolateral surfaces, each with microsetae, scattered long and short setiform macrosetae, and spiniform macrosetae, more numerous on I and II than III and IV. Basitarsi, spiniform macrosetae, I, retrolateral: *t*, *st* (polymorphic), *sb*; retroventral: *t*; proventral: *t*, *st*; II, retrolateral: *t*, *st* (polymorphic), *sb*; retroventral: *t*; proventral: *t*, *st*; III, retrolateral: *t*, *sb*; retroventral: *t*; proventral: *t*, *st*; prolateral: *t*, *st*; IV, retrolateral: *t*; retroventral: *t*; proventral: *t*, *st*; prolateral: *t*, *st*. Telotarsi I–IV short, stout, and distally broadened in dorsal and lateral views. Laterodistal lobes rounded. Dorsomedian lobes approximately equal to laterodistal lobes; each terminating in single setiform macroseta. Telotarsi, pro- and retrolateral surfaces, each with scattered microsetae and setiform macrosetae; I and II, pro- and retrolateral surfaces, in addition with two or more, dense brushlike rows of long to very long setiform macrosetae. Telotarsi each with pro- and retroventral rows of spiniform macrosetae, two of which are inserted on laterodistal lobes; macrosetal counts in pro- and retroventral rows equal on telotarsi I–IV, 3 and 4 (4 or 5) (*n* = 25), respectively (table 1). Telotarsal ungues short, curved; equal on telotarsi I and II, subequal on III and IV.

Sternum: Shape subpentagonal (fig. 4B, D). Median longitudinal sulcus shallow anteriorly, deep and narrow posteriorly.

Genital Operculum: Genital opercula suboval, completely divided longitudinally, partially overlapping, genital papillae present (♂, fig. 4B); subcordate, fused, genital papillae absent (♀, fig. 4D).

Hemispermatophore: Lamelliform, with complex, folded capsule and accessory distal lobe protruding between articular suture and distal lobe (hook). Distal lamina with distal crest truncate, unfolded.

Pectines: Distal edge reaching past distal edge of coxa IV but not reaching to distal edge of trochanter IV (♂, fig. 4B) or almost reaching distal edge of trochanter IV (♀, fig. 4D). First proximal median lamella (scape) of each pecten with mesial margin obtusely angular, greater than 90° but less than 180°, and devoid of teeth in proximal 19% (14%–23%, $n = 4$) (♂) or 24% (17%–31%, $n = 7$) (♀) of prolateral margin (table 1). Pectinal teeth straight and elongate (♂) or shorter and curved (♀); tooth count, 14/14 (13–15/14–15, $n = 4$) (♂), 13/13 (12–14/12–14, $n = 7$) (♀). Fulcra smooth proximally but densely setose (microsetae only) distally.

Mesosoma: Tergites each with shallow pair of submedian depressions and obsolete median carina. Pretergites smooth and glabrous. Posttergites smooth and glabrous anteromedially, densely and coarsely granular posteromedially and laterally (♂) or smooth and glabrous medially and anterolaterally, sparsely and coarsely granular posterolaterally (♀). Sternites IV–VI, each with paired longitudinal depressions prolateral to spiracles, absent on VII. Surface, sternites III–VII, smooth; VII, with paired, costate ventrosubmedian and ventrolateral carinae, without posteromarginal carina. Sternite VII, length of width, 52% (44%–56%, $n = 4$) (♂), 56% (47%–69%, $n = 7$) (♀) (table 1).

Metasoma and Telson: Metasomal segments I–V progressively increasing in length, decreasing in width; segment V, width of segment I width, 66% (64%–68%, $n = 4$) (♂), 66% (64%–68%, $n = 7$) (♀) (table 1). Metasoma robust; width of length, segment I, 93% (90%–95%, $n = 4$) (♂), 91% (89%–93%, $n = 7$) (♀); II, 78% (74%–81%, $n = 4$) (♂), 80% (76%–86%, $n = 7$) (♀); III, 68% (65%–73%, $n = 4$) (♂), 69% (60%–77%, $n = 7$) (♀); IV, 55% (52%–57%, $n = 4$) (♂), 58% (52%–65%, $n = 7$) (♀); V, 43% (39%–48%, $n = 4$) (♂), 43% (40%–45%, $n = 7$) (♀). Telson vesicle, width of metasomal segment V, width, 111% (105%–115%, $n = 4$) (♂), 97% (87%–107%, $n = 7$) (♀); enlarged (♂), globose, height of length, 62% (58%–66%, $n = 4$) (♂), 62% (57%–65%, $n = 7$) (♀); dorsal surface flat, ventral surface evenly curved. Aculeus relatively short, strongly curved, length of vesicle length, 32% (31%–34%, $n = 4$) (♂), 37% (33%–40%, $n = 7$) (♀). Length, metasoma and telson, of total length, 54% (52%–56%, $n = 4$) (♂), 51% (49%–53%, $n = 7$) (♀). Dorsosubmedian carinae, segments I–IV, distinct, complete, costate-granular, posterior spiniform granules obsolete; V, absent (fig. 9A). Dorsolateral carinae, segments I–V, distinct, complete, costate-granular on I–IV, granular on V. Median lateral carinae, segment I, obsolete, granular, reduced to posterior two-thirds, II–V, absent, demarcated by macroseta at posterior margin on II–IV and near anterior margin on V (fig. 9B). Ventrolateral and ventrosubmedian carinae more strongly developed on segments I and II than on segments III and IV (fig. 9C). Ventrolateral carinae, segments I–IV, distinct, complete, costate on I–III, costate-granular on IV; V, distinct, complete, diverging posteriorly, comprising subspiniform granules, terminal granule similar in size to preceding granules. Ventrosubmedian carinae, segments I–IV, distinct, complete, costate; V, vestigial, each reduced to discontinuous row of spiniform granules, demarcated by macrosetae. Ventromedian carina, segment V, comprising single row of spiniform granules, unmodified posteriorly. Ventral surface, lateral aspect, segment IV, shallowly convex. Anal arch, segment V, dorsal carina, costate; ventral carina comprising subspiniform granules. Dor-

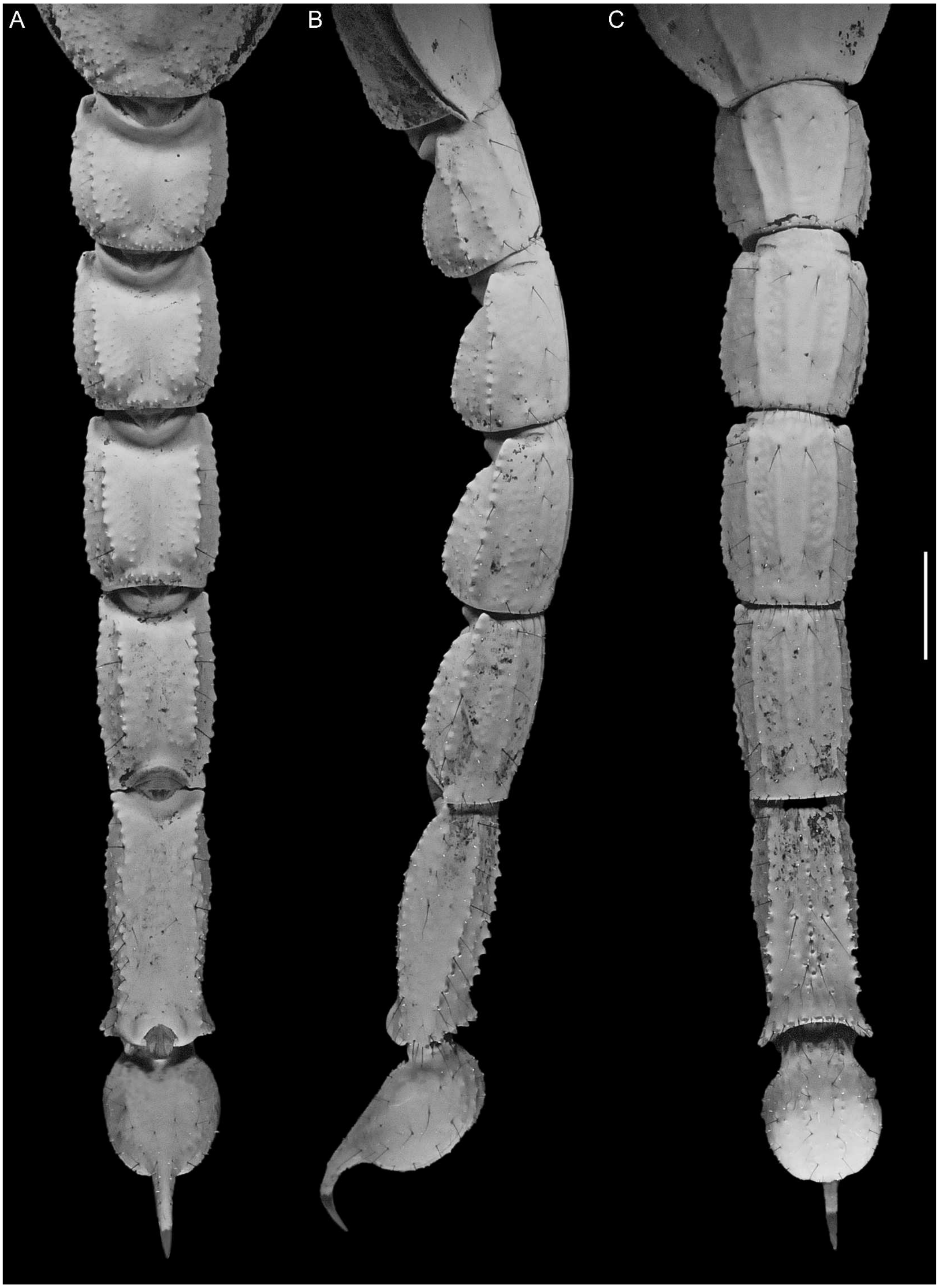


FIGURE 9. *Pandinoides cavimanus* (Pocock, 1888), ♂ (AMNH), Mapinduzi, Tanzania, metasoma and telson, dorsal (**A**), lateral (**B**), and ventral (**C**) aspects. Scale bar = 5 mm.

sal and lateral intercarinal surfaces, segments I–IV, finely and sparsely granular; V, smooth. Ventral intercarinal surfaces, segments I–IV, smooth; V with scattered granules. Telson vesicle, dorsal and lateral surfaces smooth; ventral surface with four obsolete longitudinal carinae, each comprising isolated spiniform granules, restricted to anterior half or third of vesicle.

Geographical Variation: All except three specimens examined were dark brownish black in color. One specimen with an indefinite locality in "East Africa" (BMNH) and two of the five male specimens labelled "Ugogo district, German East Africa" (BMNH 1914.7.3.3–7) were reddish brown in color, resembling *P. militaris*.

Ontogenetic Variation: Immature males and females closely resemble each other, and adult females, in general morphological features, but can be sexed by examination of the pectines and genital operculum. Males acquire secondary sexual characters in the final instar. In the specimens examined for this study, sexual maturity was determined by the presence of a marked concave depression in the retrodorsal surface of the pedipalp chela manus, at the base of the fixed finger in males (fig. 6A) and a fully developed ovariuterus or the gravid condition in females.

Sexual Dimorphism: The characters of primary external sexual dimorphism are the undivided genital operculum, which opens in a single flap in the female (fig. 4D), compared with the two unconnected sclerites, which open independently and cover a pair of genital papillae in the male (fig. 4B). Additionally, males possess larger pectines (fig. 4B, D) with a greater number of pectinal teeth (table 1). The most obvious secondary sexual characters observed in adult males, compared with adult females and juveniles of both sexes, concern the modifications of the pedipalp chela: a marked concave depression is present in the retrodorsal surface of the manus, at the base of the fixed finger; the proximal lobe of the movable finger is absent; the median lobe of the movable finger is markedly more pronounced than the other lobes; and a moderate gap is present proximally between the fingers, when closed (fig. 6A).

Distribution: *Pandinoides cavimanus* appears to be endemic to Tanzania (fig. 2). Records from Kenya are referable to *P. duffmackayi*, sp. nov., or *P. militaris*, those from Ethiopia or Somalia, including the (immature) female on the cover of Kovařík (2009), to *P. militaris*. Records of *P. cavimanus* from northeastern Tanzania, including Kilimanjaro (Pocock, 1888), Arusha (Werner, 1936), and Naberera (Kovařík, 2009) are referable to *P. duffmackayi*, sp. nov. Most of the known locality records of *P. cavimanus* occur in the central part of Tanzania, in the Dodoma, Iringa, Shinyanga, and Singida provinces. Records from the eastern shore of Lake Tanganyika and Bukoba on the western shore of Lake Victoria/Nyanza (Kraepelin, 1913; Birula, 1915b) await confirmation. This species does not occur in the northeast of the Democratic Republic of Congo (formerly Zaïre), as stated by Kovařík (1998, 2009) and Fet (2000), nor in Mozambique, as stated by Kovařík (1998).

Ecology: The known locality records of *P. cavimanus* occur in arid savannah, dominated by *Acacia* Mill. and *Commiphora* Jacq. at 1010–1120 m elevation. Most specimens, for which data are available, were excavated from burrows during the day. *Pandinoides cavimanus* is fossorial, constructing burrows in compacted clayey to sandy-loam soils. It is allopatric with *P. militaris* and parapatric with *P. duffmackayi*, sp. nov., and *Pandinurus viatoris* (Pocock, 1890), but sympatric with another scorpionid, *Opistophthalmus boehmi* (Kraepelin, 1896).

Conservation: This species is protected in the Ruaha National Park.

Remarks: Pocock (1888: 249) noted that: "The specimen from Kilima-Njaro is smaller and slightly less granular than the [type] from Umyamuezi." The smaller specimen is conspecific with *P. duffmackayi*.

In discussing the differences in coloration between *P. exitialis* and *P. gregoryi*, which Kovařík (2003) mistakenly synonymized with the former, Kovařík (2009: 55) remarked that:

> Most of *Pandinus* species are based on unqiue specimens. While I studying [sic] the holotype of *P. gregoryi*, I was convinced that *P. gregoryi* is a synonym of *P. exitialis* (see Kovařík, 2003: 151). Subsequently I had an opportunity to study and breed both populations, *P. exitialis* from southern Somalia and *P. gregoryi* from central Kenya [*P. exitialis* has since also been recorded from central Kenya (L. Prendini, unpublished data)], and can state that they are similar but nevertheless separate species which can be distinguished by granulation on dorsal side of the pedipalp manus – in *P. gregoryi* tuberculate but without conical granules of equal size, which in contrast characterize *P. exitialis*. Coloration is also different, especially the pedipalp chela is much lighter in *P. exitialis* than in *P. gregoryi*. However, differences in color should not be regarded as a decisive taxonomic criterion, which can be well demonstrated e.g. on the example of *P. cavimanus*, whose coloration is very variable in both juveniles and adults throughout the geographic range of this species."

Whereas it is indeed true that color may vary both within and among conspecific populations of some scorpion species, e.g. *Hadrurus arizonensis* Ewing, 1928, each case must be assessed on its own merits. Variation in color pattern (rather than color itself) is often both consistent and congruent with variation in other morphological (and indeed, genetic) characters, as described by Kovařík (2009) in the closely related *P. exitialis* and *P. gregoryi*, and the three closely related species of *Pandinoides* covered in the present contribution. Valid taxa, e.g., *P. gregoryi* and *P. militaris*, may be mistakenly synonymized when differences in coloration are dismissed out of hand without detailed investigation of other characters.

ADDITIONAL MATERIAL EXAMINED: 1 ♂ (NM 18769). East Africa, 1 ♂ (BMNH). **TANZANIA:** Imported for pet trade: 2 ♂ (AMNH), 1 ♀ (AMCC [LP 3250]), 1 ♀ (AMNH), [leg] (AMCC [LP 3259]), ix.2002, ex R. MacInnes, 1 subad. ♀ (AMNH), [leg] (AMCC [LP 2161]), vii.2007, ex J. Huff, 1 ♂ (AMCC [LP 7084]), iii.2008, ex A. Tietz, 1 subad. ♀ (AMNH), [pedipalp] (AMCC [LP 8271]). Ugogo district, German East Africa, Dr. E.J. Baxter, 5 ♂ (BMNH 1914.7.3.3-7), 1 ♀, 1 subad. ♂ (BMNH 1914.7.3.8–9). **Dodoma Prov.:** *Dodoma Distr.*: Dodoma [06°10′S 035°45′E], G.E.A., 8.xii.1918, A. Loveridge, 2 ♂ (MCZ 15519), 1 subad. ♀, 4 juv. (MCZ 15513), 1 ♂ (BMNH 1923.11.8.9); Dodoma, brought in by dealer, 1 ♂, 1 juv. ♂ (ZMUC); Mapinduzi Village, Dodoma region [06°11′S 035°45′E], ix.2006, J. Beraducci, found in ground, 3 ♂, 3 ♀, 2 subad. ♂, 1 subad. ♀ (AMNH), 1 juv. ♀ (AMCC [LP 8918]), x.2006, J. Beraducci, 1 ♂, 3 ♀, 1 subad. ♂ (AMNH). *Kongwa Distr.*: Kongwa [06°12′S 036°25′E], 21.iv.1918, A. Loveridge, 1 ♀ (MCZ 15522). *Mpwapwa Distr.*: Mpapua [Mpwapwa, 06°21′S 036°29′E], 1899, 1 ♂ (SAM 5111 ex ZMH). **Iringa Prov.:** *Iringa Distr.*: Ruaka [Ruaha] National Park [07°40′S 034°52′E], 1979, K.M. Howell, 1 ♂ (MRAC 159.373). **Singida Prov.:** *Manyoni Distr.*: Ikikuyu [Kikuyu, 05°52′S 035°04′E], 12.ii.1923, A. Loveridge, 1 ♂, 1 subad. ♂ (MCZ 15514), 1 ♂, 1 juv. ♂ (MCZ 15518), 1.xi.1923, A. Loveridge, 1 ♂ (MCZ 15521), 12.xi.1923, A. Loveridge, 1 juv. ♂ (MCZ 15516); Kikuyu, Dodoma, 21.xii.1929, A. Loveridge, 2 ♂, 1 ♀ (MCZ 15515).

ERRONEOUS RECORDS: Florida, U.S.A., New Bold's 5-10, Clubmont (introduction), vii.1965, University of Florida Collections, 1 ♂ (FSCA). Stanley Falls [Tshopo Prov., Democratic Republic of Congo], 00°30′N 025°12′E, 1 ♂ (MRAC 4669). Based on the known localities, the record from Stanley Falls is assumed to be a labeling error.

Pandinoides duffmackayi, sp. nov.

Figures 1C, 2, 10–16; tables 2, 3

Scorpio cavimanus: Pocock, 1888: 249 (part); Pocock, 1896: 431, 432 (part).;

Pandinus cavimanus: Kraepelin, 1899: 121, 122 (part); 1913: 183 (part); Werner, 1936: 185, 186 (part); Probst, 1973: 327 (part).

Pandinus (*Pandinoides*) *cavimanus*: Lamoral and Reynders, 1975: 564 (part); Fet, 2000: 468 (part); Kovařík, 2009: 1, 50, 52, 114 (part), table 3 (part), figs. 286, 290 [misidentification].

HOLOTYPE: ♂ (AMNH), **TANZANIA: Arusha Prov.:** *Arumeru Distr.*: Majengo Village,

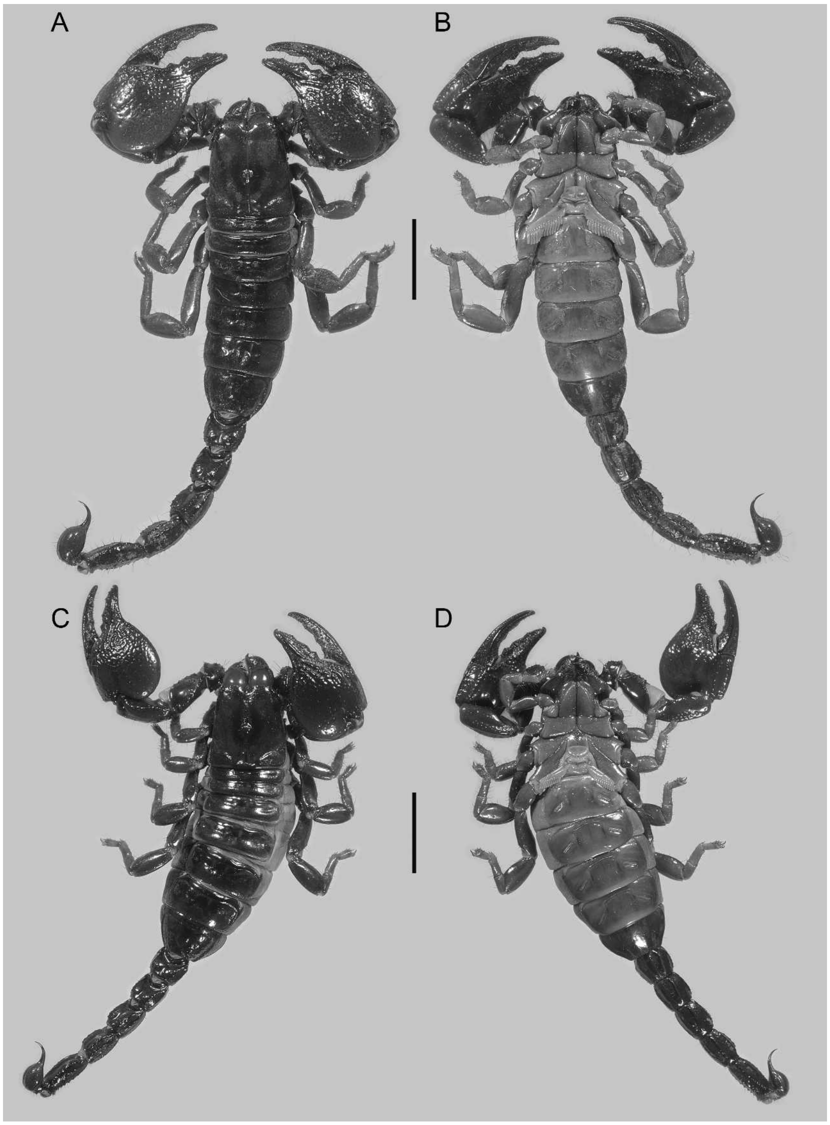


FIGURE 10. *Pandinoides duffmackayi*, sp. nov., habitus, dorsal (**A, C**) and ventral (**B, D**) aspects. **A, B.** Holotype ♂ (AMNH), **C, D.** Paratype ♀ (AMNH), Kikatitti, Tanzania. Scale bars = 10 mm.

Kikatitti [03°23′S 036°57′E], near Kilimanjaro International Airport, ix.2006, J. Beraducci, found in holes in the earth.

Paratypes: **KENYA: Eastern Prov.:** *Machakos Distr.*: Athi yu Mawe [01°27′S 036°59′E], C.S. Betton, 1 ♂ (BMNH 1899.7.31.1); Nairobi, Athi River, 01°27′S 036°59′E, xi.1945, 1 ♀ (NMK 231 old 6). **Rift Valley Prov.:** *Kajiado Distr.*: near Hunters Lodge [02°12′S 037°40′E], 1977, Mrs. Fordyce, 1 ♀ (NMK 234 old 107); Kajiado town, 01°51′S 036°47′E, J.P.E.C. Darlington, 1 ♀, 2 1st instars (NMK 557); Kiseria Ngong [Kiserian, 01°24′S 036°49′E], 15.iii.1983, J. Sylvester, 1 ♀ (NMK 230); Namanga, 13 mi. N, 02°24′S 036°50′E, 4350 ft, 19.ix.1976, A. Duff-Mackay, dug from hole 10 x 25.2 mm in red sand, dry *Aca-*

cia/Commiphora, 1 ♀ (NMK 232 old 75), dug from hole 14.6 x 31.3 mm in red sand, dry *Acacia/Commiphora*, 1 ♂ (NMK 233 old 76); Ngong hills, NW of, 01°21′S 036°35′E, 5800 ft, 17.x.1976, A. Duff-Mackay, dug out of multiple-entrance burrow, lava rocks, *Acacia*, lileshwa [*Tarchonanthus camphoratus* L.], 1 ♀ (NMK 235 old 91), 2 ♂, 1 ♀ (NMK 236 old 92), dug from burrow, lava rocks, *Acacia*, lileshwa, 1 ♀, 3 juv. ♂, 3 juv. ♀ (NMK 237 old 93), 1 subad. ♂ (NMK 238 old 90); Ngong hills, SW of, 01°23.5′S 036°35′E, 8.ix.1982, R. Drewes and A. Duff-Mackay, dug from nest 225 mm underground, 80 mm diam. by 25 mm height, length large burrow 535 mm, 3 small holes and 1 large, new diggings outside and inside blocked most of way, food: segments of millipede, open ground near brush, sparse grass heavily grazed, 2 juv. ♂, 6 juv. ♀ (NMK 239 old 289). **TANZANIA:** Imported for pet trade: 3 ♂ (AMNH), [leg] (AMCC [LP 3258]), 1 ♀ (AMNH), 1 ♀ (AMCC [LP 3249]), xi.1997, ex F. Somma, 1 ♂, 1 juv. ♀ (AMCC [LP 1600]), 3.x.2007, ex A. Tietz, 1 juv. ♂ (AMCC [LP 7294]). **Arusha Prov.:** *Arumeru Distr.*: Kikatitti [03°23′S 036°57′E], near Kilimanjaro International Airport, x.2006, J. Beraducci, 2 ♂, 1 subad. ♂, 5 juv. ♀ (AMNH), 1 juv. ♀ (AMCC [LP 8335]); Majengo Village, Kikatitti, near Kilimanjaro International Airport [03°23′S 036°57′E], ix.2006, J. Beraducci, found in holes in the earth, 2 ♂, 3 ♀, 1 juv. ♂, 3 juv. ♀ (AMNH). **Kilimanjaro Prov.:** Kilimanjaro [03°04′S 037°22′E], M.J. Jackson, 1 ♂ (BMNH 1887.147).

ETYMOLOGY: The specific epithet is a patronym in honor of Alexander Duff-Mackay (1939–2003), a herpetologist described as "one of the most knowledgeable biologists in East Africa" (Schiøtz, 2003: 1) who worked at the National Museums of Kenya, Nairobi from 1964 to 1995. Duff-Mackay was very interested in scorpions (Spawls et al., 2004: 7) and, using ultraviolet light detection and traditional methods, collected many large series in Kenya, including most of the type series of the new species, recording detailed notes about their habitat and ecology that have greatly aided our understanding of the taxonomy, distribution, and ecology of the scorpions of East Africa.

DIAGNOSIS: *Pandinoides duffmackayi*, sp. nov., may be separated from *P. cavimanus* and *P. militaris*, as follows. *Pandinoides duffmackayi*, sp. nov., is reddish brown to reddish black in color (fig. 1C), whereas *P. cavimanus* is usually brownish black (fig. 1A, B), rarely reddish brown, and *P. militaris*, yellowish brown (fig. 1D) to reddish brown. *Pandinoides duffmackayi*, sp. nov., is smaller, with total adult body length 60–78 mm, carapace length 10–13 mm and chela length 14–19 mm (tables 2, 3), than *P. cavimanus*, with total adult body length 87–111 mm, carapace length 15–18 mm and pedipalp chela length 21–29 mm (table 1), and *P. militaris*, with total adult body length 95–123 mm, carapace length 17–19 mm, and chela length 25–35 mm (tables 4, 5). The ventral surface of the telson vesicle of the male is smooth or nearly so in *P. duffmackayi*, sp. nov. (fig. 16B, C), but bears obsolete carinae, each comprising isolated spiniform granules, restricted to its anterior half or third, in *P. cavimanus* (fig. 9B, C), and distinct carinae, each comprising prominent spiniform granules, extending its entire length, in *P. militaris* (fig. 23B, C). *Pandinoides duffmackayi*, sp. nov., bears 74–82 trichobothria on the pedipalp, with 39–45 trichobothria on the patella, including 22–28 in the *v* series, whereas *P. cavimanus* bears 83–91 trichobothria on the pedipalp, with 48–55 trichobothria on the patella, including 31–37 in the *v* series, and *P. militaris* bears 84–93 trichobothria on the pedipalp, with 47–55 trichobothria on the patella, including 30–38 in the *v* series. The proximal lobe on the pedipalp chela fixed finger of the adult male is similar in size to the medial lobe, creating little to no gap proximally between the fixed and movable fingers, when closed in *P. duffmackayi*, sp. nov. (fig. 13A), whereas the proximal lobe is slightly smaller than the medial lobe, creating a moderate gap proximally between the fingers, when closed in *P. cavimanus* (fig. 6A), and it is vestigial, much smaller than the medial lobe, or absent, creating a prominent gap proximally between the fingers, when closed, in *P. militaris* (fig. 20A). The pectinal tooth count of *P. duffmackayi*, sp. nov., with 11–13, usually 12 (♂) and 10–12, usually 11 (♀), is lower than that of *P. cavimanus*, with 14 or 15, usually 14 (♂), and 13 or 14, usually 13 (♀), and *P. militaris*, with 14–16, usually 14 (♂), and 13–15, usually 14 (♀). The prolateral *t* and *st* macrosetae are setiform on basitarsi III, and *t* setiform and *st* spiniform on IV, in *P. duffmackayi,* sp. nov., whereas *t* and *st* are spiniform on II and IV in *P. cavimanus* and *P. militaris*.

Based on unpublished genetic data, *P. duffmackayi*, sp. nov., is most closely related to *P. cavimanus*, from which it may be further separated as follows. The interocular and circumocular surfaces of the carapace are smooth, or nearly so, in *P. duffmackayi*, sp. nov. (fig. 11A, C), but sparsely and finely granular anterior to the median ocular tubercle, along the median longitudinal sulcus, and often on the frontal lobes in *P. cavimanus* (fig. 4A, C). The metasoma of *P. duffmackayi*, sp. nov., is 49%–53% (♂) and 46%–49% (♀) of total body length, the summed lengths of segments IV and V, 105%–116% (♂) and 91%–110% (♀) of carapace length (tables 2, 3), whereas the metasoma of *P. cavimanus* is 52%–56% (♂) and 49%–53% (♀) of total body length, the summed lengths of segments IV and V, 115%–130% (♂) and 107%–120% (♀) of carapace length (table 1). The dorsal surfaces of metasomal segments I–IV in the male are smooth in *P. duffmackayi*, sp. nov. (fig. 16A), but finely and sparsely granular in *P. cavimanus* (fig. 9A).

Pandinoides duffmackayi, sp. nov., may be further separated from *P. militaris* as follows. The carapace is less compressed, dorsoventrally, in *P. duffmackayi*, sp. nov. (fig. 11A, C), than in *P. militaris* (fig. 18A, C). The median ocular tubercle is posteromedial, its distance from the anterior carapace margin 51%–56% of the carapace length in *P. duffmackayi*, sp. nov. (tables 2, 3), but medial, its distance from the anterior carapace margin 46%–52% of the carapace length in *P. militaris* (tables 4, 5). The ventrosubmedian carinae on metasomal segment IV are distinct, costate in *P. duffmackayi*, sp. nov. (fig. 16C), but obsolete, granular in *P. militaris* (fig. 23C). The chela manus of *P. duffmackayi*, sp. nov., is broader, the length along the retroventral carina 56%–70% (♂) and 57%–70% (♀) of the width, and more convex, the height 58%–77% (♂) and 59%–94% (♀) of the width, than the manus of *P. militaris*, in which the length along the retroventral carina is 64%–76% (♂) and 62%–72% (♀) of the width, and the height 49%–68% (♂) and 64%–73% (♀) of the width. The chela fixed finger of *P. duffmackayi*, sp. nov., arises abruptly from the manus and is wider proximally (figs. 13A, 14) than that of *P. militaris*, which arises more gradually from the manus (figs. 20A, 21). The chela fingers and distal surfaces of the manus are moderately (♂) to sparsely (♀) setose in *P. duffmackayi*, sp. nov. (fig. 1C), but densely (♂) to moderately (♀) setose in *P. militaris* (fig. 1D). *Pandinoides duffmackayi*, sp. nov., bears 31–34 trichobothria on the pedipalp chela, including 7–10 in the *V* series, whereas *P. militaris* bears 33–36 trichobothria on the chela, including 9–12 in the *V* series. The angle of the first proximal median lamella (scape) of the pecten is smaller (more acute), especially in the female, of *P. duffmackayi*, sp. nov. (fig. 11B, D), compared with *P. militaris* (fig. 18B, D).

DESCRIPTION: The following account is based on the type material. Only characters that differ from *P. cavimanus* are described.

Total Length: Adult medium, maximum length, measured from anterior margin of carapace to tip of aculeus, 70 mm (60–75 mm, $n = 8$) (♂), 69 mm (61–78 mm, $n = 9$) (♀) (tables 2, 3).

Color: Chelicerae, dorsal surfaces bicolored, proximal three-quarters of manus dorsal surface sparsely infuscate, paler than carapace and densely infuscate distal quarter of manus dorsal surface and fingers. Tergites, sternite VII, metasoma, telson and pedipalp chela fingers densely infuscate, brownish black, telson similar to metasoma; carapace lateral and posterior surfaces, pedipalp trochanter, femur, patella pro- and retrolateral surfaces infuscate but paler, dark reddish brown; carapace interocular and circumocular surfaces, pedipalp patella ventral surface and chela manus dorsal, lateral and ventral surfaces immaculate, markedly paler, light reddish brown. Coxosternal region, sternites

TABLE 2

Meristic data for adult male type specimens of *Pandinoides duffmackayi*, sp. nov., in the American Museum of Natural History, New York (AMNH) and the National Museums of Kenya, Nairobi (NMK).

Measurements (mm) follow Prendini (2000): [1]sum of carapace, tergites I–VII, metasomal segments I–V, and telson; [2]distance from anterior carapace margin; [3]sum of metasomal segments I–V and telson; [4]distance from base of condyle to tip of fixed finger. Counts of pectinal teeth, spiniform macrosetae of telotarsi and pedipalp trichobothria reflect sinistral (s) and dextral (d) sides. Setal counts include areolar cups (sockets), if setae broken.

Specimen	Locality	Kikatitti					Ngong		Namanga
	Collection	AMNH	AMNH	AMNH	AMNH	AMNH	NMK	NMK	NMK
	Number						236	236	233
	Type	holo.	para.	para.	para.	para.	para.	para.	para.
Total length[1]		70.6	60.2	68.7	74.7	72.1	68.9	70.9	74.4
Carapace	anterior width	7.7	6.7	7.7	8.3	7.8	8.0	8.1	7.9
	posterior width	10.6	8.6	10.8	11.2	10.2	9.9	11.8	11.6
	length	11.4	9.7	11.5	11.7	11.0	11.9	12.2	12.2
	median ocelli[2]	6.4	5.2	5.9	6.4	6.0	6.7	6.6	6.4
Tergite I	length	1.5	1.6	1.5	1.6	1.8	1.8	1.2	1.5
Tergite II	length	2.1	1.7	2.0	2.3	2.3	1.9	1.9	1.6
Tergite III	length	3.0	2.6	2.8	3.6	3.0	2.6	3.1	2.9
Tergite IV	length	3.5	3.1	3.3	3.9	3.7	3.4	3.2	3.6
Tergite V	length	3.9	3.7	3.7	4.2	4.2	3.6	3.3	4.4
Tergite VI	length	4.3	3.8	4.2	4.7	4.5	4.3	3.4	5.2
Tergite VII	length	5.1	4.2	4.9	5.4	5.5	5.2	5.1	6.1
Sternite VII	length	5.7	4.0	5.2	5.4	5.7	4.9	4.7	5.6
	width	8.1	6.8	8.1	9.0	8.6	8.6	10.1	9.1
Mesosoma	total length (tergites)	23.3	20.6	22.3	25.6	25.0	22.8	21.2	25.4
Metasoma I	length	4.4	3.9	4.7	5.5	5.1	4.0	5.0	5.2
	width	4.8	4.3	4.9	5.2	4.9	5.0	5.2	5.7
Metasoma II	length	5.0	4.2	5.2	5.7	5.3	5.0	5.6	5.4
	width	4.2	3.8	4.4	4.5	4.2	4.3	4.8	5.1
Metasoma III	length	5.4	4.6	5.4	5.8	5.6	5.5	5.7	5.5
	width	4.0	3.7	4.2	4.4	4.1	3.9	4.6	4.8
Metasoma IV	length	6.1	5.0	5.7	5.9	5.7	6.0	6.2	6.4
	width	3.7	3.3	3.9	4.1	3.7	3.7	3.9	4.3
Metasoma V	length	7.1	6.0	7.1	7.1	6.9	6.5	7.2	7.1
	width	3.2	3.0	3.3	3.6	3.2	3.0	3.3	3.6
Telson	vesicle length	5.0	4.0	4.6	4.9	4.9	4.6	4.9	5.1
	vesicle width	3.3	2.9	3.3	3.8	3.6	3.2	3.9	4.0
	vesicle height	2.9	2.6	3.1	3.5	3.5	2.5	2.9	3.2
	aculeus length	2.9	2.2	2.3	2.6	2.6	2.6	3.0	2.2
	total length	7.8	6.2	6.8	7.5	7.6	7.2	7.9	7.3
Metasoma	total length[3]	35.9	29.8	35.0	37.5	36.1	34.2	37.5	36.8
Femur	length	6.8	6.3	7.0	7.6	7.1	7.7	7.7	6.8
	width	3.9	3.5	4.1	4.4	3.8	4.1	4.2	4.5
Patella	length	9.0	7.5	8.6	9.5	8.7	8.4	9.5	10.3
	width	4.1	4.3	3.6	4.0	3.5	4.1	4.1	4.2
Chela	length[4]	17.7	13.9	18.4	17.9	17.0	17.6	17.6	17.8
	width	10.5	8.9	10.7	11.1	10.4	10.4	11.3	11.0
	height	7.4	6.8	8.1	8.3	7.1	6.0	8.1	7.9
	length retroventral carina	7.4	5.2	6.5	6.8	6.2	5.9	7.0	7.0
	length movable finger	11.5	9.0	12.3	11.8	11.3	12.2	13.1	12.0
Pectines	total length	5.3	4.9	5.9	5.9	5.5	6.1	5.7	5.9
	length dentate margin	4.3	4.3	4.7	4.8	4.2	4.9	4.6	4.7
	tooth count (s/d)	13/13	13/13	5+/12	12/13	12/13	13/12	12/12	11/12
Telotarsi I	prolateral row (s/d)	3/3	3/3	3/3	3/3	3/3	3/2	3/2	2/3
	retrolateral row (s/d)	3/3	3/3	3/3	3/3	3/3	3/3	3/2	3/3
Telotarsi II	prolateral row (s/d)	3/3	3/2	3/3	3/3	3/3	3/3	3/3	3/2
	retrolateral row (s/d)	3/3	3/3	3/3	3/3	3/3	2/3	3/3	3/3
Telotarsi III	prolateral row (s/d)	4/4	4/4	4/4	4/4	4/4	3/3	4/4	3/4
	retrolateral row (s/d)	4/3	4/3	4/4	4/4	4/4	4/4	4/4	3/4
Telotarsi IV	prolateral row (s/d)	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4
	retrolateral row (s/d)	4/4	4/4	4/4	4/4	4/4	3/4	4/4	4/4
Trichobothria	patella *e* (s/d)	15/15	14/14	15/15	14/15	14/14	14/14	14/14	14/14
	patella *v* (s/d)	27/26	27/28	25/26	26/27	27/27	23/25	25/25	23/23
	patella total (s/d)	45/44	44/45	43/44	43/45	44/44	40/42	42/42	40/40
	chela manus *V* (s/d)	10/9	10/9	8/8	9/9	8/9	7/8	7/7	7/7
	chela manus total (s/d)	22/21	22/21	20/20	21/21	20/21	19/20	19/19	19/19
	chela finger *i* (s/d)	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4
	chela finger total (s/d)	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12
	chela total (s/d)	34/33	34/33	32/32	33/33	32/33	31/32	31/31	31/31
	pedipalp total (s/d)	82/80	81/81	78/79	79/81	79/80	74/77	76/76	74/74

TABLE 3

Meristic data for adult female type specimens of *Pandinoides duffmackayi*, sp. nov., in the American Museum of Natural History, New York (AMNH) and the National Museums of Kenya, Nairobi (NMK).

Measurements (mm) follow Prendini (2000): [1]sum of carapace, tergites I–VII, metasomal segments I–V, and telson; [2]distance from anterior carapace margin; [3]sum of metasomal segments I–V and telson; [4]distance from base of condyle to tip of fixed finger. Counts of pectinal teeth, spiniform macrosetae of telotarsi and pedipalp trichobothria reflect sinistral (s) and dextral (d) sides. Setal counts include areolar cups (sockets), if setae broken.

Specimen	Locality	Kikatitti			Namanga	Hunter's Lodge	Ngong			Kajiado
	Collection	AMNH			NMK	NMK	NMK			NMK
	Number				232	234	235	236	237	557
	Type	para.	para.	para.	para.	para.	para.	para.	para.	para.
Total length[1]		60.9	63.9	64.9	69.7	64.2	70.4	69.9	77.8	77.0
Carapace	anterior width	6.9	6.9	6.4	7.8	7.0	8.6	8.4	9.3	8.4
	posterior width	9.1	9.8	9.5	10.9	10.9	12.8	12.0	12.5	12.3
	length	9.7	10.6	10.6	11.2	10.2	12.9	12.6	13.2	12.7
	median ocelli[2]	5.3	5.6	5.4	6.2	5.5	6.6	6.8	7.0	6.6
Tergite I	length	1.6	1.4	1.6	1.6	2.0	1.6	1.6	2.0	2.0
Tergite II	length	1.8	2.0	2.3	2.3	2.5	2.0	1.8	2.0	2.7
Tergite III	length	2.7	2.9	3.0	3.3	3.2	2.8	2.7	3.5	3.1
Tergite IV	length	3.3	3.5	3.3	3.8	3.9	3.0	3.7	4.2	4.0
Tergite V	length	3.7	3.8	4.1	4.4	4.0	3.9	4.4	5.2	4.6
Tergite VI	length	4.2	4.1	4.4	4.5	4.2	4.1	4.4	5.5	5.5
Tergite VII	length	5.2	5.3	5.7	5.3	5.0	6.0	5.1	6.2	6.3
Sternite VII	length	5.2	4.8	5.3	4.8	4.6	5.4	4.5	6.1	5.7
	width	8.2	7.7	6.1	9.1	8.5	10.3	9.7	10.5	9.7
Mesosoma	total length (tergites)	22.3	22.9	24.2	25.2	24.8	23.3	23.6	28.5	28.0
Metasoma I	length	4.0	3.7	3.9	4.6	4.3	4.3	4.9	5.2	5.1
	width	4.3	4.2	4.7	4.9	4.5	5.1	6.4	5.2	5.1
Metasoma II	length	4.1	4.1	4.2	4.7	4.4	4.4	5.1	5.6	5.4
	width	3.7	4.0	4.2	4.5	4.1	4.7	5.0	4.8	4.8
Metasoma III	length	4.4	4.7	4.6	4.8	4.5	5.3	5.5	5.8	6.0
	width	3.4	3.8	3.8	4.2	3.7	4.3	4.4	4.2	4.5
Metasoma IV	length	4.7	5.0	4.8	5.5	4.7	5.8	5.7	6.0	6.3
	width	3.1	3.4	3.4	3.7	3.3	3.8	4.4	3.6	3.9
Metasoma V	length	6.0	6.4	6.4	6.9	5.2	6.9	5.8	6.6	6.5
	width	2.8	3.1	2.8	3.2	3.1	3.3	4.0	3.4	3.7
Telson	vesicle length	3.5	3.8	3.7	4.3	4.0	4.9	4.2	3.3	4.4
	vesicle width	2.6	2.8	2.9	3.0	3.0	3.2	3.2	3.0	3.5
	vesicle height	2.3	2.4	2.5	3.0	2.5	2.9	2.3	2.8	3.0
	aculeus length	2.3	2.6	2.6	2.5	2.2	2.7	2.4	2.5	2.7
	total length	5.8	6.4	6.3	6.8	6.2	7.6	6.6	6.8	7.1
Metasoma	total length[3]	28.9	30.3	30.1	33.3	29.2	34.2	32.8	36.1	36.3
Femur	length	5.7	6.5	6.4	7.2	6.6	8.3	7.5	7.7	7.9
	width	3.3	3.3	4.1	3.6	3.3	5.5	3.8	4.4	4.2
Patella	length	7.9	8.1	7.8	8.9	7.8	9.9	9.4	8.9	9.2
	width	2.9	3.1	3.6	3.5	3.3	4.3	5.1	4.4	4.1
Chela	length[4]	14.7	15.7	15.4	15.9	13.9	18.2	17.6	17.5	17.9
	width	9.0	9.5	8.2	9.9	8.3	11.0	11.0	10.4	11.0
	height	5.4	7.0	7.7	7.4	6.7	8.8	8.7	6.2	8.2
	length retroventral carina	5.4	5.5	5.8	6.2	5.3	6.9	6.8	6.0	6.4
	length movable finger	9.2	10.6	9.6	10.9	10.3	12.9	12.8	12.5	12.7
Pectines	total length	3.8	4.0	4.8	4.6	4.3	5.1	5.3	5.2	5.3
	length dentate margin	2.7	2.7	3.2	3.1	3.2	3.6	3.7	4.0	3.4
	tooth count (s/d)	10/10	10/10	12/12	11/11	11/12	11/11	11/11	10/11	11/11
Telotarsi I	prolateral row (s/d)	3/3	3/3	3/3	3/3	3/3	3/3	3/3	-/-	3/3
	retrolateral row (s/d)	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3	3/3
Telotarsi II	prolateral row (s/d)	3/3	3/3	2/3	3/3	3/3	3/3	3/3	3/3	3/3
	retrolateral row (s/d)	3/3	3/3	3/2	2/3	3/3	3/3	3/3	3/3	3/3
Telotarsi III	prolateral row (s/d)	4/4	3/4	3/4	4/3	4/4	4/4	4/4	-/-	4/4
	retrolateral row (s/d)	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4
Telotarsi IV	prolateral row (s/d)	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4	4/4
	retrolateral row (s/d)	4/4	4/4	4/4	4/4	4/4	4/4	4/4	3/4	4/4
Trichobothria	patella *e* (s/d)	14/14	15/15	14/15	14/15	14/14	14/14	14/14	15/15	14/14
	patella *v* (s/d)	27/26	25/25	25/26	22/22	27/26	25/23	24/27	26/24	24/24
	patella total (s/d)	44/43	43/43	42/44	39/40	44/43	42/40	41/44	44/42	41/41
	chela manus *V* (s/d)	9/9	9/9	9/9	8/8	8/8	8/8	8/8	8/8	8/7
	chela manus total (s/d)	21/21	21/21	21/21	20/20	20/20	20/20	20/20	20/20	20/19
	chela finger *i* (s/d)	4/4	4/4	4/4	5/4	4/4	4/4	4/4	4/4	4/4
	chela finger total (s/d)	12/12	12/12	12/12	13/12	12/12	12/12	12/12	12/12	12/12
	chela total (s/d)	33/33	33/33	33/33	33/32	32/32	32/32	32/32	32/32	32/31
	pedipalp total (s/d)	80/79	79/79	78/80	75/75	79/78	77/75	76/79	79/77	76/75

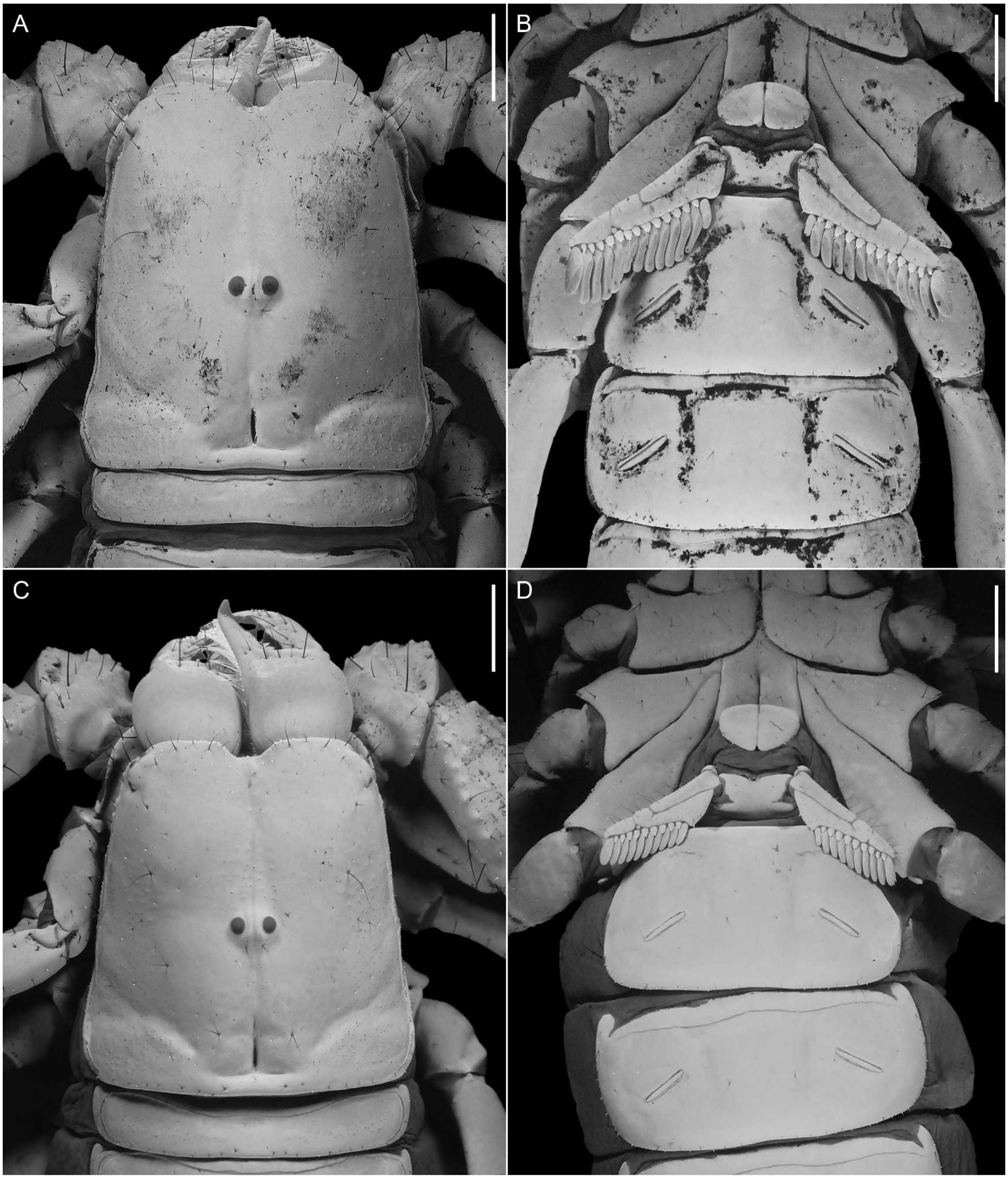


FIGURE 11. *Pandinoides duffmackayi*, sp. nov., carapace, dorsal aspect (**A, C**), and sternum, genital opercula, and pectines, ventral aspect (**B, D**). **A, B.** Holotype ♂ (AMNH), **C, D.** Paratype ♀ (AMNH), Kikatitti, Tanzania. Scale bars = 2.5 mm.

III–VI and legs faintly infuscate, yellowish brown, with maxillary lobes darker. Genital opercula and pectines immaculate, uniformly pale cream.

Carapace: As for *P. cavimanus*, except as follows. Anterior width of posterior width, 74% (68%–81%, *n* = 8) (♂), 70% (65%–76%, *n* = 9) (♀); posterior width of length, 92% (83%–96%, *n* = 8) (♂), 96% (90%–106%, *n* = 9) (♀) (tables 2, 3). Median ocular tubercle situated posteromedially, distance from anterior carapace margin 54% (51%–56%, *n* = 8) (♂), 53% (51%–55%, *n* = 9) (♀) of carapace length (tables 2, 3). Interocular, circumocular, and posteromedian surfaces smooth or nearly so (fig. 11A, C). Anterolateral and mediolateral surfaces sparsely and coarsely granular; posterolateral surfaces sparsely and finely granular.

Pedipalps: As for *P. cavimanus*, except as follows. Femur width of length, 57% (53%–66%, *n* = 8) (♂), 55% (50%–66%, *n* = 9) (♀) (tables 2, 3). Retrodorsal carina obsolete, granular; more strongly developed than prodorsal carina. Prodorsal carina obsolete, comprising few rounded granules. Promedian carina distinct, comprising row of spiniform granules (several demarcated by conspicuous macrosetae), oriented diagonally between prodorsal and proventral carinae. Patella width of length, 45% (40%–58%, *n* = 8) (♂), 44% (37%–54%, *n* = 9) (♀) (tables 2, 3). Chela short, broad, base of fixed finger arising abruptly from manus (figs. 13A, 14); manus, height of width, 71% (58%–77%, *n* = 8) (♂), 75% (59%–94%, *n* = 9) (♀); length along ventroexternal carina of width, 61% (56%–70%, *n* = 8) (♂), 62% (57%–70%, *n* = 9) (♀); length along ventroexternal carina of length movable finger, 56% (48%–64%, *n* = 8) (♂), 54% (48%–60%, *n* = 9) (♀) (tables 2, 3). Dorsomedian carina obsolete, except proximal to base of fixed finger, distinct, costate. Digital carina absent, except proximal to base of fixed finger, obsolete, costate-granular. Prodorsal, promedian and proventral carinae absent, each indicated by prominent macroseta. Chela moderately (♂) to sparsely (♀) setose on fingers and distally on manus. Manus, retrodorsal surface predominantly reticulate proximally with shallow, anastomosing granules distally; retrolateral surfaces shallowly granular; ventral intercarinal surface smooth; prolateral surfaces predominantly smooth, except for few scattered spiniform granules distally. Fixed and movable fingers, pro- and retrolateral intercarinal surfaces finely and sparsely granular (♂) to smooth (♀); median denticle rows each with six enlarged retrolateral denticles (including terminal denticle), proximal three retrolateral denticles on fixed and movable fingers situated on lobes; fixed finger with proximal lobe similar in size to medial lobe; movable finger (adult ♂) with proximal lobe, with median lobe slightly more pronounced than other lobes, and with correspondingly well-developed notch in fixed finger; little to no gap proximally between fingers, when closed (adult ♂).

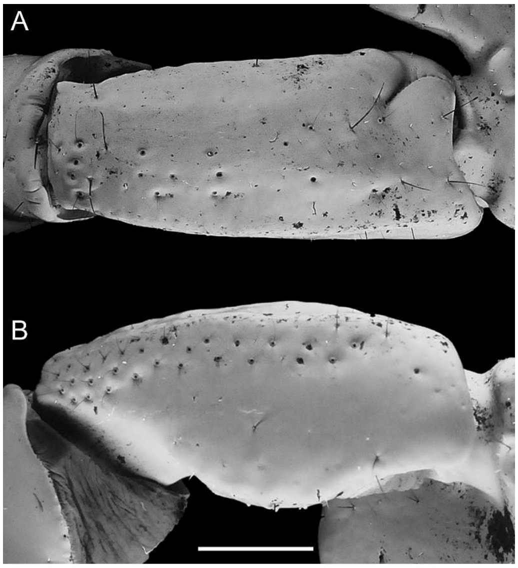


FIGURE 12. *Pandinoides duffmackayi*, sp. nov., holotype ♂ (AMNH), Kikatitti, Tanzania, dextral pedipalp patella, retrolateral (**A**) and ventral (**B**) aspects. Scale bar = 2.5 mm.

Trichobothria: As for *P. cavimanus*, except as follows. Neobothriotaxic major, Type C, with the following segment totals (*n* = 34; tables 2, 3): femur, 3 (1 *d*, 1 *i*, 1 *e*); patella, 43 (39–45): 2 *d*, 1 *i*, 25 (22–28) *v*, 14 (14 or 15) *e*, usually compris-

FIGURE 13. *Pandinoides duffmackayi*, sp. nov., holotype ♂ (AMNH), Kikatitti, Tanzania, dextral pedipalp chela, retrolateral (**A**), ventral (**B**), and prolateral (**C**) aspects. Scale bar = 2.5 mm.

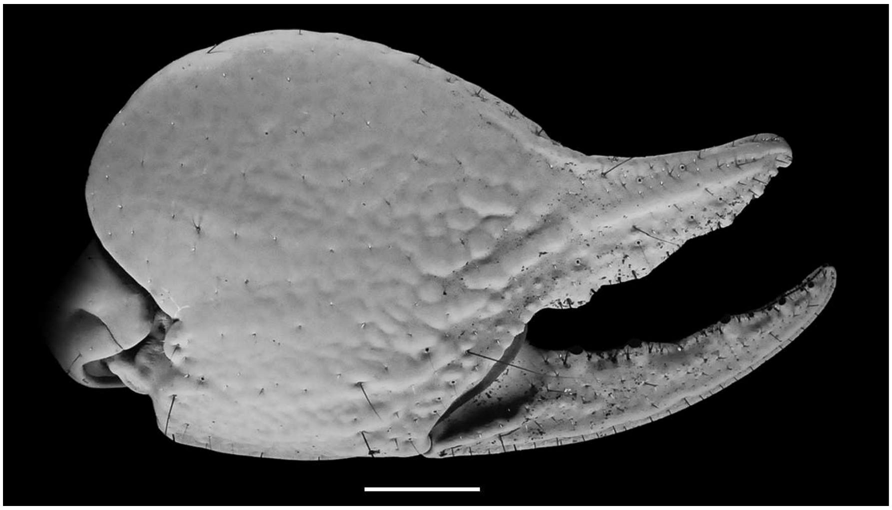


FIGURE 14. *Pandinoides duffmackayi*, sp. nov., paratype ♀ (AMNH), Kikatitti, Tanzania, dextral pedipalp chela, retrolateral aspect. Scale bar = 2.5 mm.

ing 3 *et*, 2 *est*, 2 *em*, 2 *esb*, 5 *eb*; chela, 32 (31–34), manus, 20 (19–22), comprising 2 *D*, 10 *E*, 8 (7–10) *V*; fixed finger, 12 (12–13), comprising 4 *d*, 4 *e*, 4 (4 or 5) *i* (figs. 12–14). Total count of trichobothria per pedipalp: 78 (74–82). Chela, distance *et–est* half to greater than half distance *est–esb*; *est* proximal to or aligned with *dst*.

Legs: As for *P. cavimanus*, except as follows. Basitarsi, spiniform macrosetae, I, retrolateral: *t*, *sb*; retroventral: *t*; proventral: *t*, *st*; II, retrolateral: *t*, *sb*; retroventral: *t*; proventral: *t*, *st*; III, retrolateral: *t*, *sb*; retroventral: *t*; proventral: *t*, *st*; IV, retrolateral: *t*; retroventral: *t*; proventral: *t*, *st*; prolateral: *st* (fig. 15). Telotarsi, macrosetal counts in pro- and retroventral rows equal on I–IV, 3 (2 or 3) and 4 (3 or 4) (*n* = 34), respectively (tables 2, 3).

Pectines: As for *P. cavimanus*, except as follows. Distal edge reaching past distal edge of coxa IV but not reaching to distal edge of trochanter IV (♂, fig. 11B) or not reaching to distal edge of trochanter IV (♀, fig. 11D). First proximal median lamella (scape) of each pecten with mesial margin obtusely angular, greater than 90° but less than 180°, and devoid of teeth in proximal 19% (12%–24%, *n* = 8) (♂) or 30% (22%–35%, *n* = 9) (♀) of prolateral margin (tables 2, 3). Pectinal tooth count, 12/13 (11–13/12–13, *n* = 8) (♂), 11/11 (10–12/10–12, *n* = 9) (♀).

Mesosoma: As for *P. cavimanus*, except as follows. Posttergites smooth and glabrous medially and anterolaterally, sparsely (♂) to very sparsely (♀), and finely granular posterolaterally. Sternite VII, length of width, 60% (47%–70%, *n* = 8) (♂), 59% (46%–87%, *n* = 9) (♀) (tables 2, 3).

Metasoma and Telson: As for *P. cavimanus*, except as follows. Metasomal segments I–V progressively increasing in length, decreasing in width; segment V, width of segment I width, 66% (59%–71%, *n* = 8) (♂), 66% (58%–73%, *n* = 9) (♀) (tables 2, 3). Metasoma robust; width of length, segment I, 107% (95%–126%, *n* = 8) (♂), 111% (101%–130%, *n* = 9) (♀); II, 86% (80%–95%, *n* = 8) (♂), 95% (85%–105%, *n* = 9) (♀); III, 78% (72%–88%, *n* = 8) (♂), 80% (72%–88%, *n* = 9) (♀); IV, 65% (61%–69%, *n* = 8) (♂), 68% (59%–77%, *n* = 9) (♀); V, 48% (45%–51%, *n* = 8) (♂), 52% (43%–68%, *n* = 9) (♀). Telson vesicle, width of metasomal segment V, width, 107% (95%–118%, *n* = 8) (♂), 94% (80%–107%, *n* = 9) (♀); enlarged (♂), globose, height of length, 64% (55%–72%, *n* = 8) (♂), 66% (54%–86%, *n* = 9) (♀); dorsal surface flat, ventral surface evenly curved. Aculeus relatively short, strongly curved, length of vesicle length, 35% (30%–38%, *n* = 8) (♂), 38% (35%–41%, *n* = 9) (♀). Length, metasoma and telson, of total length, 50% (49%–53%,

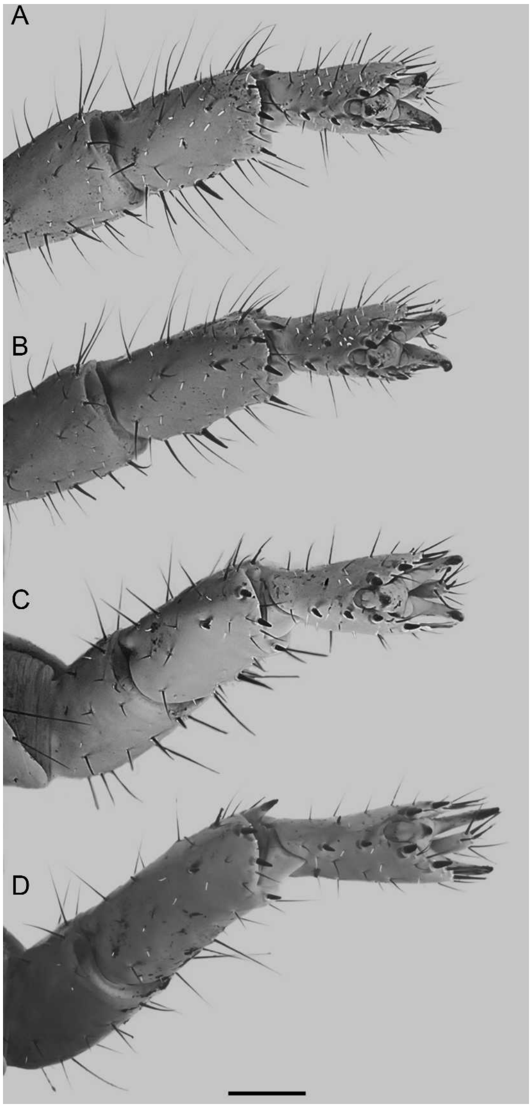


FIGURE 15. *Pandinoides duffmackayi*, sp. nov., paratype ♂ (AMNH), Kikatitti, Tanzania, legs I–IV, tibiae, basitarsi and telotarsi, ventral aspect (**A–D**). Scale bar = 1 mm.

n = 8) (♂), 47% (46%–49%, *n* = 9) (♀). Median lateral carinae, segments I–III, obsolete, granular, reduced to posterior half of segment, IV and V, absent demarcated only by macroseta at posterior margin on IV and near anterior margin on V (fig. 16B). Ventrosubmedian carinae, segments I–IV, complete, costate, distinct on I and II, obsolete on III and IV; V, vestigial, each reduced to discontinuous row of spiniform granules, demarcated by macrosetae (fig. 16C). Dorsal intercarinal surfaces, segments I–V, smooth (fig. 16A). Lateral intercarinal surfaces, segments I–V, sparsely granular (♂) to smooth (♀). Telson vesicle, dorsal and lateral surfaces smooth; ventral surface smooth or nearly so.

Geographical Variation: No noticeable variation.

Ontogenetic Variation: As for *P. cavimanus*, except that immature stages are often markedly more infuscate than adults, in some cases entirely so.

Sexual Dimorphism: As for *P. cavimanus*, except as follows. *Pandinoides duffmackayi*, sp. nov., is the least sexually dimorphic of the three species, the adult male differing from the adult female as follows. The concave depression in the retrodorsal surface of the pedipalp chela manus, at the base of the fixed finger, is shallower than in the other species. The proximal lobe of the movable finger is present and the median lobe of the movable finger only slightly more pronounced than the other lobes, such that little to no gap is present proximally between the fixed and movable fingers, when closed (fig. 13A).

Distribution: *Pandinoides duffmackayi*, sp. nov., is endemic to Kenya and Tanzania (fig. 2). The known locality records fall within a fairly small area in southwestern Kenya (Eastern and Rift Valley provinces) and northeastern Tanzania (Arusha and Kilimanjaro provinces). Records attributed to *P. cavimanus* from this area, including Kilimanjaro (Pocock, 1888), Arusha (Werner, 1936), and Naberera (Kovařík, 2009) are referable to *P. duffmackayi*, sp. nov.

Ecology: The known locality records of *P. duffmackayi*, sp. nov., occur in arid savannah, dominated by *Acacia* and *Commiphora* or Leleshwa (*Tarchonanthus camphoratus*), with sparse grass at 1325–1770 m elevation. Most specimens for which data are available were excavated from burrows during the day. *Pandinoides duffmackayi*, sp. nov., constructs burrows up to 55 cm long and 25 cm deep in compacted clayey soil with pumice to consolidated red sandy loam. This

FIGURE 16. *Pandinoides duffmackayi*, sp. nov., holotype ♂ (AMNH), Kikatitti, Tanzania, metasoma and telson, dorsal (**A**), lateral (**B**), and ventral (**C**) aspects. Scale bar = 2.5 mm.

species is parapatric with the other two congeners. It may be sympatric with *Pandinurus exitialis* (Pocock, 1888) in the Namanga area of Kenya.

Conservation: This species appears to be protected in the Ngong Hills Nature Reserve near Nairobi, Kenya.

Remarks: Pocock (1888: 249) first noted differences in size and granulation between an individual of this species and the holotype of *P. cavimanus* when stating:

> I have seen two specimens of [*Scorpio cavimanus*]—one (dried) brought from Kilima-Njaro by Mr. M. J. Jackson; the other, which, being preserved in spirit of wine, I have selected as the type, brought by Capt. Speke from Umyamuezi.... The specimen from Kilima-Njaro is smaller and slightly less granular than the other.

However, with only two specimens available for study, neither in good condition, Pocock (1888) was apparently unable to appreciate the significance of the variation.

Erroneous Record: Port Herald [Nsanje], Nyasaland [Malawi], Dr. J.E.S. Old, 1 ♂ (BMNH 1914.4.7.1). Based on the known localities of the other material examined, this specimen is probably mislabeled.

Pandinoides militaris Pocock, 1900, stat. rev.

Figures 1D, 2, 17–23; tables 4, 5

? *Scorpio bellicosus* (*nec* L. Koch, 1875): Pocock, 1898: 498.

Scorpio bellicosus (*nec* L. Koch, 1875): Pocock, 1897b: 397, 398.

Pandinus militaris Pocock, 1900b: 61, 62; Birula, 1915b: 29, 30; Birula, 1927: 88; Moriggi, 1941: 96; Roewer, 1943: 229; Kovařík, 1998: 140.

Pandinus cavimanus: Pocock, 1896: 431, 432; Birula, 1915b: 26, 27 (part); Borelli, 1925a: 16; Borelli, 1925b: 324; Moriggi, 1941: 94 (part); Probst, 1973: 327 (part); Kovařík, 1998: 140 (part).

Pandinus (*Pandinoides*) *militaris*: Vachon, 1974: 953; Lamoral and Reynders, 1975: 564; El-Hennawy, 1992: 100, 136 (part).

Pandinus (*Pandinoides*) *cavimanus*: Lamoral and Reynders, 1975: 564 (part); Fet, 2000: 468 (part); Kovařík, 2002: 1, 18, 20 (part); 2003: 136, 149, table 1 (part); 2009: cover photo [misidentification], 2, 50–52 (part), 114, 129 (part), table 3 (part), figs. 284, 285, 287–289, 404 [misidentification].

Pandinoides cavimanus: Rossi, 2015a: 13 (part), 50, fig. 11.

Type Material: Holotype subad. ♀ (BMNH 1897.11.10.4–5) [examined], **ETHIOPIA: Oromia Regional State:** *Borena Administrative Zone*: El Dere [03°52′N 039°46′E] near Aimola [ca. 04°05′30″N 040°21′15″E, Mandera Distr., North Eastern Prov., Kenya], Boran country, Somaliland, 23.iii.1895, A. Donaldson Smith.

In the original description of *P. militaris*, Pocock (1900b: 61) listed two specimens from the BMNH: "Aimola in the Boran Country (Donaldson Smith); also Ndi, on the Weiss Road inland from Mombasa (C. Steuart Betton)." Pocock (1897b: 397) had previously mentioned "three female examples … of which … only one, the smallest, is labeled with an exact locality… near Aimola in the Boran country, 3,000 ft. 23.3.95" and prior to that "two mutilated males obtained by Dr. Gregory at Kinani and a place 4 miles to the south of it," which Pocock (1896: 431) determined to be *P. cavimanus*. All these specimens were examined for the present study and determined to be conspecific. In spite of the availability of two adult males from Kinani, two adult females from Somaliland with no precise locality data, a subadult female from Aimola, and a juvenile male from Ndi, Pocock (1896, 1897b, 1900b: 61) based the description of *P. militaris* solely on the subadult female from Aimola (actually, El Dere), specifically stating the measurements were "of [the] type." No mention was made of more than one type. Therefore, the specimen from Aimola is the holotype of *P. militaris*, the specimen from Ndi was mistakenly listed as a paratype (Fet, 2000: 468; Kovařík, 2003: 149), and the subsequent designation of the specimen from Aimola as lectotype (Kovařík, 2009: 50; also see Rossi, 2015a: 50, fig. 11) was unjustified.

Based on the original label, the type locality is “El Dere” not “Aimola” and, according to the maps of A. Donaldson Smith’s expedition route (Donaldson Smith, 1896: 121; 1897, map sheet 3), El Dere is in southern Ethiopia whereas Aimola, to the northeast, is in northeastern Kenya, near the Ethiopian border, not in Somalia as generally assumed (e.g. Fet, 2000; Kovařík, 2003, 2009).

Diagnosis: *Pandinoides militaris* may be separated from *P. cavimanus* and *P. duffmackayi*, sp. nov., by the following combination of characters. *Pandinoides militaris* is yellowish brown (fig. 1D) to reddish brown in color, whereas *P. cavimanus* is usually brownish black (fig. 1A, B), rarely reddish brown, and *P. duffmackayi*, sp. nov., reddish brown to reddish black (fig. 1C). The carapace is more compressed, dorsoventrally, in *P. militaris* (fig. 18A, C) than in *P. cavimanus* (fig. 4A, C) and *P. duffmackayi*, sp. nov. (fig. 11A, C). The median ocular tubercle is medial, its distance from the anterior carapace margin 46%–52% of the carapace length in *P. militaris* (tables 4, 5), but posteromedial, its distance from the anterior carapace margin 51%–56% of the carapace length in *P. duffmackayi*, sp. nov. (tables 2, 3), and *P. cavimanus* (table 1). The ventrosubmedian carinae on metasomal segment IV are distinct, costate in *P. cavimanus* (fig. 9C) and *P. duffmackayi*, sp. nov. (fig. 16C), but obsolete, granular in *P. militaris* (fig. 23C). The ventral surface of the telson vesicle of the male bears distinct carinae, each comprising prominent spiniform granules, extending its entire length in *P. militaris* (fig. 23B, C), whereas the vesicle bears obsolete carinae, each comprising isolated spiniform granules, restricted to its anterior half or third in *P. cavimanus* (fig. 9B, C), and is smooth or nearly so in *P. duffmackayi*, sp. nov. (fig. 16B, C). The chela manus of *P. militaris* is narrower, the length along the retroventral carina 64%–76% (♂) and 62%–72% (♀) of the width, and less convex, the height 49%–68% (♂) and 64%–73% (♀) of the width, than the manus of *P. cavimanus*, in which the length along the retroventral carina is 56%–63% (♂) and 58%–67% (♀) of the width, and the height 59%–73% (♂) and 66%–76% (♀) of the width, and that of *P. duffmackayi*, sp. nov., in which the length along the retroventral carina is 56%–70% (♂) and 57%–70% (♀) of the width, and the height 58%–77% (♂) and 59%–94% (♀) of the width. The chela fixed finger of *P. militaris* arises more gradually from the manus, and is narrower proximally (figs. 20A, 21), than the fingers of *P. cavimanus* (figs. 6A, 7) and *P. duffmackayi*, sp. nov. (figs. 13A, 14), which arise abruptly from the manus. The chela fingers and distal surfaces of the manus are densely (♂) to moderately (♀) setose in *P. militaris* (fig. 1D), but moderately (♂) to sparsely (♀) setose in *P. cavimanus* (fig. 1B) and *P. duffmackayi*, sp. nov. (fig. 1C). The proximal lobe on the pedipalp chela fixed finger of the adult male is vestigial, much smaller than the medial lobe, or absent, creating a prominent gap proximally between the fixed and movable fingers, when closed in *P. militaris* (fig. 20A), whereas the proximal lobe is similar in size to the medial lobe, creating little to no gap proximally between the fingers, when closed in *P. duffmackayi*, sp. nov. (fig. 13A), and it is slightly smaller than the medial lobe, creating a moderate gap proximally between the fingers, when closed in *P. cavimanus* (fig. 6A). *Pandinoides militaris* bears 33–36 trichobothria on the pedipalp chela, including 9–12 in the *V* series, whereas *P. cavimanus* and *P. duffmackayi*, sp. nov., bear 31–35 and 31–34 trichobothria on the chela, respectively, including 7–10 in the *V* series. The angle of the first proximal median lamella (scape) of the pecten is greater (more obtuse), especially in the female, of *P. militaris* (fig. 18B, D), compared with *P. cavimanus* (fig. 4B, D) and *P. duffmackayi*, sp. nov. (fig. 11B, D).

Pandinoides militaris has often been confused with *P. cavimanus* due to their similar size and high trichobothrial counts, but may be separated from the latter as follows. The circumocular surfaces of the carapace are smooth or with a few granules anterior to the ocular tubercle in *P. militaris* (fig. 18A, C), but sparsely and finely granular anterior to the median ocular tubercle, along the median longitudinal sulcus, and often on the frontal lobes in *P. cavimanus* (fig. 4A, C). The metasoma of *P. militaris* is 46%–52% (♂), 42%–

TABLE 4

Meristic data for adult male specimens of *Pandinoides militaris* (Pocock, 1900) in the American Museum of Natural History, New York (AMNH), the Musée Royal de l'Afrique Centrale, Tervuren (MRAC), and the National Museums of Kenya, Nairobi (NMK).

Measurements (mm) follow Prendini (2000): [1]sum of carapace, tergites I–VII, metasomal segments I–V, and telson; [2]distance from anterior carapace margin; [3]sum of metasomal segments I–V and telson; [4]distance from base of condyle to tip of fixed finger. Counts of pectinal teeth, spiniform macrosetae of telotarsi and pedipalp trichobothria reflect sinistral (s) and dextral (d) sides. Setal counts include areolar cups (sockets), if setae broken.

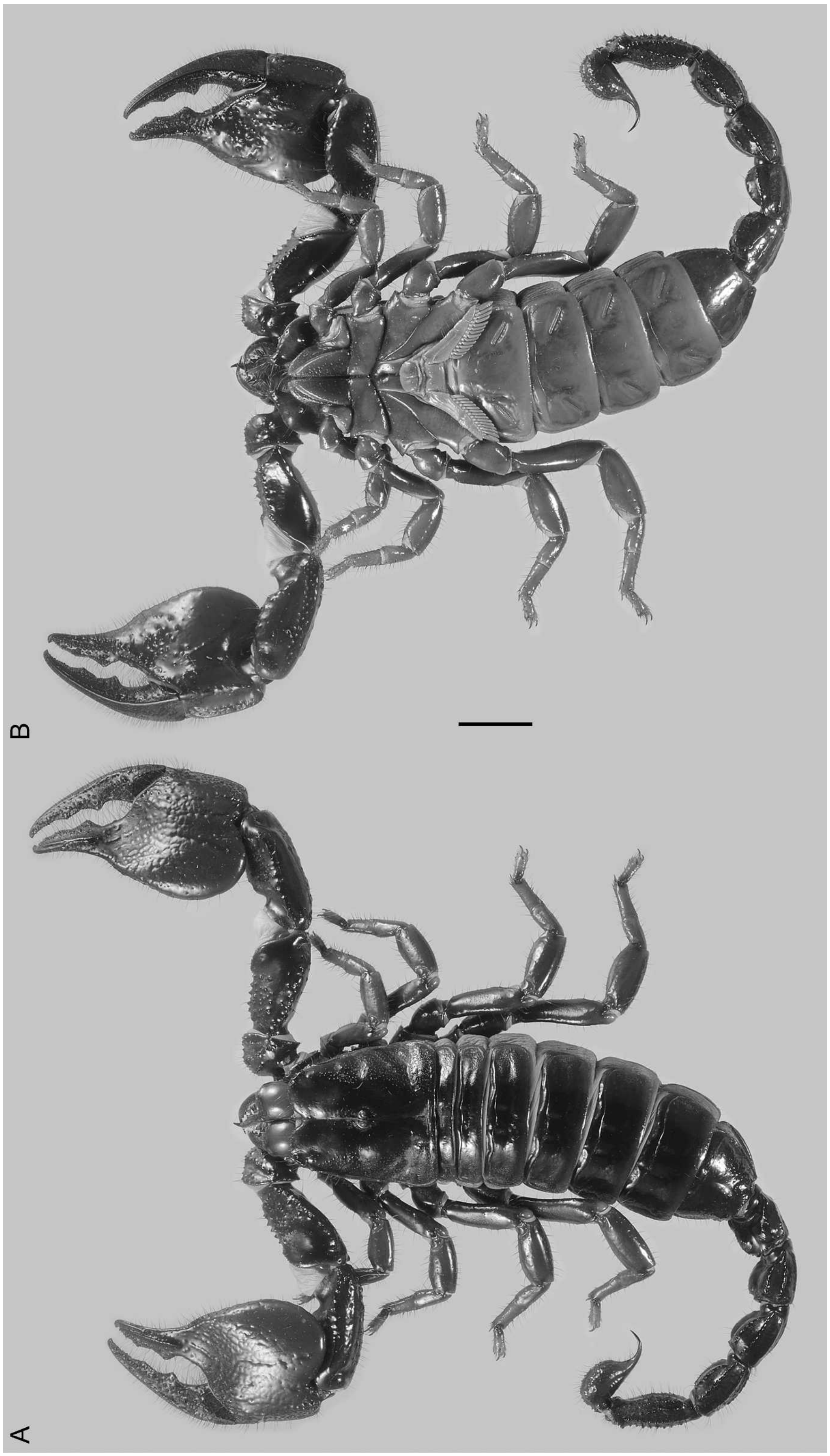
		Kishushe		Tsavo		Jora, Kasigau	Kora National Park	Kenani
		AMNH		MRAC		NMK	NMK	NMK
	Number			209.644	210.006	240	242	251
Total length[1]		122.4	123.4	119.5	117.8	119.5	106.3	98.9
Carapace	anterior width	13.2	13.5	12.7	12.6	12.4	12.5	11.4
	posterior width	19.5	19.6	20.7	19.4	17.2	18.4	17.6
	length	19.3	19.5	19.0	18.8	18.9	18.0	17.5
	median ocelli[2]	9.9	9.6	9.6	9.2	9.6	8.9	8.2
Tergite I	length	3.3	3.1	3.6	3.4	3.6	2.3	2.2
Tergite II	length	4.1	4.0	3.7	3.5	4.1	2.8	3.4
Tergite III	length	6.0	5.9	5.9	5.2	6.1	4.3	4.6
Tergite IV	length	6.7	7.0	6.4	6.4	6.4	5.0	4.7
Tergite V	length	7.6	7.9	6.4	6.8	6.7	5.2	5.2
Tergite VI	length	8.7	8.6	6.4	7.5	7.5	5.9	5.8
Tergite VII	length	9.8	10.2	8.2	9.4	8.6	7.4	6.2
Sternite VII	length	9.2	9.2	6.9	8.9	8.9	6.9	6.1
	width	14.0	13.9	14.1	13.7	13.0	12.8	10.8
Mesosoma	total length (tergites)	46.1	46.6	40.4	42.2	43.0	32.8	32.2
Metasoma I	length	8.2	8.4	8.2	6.3	8.5	7.6	6.9
	width	7.5	7.6	7.1	7.6	7.2	7.3	6.7
Metasoma II	length	8.6	8.8	8.6	8.5	8.5	7.8	7.7
	width	6.9	7.3	7.0	6.7	6.5	6.2	6.0
Metasoma III	length	8.8	9.3	9.2	8.9	8.9	8.8	7.3
	width	6.6	6.7	6.8	6.4	6.3	6.0	5.8
Metasoma IV	length	8.9	9.8	9.7	9.5	9.9	9.7	8.0
	width	6.0	5.8	5.9	5.9	5.2	5.5	5.2
Metasoma V	length	10.5	10.4	12.4	11.1	11.1	10.6	9.1
	width	5.0	4.8	5.1	5.0	4.2	4.8	4.5
Telson	vesicle length	7.6	7.6	7.9	7.8	7.5	7.7	6.5
	vesicle width	4.8	5.1	5.3	5.1	5.0	5.0	3.9
	vesicle height	4.4	4.1	4.8	4.6	4.5	4.3	4.6
	aculeus length	4.4	2.9	4.2	4.7	3.2	3.4	3.7
	total length	12.0	10.5	12.1	12.5	10.7	11.1	10.2
Metasoma	total length[3]	57.0	57.3	60.1	56.8	57.6	55.5	49.2
Femur	length	15.0	16.2	14.1	13.8	14.4	13.5	12.0
	width	7.8	7.8	7.7	8.2	7.4	7.8	6.8
Patella	length	18.1	18.3	17.1	17.2	16.3	16.9	15.4
	width	7.4	7.4	7.5	6.8	7.1	7.2	6.6
Chela	length[4]	29.7	31.5	30.0	30.0	30.2	30.0	27.8
	width	16.9	16.2	15.9	15.2	14.1	16.7	15.7
	height	10.5	9.9	8.6	7.4	9.6	10.7	8.6
	length retroventral carina	11.2	11.5	10.9	10.3	10.7	11.2	10.0
	length movable finger	20.7	22.9	22.2	21.9	21.7	20.4	19.7
Pectines	total length	9.6	11.2	10.9	10.9	9.6	9.1	9.6
	length dentate margin	7.7	9.6	8.6	8.2	7.8	7.3	7.5
	tooth count (s/d)	14/14	15/14	14/15	14/16	14/14	15/14	15/15
Telotarsi I	prolateral row (s/d)	3/3	3/3	3/3	3/3	3/3	3/3	3/3
	retrolateral row (s/d)	3/3	3/3	3/3	3/2	3/3	3/3	3/-
Telotarsi II	prolateral row (s/d)	3/4	3/3	3/3	3/3	3/3	3/3	3/3
	retrolateral row (s/d)	3/3	3/3	3/3	3/3	3/-	3/3	3/3
Telotarsi III	prolateral row (s/d)	3/4	4/4	4/4	4/4	4/4	4/4	4/4
	retrolateral row (s/d)	4/4	4/4	5/4	4/3	4/4	4/4	4/-
Telotarsi IV	prolateral row (s/d)	5/5	5/4	5/5	5/4	4/4	4/4	4/4
	retrolateral row (s/d)	5/5	4/4	5/4	5/4	5/-	5/4	4/5
Trichobothria	patella *e* (s/d)	14/14	14/14	14/14	14/14	14/14	14/14	14/13
	patella *v* (s/d)	32/36	36/35	37/36	33/35	34/35	35/34	38/34
	patella total (s/d)	49/53	53/52	54/53	50/52	51/52	52/51	55/50
	chela manus *V* (s/d)	10/11	11/10	10/10	9/10	11/12	9/9	10/10
	chela manus total (s/d)	22/23	23/22	22/22	21/22	23/24	21/21	22/22
	chela finger *i* (s/d)	5/4	5/5	4/4	5/5	4/4	5/4	5/5
	chela finger total (s/d)	13/12	13/13	12/12	13/13	12/12	13/12	13/13
	chela total (s/d)	35/35	36/35	34/34	34/35	35/36	34/33	35/35
	pedipalp total (s/d)	87/91	92/90	91/90	87/90	89/91	89/87	93/88

TABLE 5

Meristic data for adult female specimens of *Pandinoides militaris* (Pocock, 1900) in the American Museum of Natural History, New York (AMNH) and the National Museums of Kenya, Nairobi (NMK).

Measurements (mm) follow Prendini (2000): [1]sum of carapace, tergites I–VII, metasomal segments I–V, and telson; [2]distance from anterior carapace margin; [3]sum of metasomal segments I–V and telson; [4]distance from base of condyle to tip of fixed finger. Counts of pectinal teeth, spiniform macrosetae of telotarsi and pedipalp trichobothria reflect sinistral (s) and dextral (d) sides. Setal counts include areolar cups (sockets), if setae broken.

Specimen	Locality	Kishushe					Kora National Park				
	Collection	AMNH					NMK				
	Number						242	245	246	246	558
Total length[1]		105.6	103.8	102.7	98.6	95.4	98.5	111.2	111.8	101.7	111.7
Carapace	anterior width	12.2	12.2	12.2	11.5	11.6	12.6	12.0	13.1	11.1	13.1
	posterior width	18.3	18.2	18.6	17.4	17.9	17.5	18.5	18.2	16.3	19.0
	length	17.8	17.8	18.4	16.7	17.6	17.1	17.6	18.3	16.8	18.3
	median ocelli[2]	8.5	8.1	9.6	8.3	8.7	8.4	8.8	9.3	8.0	8.9
Tergite I	length	3.2	2.8	2.5	2.9	2.1	2.8	3.4	2.4	3.6	3.6
Tergite II	length	3.6	3.1	3.5	3.4	2.7	3.0	3.9	2.6	3.7	3.7
Tergite III	length	5.0	4.6	5.1	4.8	3.9	4.9	5.6	3.1	4.9	5.6
Tergite IV	length	6.1	5.7	5.4	5.6	4.9	6.3	6.0	5.1	5.8	5.7
Tergite V	length	6.9	6.0	6.0	6.1	6.0	7.0	7.2	7.1	6.1	6.5
Tergite VI	length	7.6	6.2	6.5	6.8	6.1	7.4	7.4	8.0	6.7	6.6
Tergite VII	length	8.4	8.1	7.1	7.6	6.6	9.0	8.2	9.5	8.5	7.4
Sternite VII	length	8.4	6.6	7.1	7.6	6.4	8.3	9.0	7.6	7.1	7.1
	width	13.2	13.3	13.1	12.5	13.3	12.4	14.3	14.4	13.1	14.8
Mesosoma	total length (tergites)	40.8	36.5	36.1	37.2	32.4	40.4	41.7	37.8	39.4	39.1
Metasoma I	length	6.9	7.0	6.8	6.4	6.4	5.3	7.4	8.1	6.5	7.9
	width	6.8	6.8	7.1	6.5	6.7	6.9	7.3	7.3	6.5	7.2
Metasoma II	length	7.0	7.5	6.9	6.6	6.5	5.4	7.9	8.2	6.5	8.2
	width	6.2	6.4	6.0	5.8	6.0	6.3	6.8	6.5	5.9	6.7
Metasoma III	length	7.4	8.0	7.5	7.3	7.0	5.6	8.2	8.4	7.5	8.5
	width	5.6	5.8	5.5	5.5	5.5	5.6	6.2	6.1	5.2	6.2
Metasoma IV	length	7.8	8.3	7.7	7.6	7.6	6.1	8.4	8.5	7.6	8.9
	width	4.9	5.1	5.0	4.7	4.9	5.2	5.5	5.1	4.9	5.4
Metasoma V	length	8.2	8.5	9.4	8.2	8.1	8.7	8.6	10.8	8.2	9.5
	width	4.3	4.3	4.7	4.1	4.1	4.6	4.7	4.4	4.1	4.7
Telson	vesicle length	6.3	6.4	6.5	5.7	5.8	6.3	7.7	7.1	6.1	6.6
	vesicle width	3.9	3.9	3.9	3.4	3.6	3.7	4.1	4.9	3.6	4.4
	vesicle height	3.4	3.3	3.6	3.1	3.2	3.6	3.8	4.4	3.2	4.2
	aculeus length	3.4	3.6	3.6	2.9	4.0	3.7	3.8	4.7	3.2	4.7
	total length	9.8	10.1	10.1	8.7	9.8	9.9	11.5	11.8	9.3	11.3
Metasoma	total length[3]	47.0	49.4	48.3	44.7	45.5	41.0	51.9	55.7	45.6	54.3
Femur	length	11.4	12.2	12.6	11.6	11.9	11.6	13.9	12.7	11.3	12.0
	width	6.8	7.1	7.0	6.1	6.4	6.8	7.1	6.5	6.1	6.9
Patella	length	14.3	14.7	15.7	13.4	13.9	14.4	15.7	15.2	13.8	15.8
	width	6.4	6.8	6.5	5.6	5.7	6.3	6.6	6.8	6.0	6.9
Chela	length[4]	26.4	26.5	27.6	25.3	25.0	26.0	26.6	26.0	25.0	29.0
	width	15.0	14.4	15.5	13.9	14.7	14.1	15.7	14.3	14.5	14.8
	height	9.7	9.9	10.7	10.0	10.7	9.5	11.1	10.0	9.3	9.7
	length retroventral carina	9.6	9.9	10.1	9.3	9.2	10.2	10.0	9.8	9.0	9.5
	length movable finger	18.4	18.4	18.5	17.5	17.6	18.6	19.2	18.0	17.0	19.5
Pectines	total length	8.0	8.6	8.5	8.1	7.8	7.9	8.4	8.3	7.3	9.1
	length dentate margin	5.9	7.8	6.2	6.5	5.3	6.4	6.5	6.2	5.2	7.3
	tooth count (s/d)	14/14	14/14	14/13	14/14	14/13	14/14	14/14	14/14	14/15	14/14
Telotarsi I	prolateral row (s/d)	3/3	3/3	2/3	3/3	1/3	2/3	3/3	3/3	3/2	3/3
	retrolateral row (s/d)	3/3	3/3	3/2	-/3	3/3	3/2	3/3	2/2	2/2	3/3
Telotarsi II	prolateral row (s/d)	3/3	3/3	3/2	3/3	3/3	2/3	3/3	2/2	2/2	3/3
	retrolateral row (s/d)	3/3	2/3	3/2	3/3	3/3	2/3	3/3	2/2	2/2	3/3
Telotarsi III	prolateral row (s/d)	4/4	4/4	3/5	4/4	4/4	3/4	4/4	4/4	4/4	4/4
	retrolateral row (s/d)	4/4	4/4	4/2	-/4	4/4	4/4	4/4	3/4	4/4	4/4
Telotarsi IV	prolateral row (s/d)	5/5	4/4	5/3	4/4	4/4	4/4	4/4	4/4	4/4	4/4
	retrolateral row (s/d)	4/5	5/4	5/3	4/4	5/5	4/4	4/4	4/4	4/4	4/4
Trichobothria	patella *e* (s/d)	14/14	14/14	14/14	14/14	14/14	14/14	15/14	14/14	14/14	14/14
	patella *v* (s/d)	34/34	34/35	33/34	31/30	35/37	30/31	35/35	34/35	34/34	35/35
	patella total (s/d)	51/51	51/52	50/51	48/47	52/54	47/48	53/52	51/52	51/51	52/52
	chela manus *V* (s/d)	11/10	9/10	10/9	9/9	9/10	11/10	10/11	10/11	9/9	12/10
	chela manus total (s/d)	23/22	21/22	22/21	21/21	21/22	23/22	22/23	22/23	21/21	24/22
	chela finger *i* (s/d)	5/5	4/4	5/5	4/5	4/4	5/5	5/5	5/5	5/5	4/5
	chela finger total (s/d)	13/13	12/12	13/13	12/13	12/12	13/13	13/13	13/13	13/13	12/13
	chela total (s/d)	36/35	33/34	35/34	33/34	33/34	36/35	35/36	35/36	34/34	36/35
	pedipalp total (s/d)	90/89	87/89	88/88	84/84	88/91	86/86	91/91	89/91	88/88	91/90


A
B

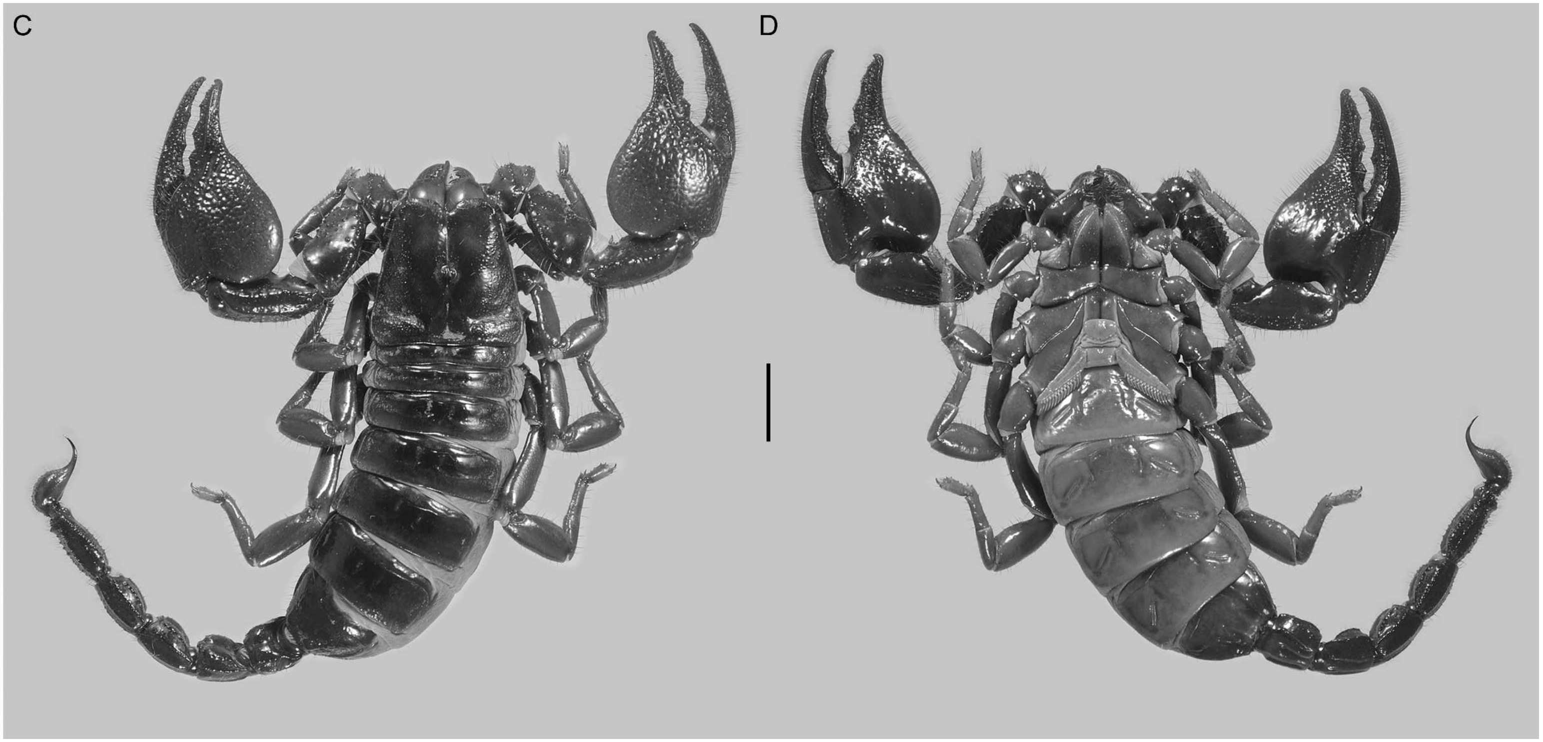


FIGURE 17. *Pandinoides militaris* (Pocock, 1900), habitus, dorsal (**A, C**) and ventral (**B, D**) aspects. **A, B.** ♂ (AMNH), **C, D.** ♀ (AMNH), Kishushe, Kenya. Scale bars = 10 mm.

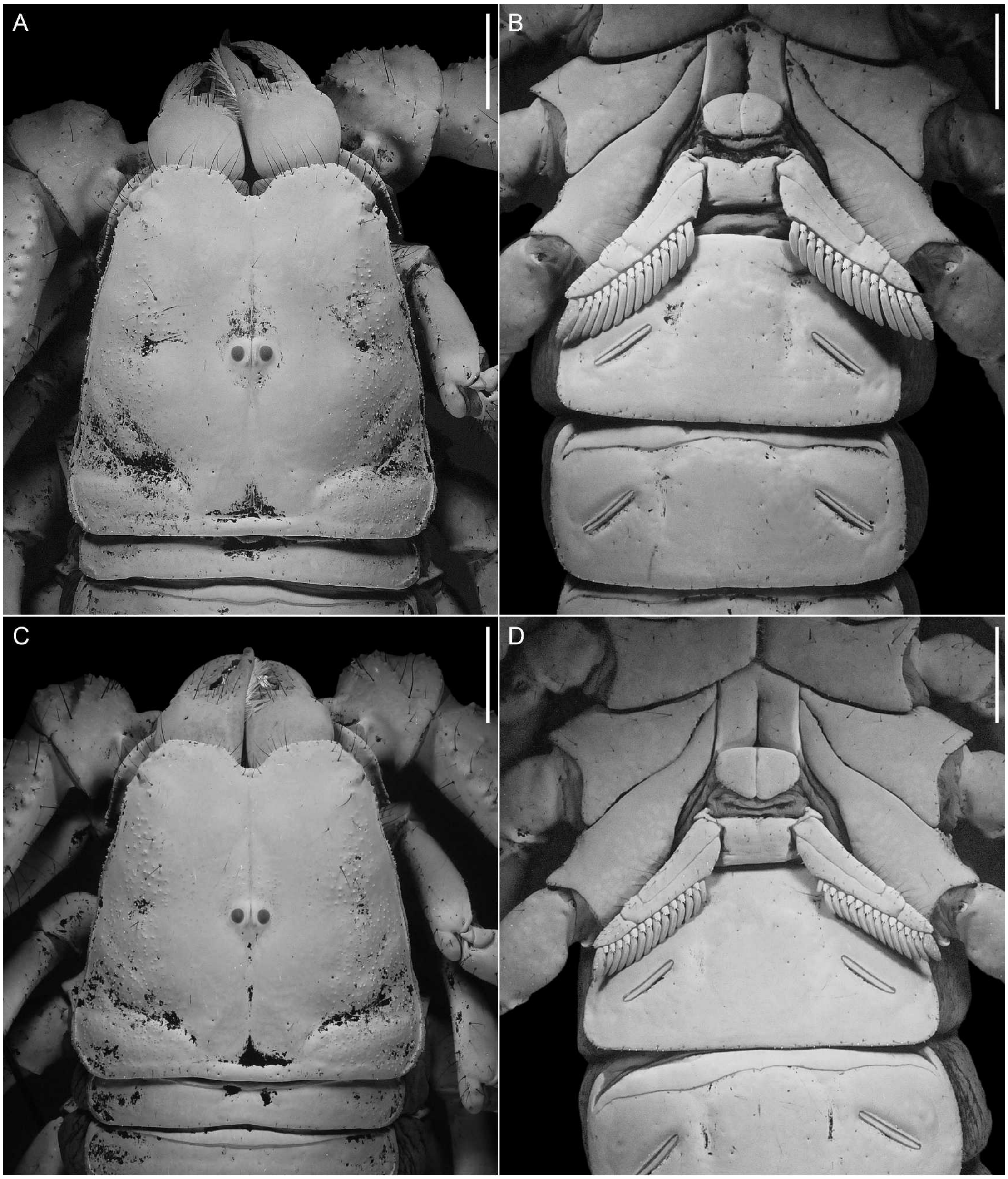


FIGURE 18. *Pandinoides militaris* (Pocock, 1900), carapace, dorsal aspect (**A, C**), and sternum, genital opercula, and pectines, ventral aspect (**B, D**). **A, B.** ♂ (AMNH), **C, D.** ♀ (AMNH), Kishushe, Kenya. Scale bars = 5 mm.

50% (♀) of total body length, the summed lengths of segments IV and V, 98%–117% (♂), 87%–105% (♀) of carapace length, whereas the metasoma of *P. cavimanus* is 52%–56% (♂) and 49%–53% (♀) of total body length, the summed lengths of segments IV and V, 115%–130% (♂), 107%–120% (♀) of carapace length. The dorsal surfaces of metasomal segments I–IV in the male are smooth in *P. militaris* (fig. 23A), but finely and sparsely granular in *P. cavimanus* (fig. 9A).

Pandinoides militaris may be further separated from *P. duffmackayi*, sp. nov., as follows. *Pandinoides militaris* is larger, with total adult body length 95–123 mm, carapace length 17–19 mm and pedipalp chela length 25–35 mm (tables 4, 5), than *P. duffmackayi*, sp. nov., with total adult body length 60–78 mm, carapace length 10–13 mm and chela length 14–19 mm (tables 2, 3). *Pandinoides militaris* bears 84–93 trichobothria on the pedipalp, with 47–55 trichobothria on the patella, including 30–38 in the *v* series, whereas *P. duffmackayi*, sp. nov., bears 74–82 trichobothria on the pedipalp, with 39–45 trichobothria on the patella, including 22–28 in the *v* series. The pectinal tooth count of *P. militaris*, with 14–16, usually 14 (♂), and 13–15, usually 14 (♀), is higher than that of *P. duffmackayi*, sp. nov., with 11–13, usually 12 (♂), and 10–12, usually 11 (♀).The prolateral *t* and *st* macrosetae of basitarsi III and IV are spiniform in *P. militaris* (fig. 22C, D), whereas *t* and *st* are setiform on III, and *t* setiform and *st* spiniform on IV in *P. duffmackayi*, sp. nov. (fig. 15C, D).

Redescription: The following redescription supplements the original description by Pocock (1900b) and is based on the material examined. Only characters that differ from *P. cavimanus* are described.

Total Length: Adult medium, maximum length, measured from anterior margin of carapace to tip of aculeus, 115 mm (99–123 mm, *n* = 7) (♂), 104 mm (95–112 mm, *n* = 10) (♀) (tables 4, 5).

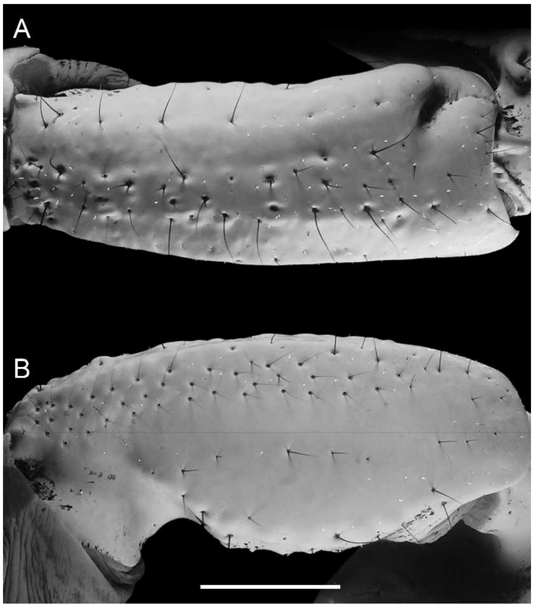


FIGURE 19. *Pandinoides militaris* (Pocock, 1900), ♂ (AMNH), Kishushe, Kenya, dextral pedipalp patella, retrolateral (**A**) and ventral (**B**) aspects. Scale bar = 5 mm.

Color: Chelicerae, dorsal surfaces bicolored, proximal three-quarters of manus dorsal surface with sparsely reticulate infuscation, markedly paler than carapace and densely infuscate distal quarter of manus dorsal surface and fingers. Pedipalp chela fingers densely infuscate, brownish black; carapace lateral and posterior surfaces, tergites, sternite VII, metasoma, telson and pedipalp trochanter, femur, patella pro- and retrolateral surfaces infuscate but paler, dark yellowish brown to olive brown, telson paler than metasoma; carapace interocular and circumocular surfaces, telson, pedipalp patella ventral surface, chela manus dorsal, lateral and ventral surfaces and legs immaculate, markedly paler, light yellowish brown; legs dorsal and retrolateral surfaces becoming paler distally, tibia, basitarsus, and telotarsus paler than femur and patella. Coxosternal region and sternites III–VI immaculate, yellowish. Genital opercula and pectines immaculate, uniformly pale cream.

Carapace: As for *P. cavimanus*, except as follows. Anterior width of posterior width, 67% (62%–72%, *n* = 7) (♂), 68% (65%–72%, *n* = 10) (♀); posterior width of length, 101% (91%–109%, *n* = 7) (♂), 102% (97%–105%, *n* = 10) (♀) (tables 4, 5). Median ocular tubercle situated medially, distance from anterior carapace margin 50% (47%–51%, *n* = 7) (♂), 49% (46%–52%, *n* = 10) (♀) of carapace length (tables 4, 5). Inter-

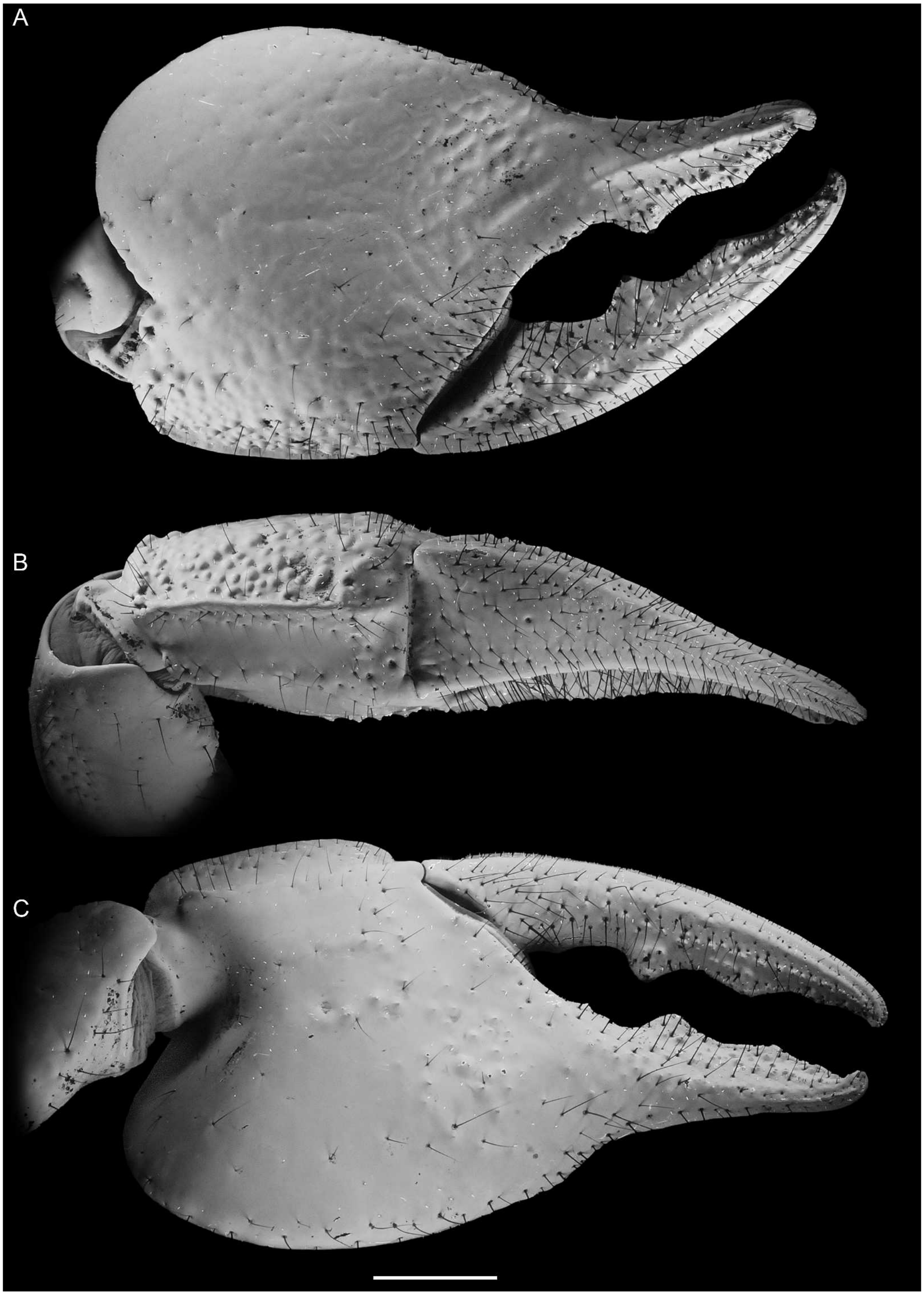


FIGURE 20. *Pandinoides militaris* (Pocock, 1900), ♂ (AMNH), Kishushe, Kenya, dextral pedipalp chela, retrolateral (**A**), ventral (**B**), and prolateral (**C**) aspects. Scale bar = 5 mm.

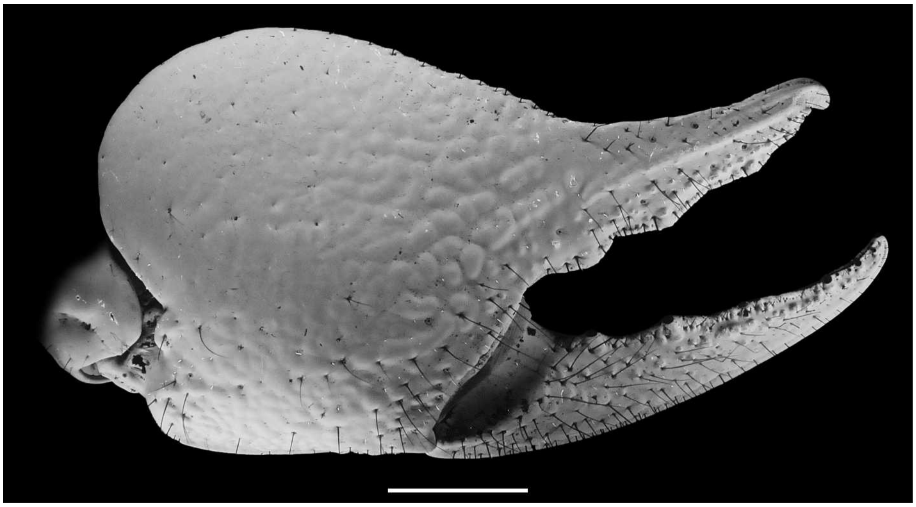


FIGURE 21. *Pandinoides militaris* (Pocock, 1900), ♀ (AMNH), Kishushe, Kenya, dextral pedipalp chela, retrolateral aspect. Scale bar = 5 mm.

ocular and circumocular surfaces smooth or with few granules anterior to ocular tubercle (fig. 18A, C). Anterolateral, mediolateral, and posterolateral surfaces finely and sparsely granular, more coarsely and densely so in male. Posteromedian surfaces smooth or nearly so.

Pedipalps: As for *P. cavimanus*, except as follows. Femur width of length, 54% (48%–59%, *n* = 7) (♂), 55% (51%–60%, *n* = 10) (♀) (tables 4, 5). Retrodorsal carina obsolete, granular; more strongly developed than prodorsal carina. Prodorsal carina obsolete, comprising few rounded granules. Promedian carina distinct, comprising row of subspiniform granules (several demarcated by conspicuous macrosetae), oriented diagonally between prodorsal and proventral carinae. Patella width of length, 42% (39%–44%, *n* = 7) (♂), 43% (41%–46%, *n* = 10) (♀) (tables 4, 5). Chela fairly short, broad, base of fixed finger arising gradually from manus (figs. 20A, 21); manus, height of width, 59% (49%–68%, *n* = 7) (♂), 69% (64%–73%, *n* = 10) (♀); length along ventroexternal carina of width, 69% (64%–76%, *n* = 7) (♂), 66% (62%–72%, *n* = 10) (♀); length along ventroexternal carina of length movable finger, 51% (47%–55%, *n* = 7) (♂), 53% (49%–55%, *n* = 10) (♀) (tables 4, 5). Dorsomedian carina obsolete. Digital carina absent, except proximal to base of fixed finger, obsolete, granular to costate-granular. Proventral and promedian carinae obsolete, granular, each indicated by prominent macroseta. Prodorsal carina absent, but indicated by prominent macroseta. Chela densely (♂) to moderately (♀) setose on fingers and distally on manus. Manus, retrodorsal surface predominantly smooth (♂) to reticulate (♀) proximally with shallow, anastomosing granules distally; retrolateral surfaces shallowly granular; ventral intercarinal surface smooth; prolateral intercarinal surfaces predominantly smooth, with scattered spiniform granules dorsally and distally. Fixed and movable fingers, pro- and retrolateral intercarinal surfaces finely and sparsely granular; median denticle rows each with six enlarged retrolateral denticles (including terminal denticle), proximal three (♀) or second and third most proximal (♂) retrolateral denticles on fixed and movable fingers situated on lobes; fixed finger proximal lobe, similar in size to medial lobe (♀, immatures), vestigial, much smaller than medial lobe, or absent (adult ♂); movable finger (adult ♂) without proximal lobe, median lobe markedly more pronounced than other lobes, and with correspondingly well-developed notch in fixed finger; prominent gap proximally between fingers, when closed (adult ♂).

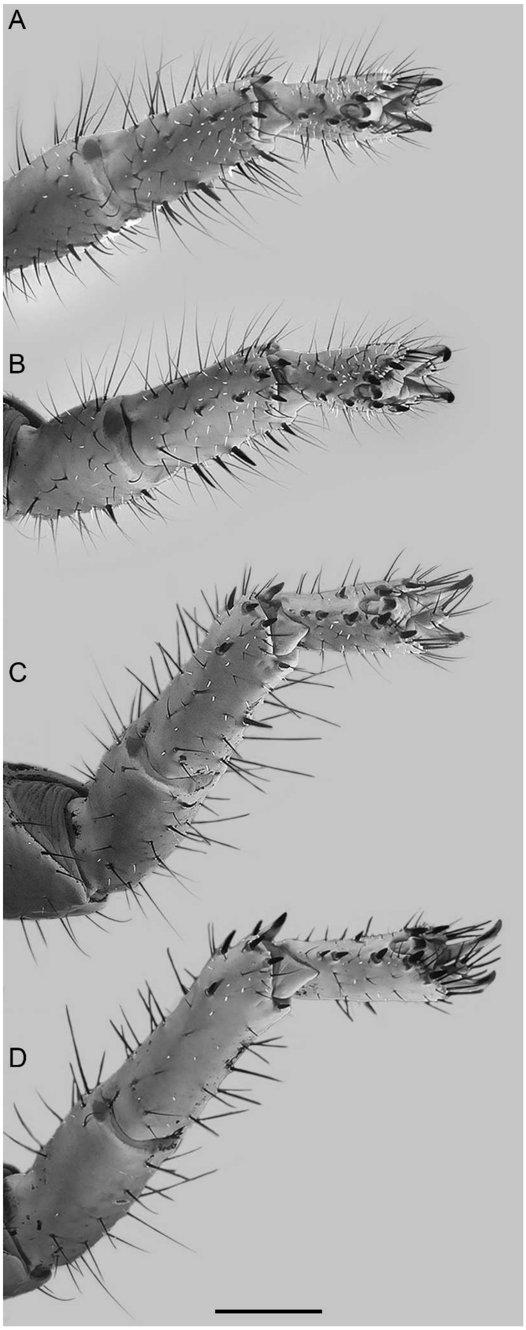


FIGURE 22. *Pandinoides militaris* (Pocock, 1900), ♂ (AMNH), Kishushe, Kenya, legs I–IV, tibiae, basitarsi and telotarsi, ventral aspect (**A–D**). Scale bar = 2.5 mm.

Trichobothria: As for *P. cavimanus*, except as follows. Neobothriotaxic major, Type C, with the following segment totals (*n* = 34; tables 4, 5): femur, 3 (1 *d*, 1 *i*, 1 *e*); patella, 51 (47–55): 2 *d*, 1 *i*, 34 (30–38) *v*, 14 (13–15) *e*, usually comprising 3 *et*, 2 *est*, 2 *em*, 2 *esb*, 5 *eb*; chela, 35 (33–36), manus, 22 (21–24), comprising 2 *D*, 10 *E*, 10 (9–12) *V*; fixed finger, 13 (12 or 13), comprising 4 *d*, 4 *e*, 5 (4 or 5) *i* (figs. 19–21). Total count of trichobothria per pedipalp: 89 (84–93). Chela, distance *et–est* half to less than half distance *est–esb*; *est* aligned with or distal to *dst*.

Legs: As for *P. cavimanus*, except as follows. Basitarsi, spiniform macrosetae, I, retrolateral: *t*, *st*, *sb*, *b* (polymorphic); retroventral: *t*; proventral: *t*, *st*; II, retrolateral: *t*, *st*, *sb*, *b* (polymorphic); retroventral: *t*; proventral: *t*, *st*; III, retrolateral: *t*, *sb*; retroventral: *t*; proventral: *t*, *st*; prolateral: *t*, *st*; IV, retrolateral: *t*; retroventral: *t*; proventral: *t*, *st*; prolateral: *t*, *st* (fig. 22). Telotarsi, macrosetal counts in pro- and retroventral rows equal on I–IV, 3 (1–4) and 4 (2–5) (*n* = 34), respectively (tables 4, 5). Telotarsal ungues subequal on telotarsi I–IV.

Pectines: As for *P. cavimanus*, except as follows. Distal edge reaching past distal edge of coxa IV but not reaching to distal edge of trochanter IV (♂, fig. 18B; ♀, fig. 18D). First proximal median lamella (scape) of each pecten with mesial margin obtusely angular, greater than 90° but less than 180° (♂) or sublinear (♀), and devoid of teeth in proximal 20% (14%–24%, *n* = 7) (♂) or 23% (10%–31%, *n* = 10) (♀) of prolateral margin (tables 4, 5). Pectinal tooth count, 14/15 (14–15/14–16, *n* = 7) (♂), 14/14 (14/13–15, *n* = 10) (♀).

Mesosoma: As for *P. cavimanus*, except as follows. Posttergites smooth and glabrous medially and anterolaterally, sparsely and finely granular posterolaterally. Sternite VII, length of width, 61% (49%–68%, *n* = 7) (♂), 56% (48%–67%, *n* = 10) (♀) (tables 4, 5).

Metasoma and Telson: As for *P. cavimanus*, except as follows. Metasomal segments I–V progressively increasing in length, decreasing in width; segment V, width of segment I width, 65% (58%–73%, *n* = 7) (♂), 63% (61%–67%, *n* = 10) (♀)

FIGURE 23. *Pandinoides militaris* (Pocock, 1900), ♂ (AMNH), Kishushe, Kenya, metasoma and telson, dorsal (**A**), lateral (**B**), and ventral (**C**) aspects. Scale bar = 5 mm.

(tables 4, 5). Metasoma robust; width of length, segment I, 95% (85%–121%, *n* = 7) (♂), 102% (90%–130%, *n* = 10) (♀); II, 80% (77%–83%, *n* = 7) (♂), 89% (79%–118%, *n* = 10) (♀); III, 73% (68%–79%, *n* = 7) (♂), 77% (70%–101%, *n* = 10) (♀); IV, 61% (53%–67%, *n* = 7) (♂), 65% (60%–85%, *n* = 10) (♀); V, 45% (38%–50%, *n* = 7) (♂), 50% (41%–55%, *n* = 10) (♀). Telson vesicle, width of metasomal segment V, width, 103% (87%–118%, *n* = 7) (♂), 90% (81%–110%, *n* = 10) (♀); enlarged (♂), globose, height of length, 59% (54%–70%, *n* = 7) (♂), 55% (49%–63%, *n* = 10) (♀); dorsal surface flat, ventral surface evenly curved. Aculeus relatively short, strongly curved, length of vesicle length, 33% (27%–37%, *n* = 7) (♂), 37% (33%–42%, *n* = 10) (♀). Length metasoma and telson, of total length, 49% (46%–52%, *n* = 7) (♂), 46% (42%–50%, *n* = 10) (♀). Dorsosubmedian carinae, segments I–IV, distinct, complete, granular, posterior spiniform granules obsolete; V, absent (fig. 23A). Dorsolateral carinae, segments I and II, obsolete, complete, granular; III–V, distinct, complete, granular. Median lateral carinae, segment I, obsolete, costate, restricted to posterior third; II–V, absent, demarcated by macroseta at posterior margin on I–IV and near anterior margin on V (fig. 23B). Ventrolateral carinae, segments I–IV, distinct, complete, costate on I–III, granular on IV; V, distinct, complete, comprising subspiniform granules, diverging posteriorly, terminal granule similar in size to preceding granules (fig. 23C). Ventrosubmedian carinae, segments I–III, distinct, complete, costate; IV, obsolete, complete, granular (♂) or costate-granular (♀); V, vestigial, each reduced to discontinuous row of spiniform granules, demarcated by conspicuous macrosetae. Ventromedian carina, segment V, comprising single row of spiniform granules, breaking up into numerous granules posteriorly. Dorsal and lateral intercarinal surfaces, segments I–V, smooth. Ventral intercarinal surfaces, segments I–III, smooth; IV and V, with scattered granules. Telson vesicle, dorsal and lateral surfaces smooth; ventral surface with four distinct longitudinal carinae, each comprising prominent spiniform granules, extending entire length of vesicle.

Geographical Variation: Specimens from the south of the distribution are usually yellowish brown in color, those from the north are reddish brown.

Ontogenetic Variation: As for *P. cavimanus*, except that immature stages are often markedly more infuscate than adults.

Sexual Dimorphism: As for *P. cavimanus*, except as follows. *Pandinoides militaris* is the most sexually dimorphic of the three species. The most obvious secondary sexual characters observed in adult males, compared with adult females and juveniles of both sexes, concern the modifications of the pedipalp chela: a marked concave depression is present in the retrodorsal surface of the manus, at the base of the fixed finger, the proximal lobe of the fixed finger is vestigial, much smaller than medial lobe, or absent, the proximal lobe of the movable finger is absent, the median lobe of the movable finger is markedly more pronounced than the other lobes, and a prominent gap is present proximally between the fingers, when closed (fig. 20A).

Distribution: Recorded from Ethiopia (Oromia Regional State), Kenya (Coast, Eastern, North Eastern and Rift Valley provinces) and Somalia (Gedo, Jubbada Hoose, Shabeellaha Dhexe and Shabeellaha Hoose regions). All records attributed to *P. cavimanus* from Somalia and most from Kenya, e.g., Kinani (Pocock, 1896) and Nguni, N of Ngomeni (Kovařík, 2009), are referable to *P. militaris* (fig. 2). The presence of *P. militaris* in Ethiopia is based on the type locality and an additional record, Arigalgalu [04°25′N 039°55′E], reported by Moriggi (1941: 94). Its presence in Tanzania remains to be confirmed, but unpublished reports of *P. cavimanus* from the vicinity of the Usambara Mountains may be referable to *P. militaris*. The alleged occurrence of *P. militaris* in Sudan (Lamoral and Reynders, 1975; Kovařík, 1998, 2002, 2009; Fet, 2000) is dubious. It was based on Roewer's (1943) record from "Dufile, Lado district, Sudan," which is in the Moyo District of northern Uganda [03°33′N 031°57′E] and remains to be confirmed.

ECOLOGY: The known locality records of *P. militaris* occur in arid savannah, dominated by *Acacia* and *Commiphora*, or riverine woodland dominated by *Salvadora* at 240–700 m elevation. Although several adult males were collected on the surface at night with UV light detection, most specimens for which data are available, were excavated from burrows during the day. *Pandinoides militaris* constructs burrows up to 75 cm long in red sandy-loam soils. A few specimens have been collected in or under rotten logs. This species is allopatric with *P. cavimanus* and parapatric with *P. duffmackayi*, sp. nov., but sympatric with *Pandinurus gregoryi* (Pocock, 1896), *P. exitialis*, and at least one species of *Pandinops* Birula, 1913. It appears to differ ecologically from *P. exitialis*, which has been collected under stones, and *P. gregoryi*, which has been collected under the peeling bark of fallen and standing trees.

CONSERVATION: This species has been recorded in at least three protected areas in Kenya: the Kora National Park, Samburu Game Reserve and Tsavo West National Park.

REMARKS: Pocock (1897b: 397, 398) regarded three specimens collected in Somaliland by A. Donaldson Smith as conspecific with *S. bellicosus*, stating:

> Three female examples, referred with some hesitation to this species [*Scorpio bellicosus* L. Koch], were collected, of which unfortunately only one, the smallest, is labeled with an exact locality. This was obtained near Aimola in the Boran country, 3,000 ft. 23.3.95. Fortunately, this example has the carapace of almost exactly the same length as the female example of *Sc. cavimanus*, Poc., from Ugogo, mentioned in Ann. Mag. Nat. Hist. (6), xvi., p. 431; and since it is largely upon the differences in measurements presented by these two specimens that the examples obtained by Dr. Smith are referred to *bellicosus* rather than to *cavimanus*, I give here their measurements:–
>
> ♀ of *cavimanus* from Ugogo. Total length, 92; length of carapace, 16; of tail, 46; of caudal segment 1 and 2, 12; of 4 and 5, 17.3; length of hand-back, 8.5; width of hand, 14; length of immovable digit along its free (untoothed) edge, 7.5; width of the same at the base, 5.
>
> ♀ of *bellicosus* [*militaris*] from the Boran country. Total length, 82; length of carapace, 15.5; of tail, 37; of its 1st and 2nd segments, 10; of 4 and 5, 13; length of hand-back, 7.6; width of hand, 11; length of immovable digit along its free edge, 8.5; width of latter at base, 3.8.
>
> These data show (1) that the tail as compared with the carapace is much shorter in *bellicosus* [*militaris*] than in *cavimanus*, the carapace in the former being shorter than the 4th and 5th caudal segments, whereas in the latter it is longer; and (2) that the immovable digit in *cavimanus* is much wider at the base as compared to its width than in *bellicosus* [*militaris*]. Corresponding features are presented by the two larger specimens ….

Pocock's (1897b: 397) statement should actually read "the carapace in the latter being shorter than the 4th and 5th caudal segments, whereas in the former it is longer."

Pocock (1898: 498) subsequently listed the specimen from Ndi (Weiss Road Camp), inland from Mombasa, as "? *Scorpio bellicosus*":

> A single female example collected by Mr. Betton resembles the females obtained in Somaliland by Dr. Donaldson Smith, which I have identified as *Scorpio bellicosus* of L. Koch. The accuracy of the determination, however, must remain a matter of doubt until the male is procured or until the genuine female of *bellicosus* comes to hand for comparison.

Following Kraepelin's (1899) rediagnosis of *P. bellicosus*, Pocock (1900b: 62) realized that the specimens previously determined to that species (Pocock, 1897b, 1898), were misidentified:

> I at one time supposed this species to be the female of the Abyssinian *P. bellicosus* L. Koch, but judging by Kraepelin's recent diagnosis of the latter species (Das Tierr., Scorpiones, p. 121, 1899), *P. militaris* certainly differs in having the superior caudal keels denticulated, the hand finely punctulate above and below, and the last abdominal sternite scarcely visibly crested.

Pocock (1900b: 61) described these specimens as *P. militaris*, diagnosing that species from *P. cavimanus* on the basis of the characters Pocock (1897b, 1898) had used to separate *P. bellicosus* from the latter:

> Nearly allied to *P. cavimanus* … but differing in the following characters:– the carapace in the female is longer than the 4th and 5th caudal segments, and the basal width of the immovable finger is only about half the length of its free margin; whereas in *P. cavimanus* (female symbol) the carapace is shorter than 4th and 5th caudal segments, and the basal width of the immovable digit is about two-thirds the length of its free margin.

Pocock's (1900b: 61) description of the holotype from El Dere near Aimola agrees with the redescription presented above:

> Colour yellowish brown; legs paler yellow, hand reddish brown with black fingers. Carapace granular laterally, entirely smooth above except for a few granules in the anteocular groove. Terga finely granular laterally. Tail a little more than two and a half times as long as the carapace, the inferior keels on segments 1–3 quite smooth, those on 4th at most slightly rugose; superior and superior-lateral keels of all the segments granular or weakly denticulated; superior surface of 1st granular, of 2nd less so; width of 1st exceeding length of 3rd, almost equal to that of 4th; 5th about twice as long as wide. Chelae: humerus granular above at least on its basal half, smooth below; brachium almost entirely smooth, its anterior side weakly granular above, more coarsely below; hand wide, its width in adult exceeding length of 3rd and 4th caudal segments, inner edge smooth, upper surface smooth, finely reticulated, a few low tubercles just above the keel of the underhand and at the base of the immovable digit; external portion of upper surface rising vertically above keel of underhand; thickness of hand at the front equal to length of 4th caudal segment. Lower side of hand granular distally, scarcely crested. Pectinal teeth 12–15. Measurements in millimetres (of type). Total length 112, carapace 19, tail 51; width of hand 16.8, underhand 10.5.

In spite of these consistent differences (and many others mentioned in the diagnosis, above), Kovařík (2002: 20) synonymized *P. militaris* with *P. cavimanus*, based solely upon an appeal to authority: "I have examined the types of both species and conclude that *Pandinus militaris* Pocock, 1900, is a junior synonym of *Pandinus cavimanus* (Pocock, 1888)." This synonymy was repeated by Kovařík (2003, 2009) and perpetuated by Rossi (2015a). In view of the abundant differences described herein, *P. militaris* is hereby revalidated.

Additional Material Examined: **KENYA:** 1 subad. ♂ (NMK 259), 1 ♀ (NMK 260), Ritcher?, 1 ♂ (NMK 258), iii.1969, imported, 1 ♀ (AMNH), 1994, ex M. Scharmach, pet trade, 1 ♀ (AMNH [LP 341]). **Coast Prov.:** *Taita Taveta Distr.*: Jora, Kasigau [03°35′S 038°36′E], vii.1965, R. Dio, 1 ♂ (NMK 240); Kishushe [03°17′S 038°18′E], 25.vii–8.viii.2008, S. Mwangi, collected in burrows, 2 ♂, 5 ♀, 1 subad. ♂, 17 juv. ♂, 16 juv. ♀ (AMNH), 1 juv. ♂ (AMCC [LP 8879]); Voi, Segala region [Sagala, 03°29′S 038°36′E], xii.1971, K. Werner, 3 ♀ (NHRM [JF 58]); Tsavo West National Park: Ndi [Ndii, 03°14′S 038°30′E], Weiss Road Camp, inland from Mombasa, C.S. Betton, collected during construction of Mombasa-Uganda railway, 1 juv. ♂ (BMNH); Tsavo, Taita Discovery Centre, 03°25′S 038°46′E, 27.iii.2000, R. Jocqué and C. Warui, *Acacia-Commiphora* forest, by hand on ground, 1 ♂ (MRAC 209.615), night catch around center, 2 ♂ (MRAC 209.644, 210.006). *Tana River Distr.*: Kora National Park: Kampiya Ndovu [00°05′S 038°46′E], 30.iii.1984, Kilamuntu, 1 subad. ♂ (NMK 241); Kora Base Camp, 2.viii.1983, Kora Research Project, 1 ♂, 1 ♀, 1 subad. ♀ (NMK 242); near Kora expedition camp, 20.viii.1983, A. Duff-Mackay, in nest with multiple entrances, in *Salvadora* bush, 1 juv. ♂, 2 juv. ♀ (NMK 243), 21.viii.1983, A. Duff-Mackay, in rotten log on ground, 2 juv. ♂ (NMK 244); Kora National Reserve, 26.ii.1984, A. Duff-Mackay, 1 ♀, 1 juv. ♂ (NMK 245 old 323); Kora National Reserve, near base camp, vii.1983, M. Ritchie, M. Collins, J. Muhangani and M. Coe, 2 ♀, 2 juv. ♂ (NMK 246); near Kora, S bank Tana River, 780 ft, 5.viii.1976, A. Duff-Mackay, three found together in one burrow, 4 entrances, 3 blocked, transition riverine forest, dry *Acacia/Commiphora*, 1 subad. ♂ (NMK 253 old 8); Nzoka, Kora reserve [00°07′S 038°46′E], 2.ii.1983, Kora Research Project, in burrow, 1 ♀, 6 juv. ♂, 2 juv. ♀ (NMK 558). Tana River, between coast and Kamega [Kamuga, 00°04′S 038°11′E], xi.1892, Chanler's Expedition, 1 ♂ (USNM 57-275), 1 ♂ (USNM 57-316). **Eastern Prov.:** *Machakos Distr.*: viii–ix.1976, Mutisya, specimens died in snake park, 1 subad. ♂, 1 subad. ♀, 1 juv. ♀ (NMK 257 old 68). Tsavo West National Park: Lugard Falls, Athi River [03°03′S 038°41′E], iii.1937, Hitchens, 3 juv. ♀ (NMK 247). *Makueni Distr.*: Mtito Andei [02°41′S 038°10′E], vi.1950, E.C. Swete-Kelly, 2 ♂ (NMK 248, 249), 1 ♀, 1 subad. ♂ (NMK 250); Tsavo West National Park: Kinani [Kenani, 02°51′S 038°20′E], J.W. Gregory, 1 ♂ (BMNH 1893.11.9.4); Kinani, 4 mi. S [02°55′S 038°23′E], J.W. Gregory, 1 ♂ (BMNH 1893.11.9.5); near Kenani River, 02°48′S 038°18′E, 2200 ft, 13.ix.1976, A. Duff-Mackay, dug from burrow, single entrance, *Acacia*/*Commiphora* on red sand, newly sloughed, 1 ♂ with exuvium (NMK 251 old 71), six specimens dug together from hole with five entrances, *Acacia*/*Commiphora* on red sand, debris from burrow collected, 1 juv. ♂, 1 juv. ♀ (NMK 252 old 72). *Kitui Distr.*: near Mitamisyi, 00°31′S 038°24′E, 2300 ft, 7.viii.1976, A. Duff-Mackay, in burrow with single elliptical entrance, in red sand, *Acacia*/*Commiphora* woodland, 1 subad. ♂ (NMK 254 old 11). *Marsabit Distr.*: North Horr, 8 km N, 03°23′N 037°05′E, 2600 ft, 11.vii.1987, A. Duff-Mackay, burrow straight 28 ins. and 2 ins. deep, 1 subad. ♂ (NMK 255 old 341). *Meru Distr.:* Mweru River, 13.viii.1909, S.M. Allen, 1 ♀ (MCZ 15512). **Rift Valley Prov.:** *Narok Distr.:* Northern Guaso Nigero [Ewaso Ngiro] River [01°09′S 035°46′E], 1909, Heller, 1 subad. ♂ (USNM). *Samburu Distr.*: Samburu Game Reserve [00°35′N 037°32′E], campsite 5 or 6, 1976, L. Williams, under tent, one jumped off bush (lighter) and one of same type found on log on fire, sympatric with *Pandinurus exitialis* [NMK 561 old 101], 1 subad. ♂ (NMK 256 old 101). **SOMALIA:** Somaliland, A. Donaldson Smith, 2 ♀ (BMNH, 1897.11.10.4–5); Somalia, imported for pet trade: iii.2008, ex A. Tietz, 1 ♂ (AMNH [LP 10206]), [leg] (AMCC [LP 8273]), 1 ♀, 1 subad. ♂ (AMNH). **Gedo Region:** Juba [Jubba] River, C.L. Chevallier, 1 ♂ (BMNH 12.10.15.1). **Shabeellaha Hoose Region:** *Afgooye Distr.*: Afgoi [Afgoye/Afgooye], 15 km S [02°02′N 045°01′E], 25.vii.1961, C. Gans, under stump, 1 ♂ (MCZ 15517).

HISTORY AND CRITIQUE OF THE TAXONOMY OF *PANDINUS*, SENSU LATO

The genus *Pandinus* was originally created to accommodate the tropical African species of *Scorpio* L., which Thorell (1876a) regarded as generically distinct, and appropriately accommodated within the genus *Heterometrus* Ehrenberg, 1828. Different opinions concerning the content and validity of these three genera, and *Palamnaeus* Thorell, 1876, later demonstrated to be a junior synonym of *Heterometrus* (Karsch, 1879), were presented by Simon (1872), Thorell (1876a, 1876b), Karsch (1879), and Pocock (1888, 1896). The matter was finally resolved by Kraepelin (1899), who listed nine species and three subspecies of *Pandinus*. Another 11 species and two subspecies were added subsequently (Pocock, 1897b, 1899, 1900a, 1900b, 1902; Borelli, 1901, 1919; Hirst, 1911; Werner, 1916; Caporiacco, 1937), one of which was later synonymized (Birula, 1927). When Vachon (1967) elevated *Pandinus imperator gambiensis* Pocock, 1899, to the rank of species, *Pandinus* comprised five subgenera, 24 species, and two subspecies.

The first attempt to subdivide the variation within *Pandinus* was a detailed study by Birula (1913), wherein subgenus *Pandinops* Birula, 1913, was created. Building on this work, Vachon (1974) redefined *Pandinops* and the nominotypical subgenus, and created three new subgenera, all diagnosed on the basis of differences in the counts of pedipalp trichobothria, to accommodate 23 species of *Pandinus*. Vachon (1974) neglected to designate type species for the three new subgenera, however, resulting in two nomina nuda. Upon the designation of type species, *Pandinoides* and *Pandinurus* Fet, 1997, took Fet's (1997) name as author, whereas the monotypic *Pandinopsis* Vachon, 1974, retained its original authorship.

Following Lamoral and Reynders (1975), Fet (2000) listed five subgenera, 24 species, and two subspecies of *Pandinus*, and formally synonymized *Pandinus africanus* Thorell, 1876, with *Pandinus imperator* (C.L. Koch, 1841). Five species and two subspecies were included in the nominotypical subgenus, three species in subgenus *Pandinoides*, four in subgenus *Pandinops*, one in subgenus *Pandinopsis*, and 10 in subgenus *Pandinurus*. *Pandinus boschisi* Caporiacco, 1937, was not assigned to a subgenus by Vachon (1974).

Two and a half decades later, taxonomic work on *Pandinus* resumed when Kovařík (2000) synonymized *Scorpio pugilator* Pocock, 1900, with *Pandinus* (*Pandinurus*) *bellicosus* (L. Koch, 1875), transferred the latter to subgenus *Pandinops*, and described a new species thereof. Kovařík (2002) synonymized *Pandinoides militaris* with *Pandinoides cavimanus* (discussed above). Kovařík (2003) described another new species of subgenus *Pandinops*, proclaimed *Pandinus boschisi* to be a nomen dubium, and synonymized *Scorpio gregoryi* Pocock, 1896, with *Pandinus* (*Pandinurus*) *exitialis* (Pocock, 1888), *Scorpio africanus subtypicus* Kraepelin, 1894, with *Pandinus* (*Pandinurus*) *magrettii* Borelli, 1901, and *Pandinus intermedius* Borelli, 1919, and *Pandinus citernii* Borelli, 1919, with *Pandinus* (*Pandinus*) *phillipsii* (Pocock, 1896).

Prendini (2000b) presented the first analysis of *Pandinus* phylogeny, testing and confirming the monophyly of the genus with morphological characters scored for exemplar species representing three of the subgenera, as part of a larger phylogenetic analysis of superfamily Scorpionoidea Latreille, 1802. Prendini et al. (2003) subsequently tested and again confirmed the monophyly of *Pandinus*, based on exemplar species representing all five subgenera, in the first and, to date, only phylogenetic analysis of the genus using morphological characters and multilocus DNA sequence data from the nuclear and mitochondrial genomes. Prendini et al. (2003) also presented the first comprehensive morphological diagnosis for *Pandinus* and synthesized all that was known about the distribution, biology, and conservation status of its species. Prendini (2004) presented comprehensive distribution maps for the three West African species recognized at the time.

Following an illustrated summary and key to the five subgenera and 21 species of *Pandinus* recognized by Kovařík (2009), wherein *P. gregoryi* was revalidated from synonymy by Kovařík (2003), there has been renewed interest in the systematics of the genus. First, Kovařík (2011, 2013b) described three new species of subgenus *Pandinus*, while Kovařík (2012) described three new species of subgenus *Pandinurus*. Next, Lourenço (2014) described a new species of subgenus *Pandinus* and revalidated *Pandinus roeseli* (Simon, 1872), originally synonymized by Thorell (1893). Lourenço (2014: 141) neglected to cite previous work by Kovařík (2000, 2003, 2009, 2011, 2012, 2013b), Prendini (2000b, 2004), and Prendini et al. (2003) and condescendingly remarked that "little serious research has been carried out on *Pandinus*." Last, and perhaps ironically in response to Lourenço's (2014) call for "serious research," Rossi (2014a, 2014b, 2014c, 2014d, 2015a, 2015b, 2015c) followed with seven contributions in which the historical subgenera of *Pandinus* were elevated to genera, four new subgenera (subgenus *Pandinoriens* Rossi, 2015, of *Pandinus*, and subgenera *Pandiborellius* Rossi, 2015, *Pandicaporiaccous* Rossi, 2015, and *Pandipalpus* Rossi, 2015, of *Pandinurus*) created, and 14 new species (three new *Pandinus* and 11 new *Pandinurus*) described, more than doubling the number of species in *Pandinus*, sensu lato, listed five years earlier by Kovařík (2009) to 43.

Unfortunately, the new developments have confused, rather than clarified, the taxonomy of these scorpions. Despite Rossi's (2015a: 10) claim that the decision to elevate the historical subgenera of *Pandinus* to genera was based on "previous phylogenetic and molecular studies" (i.e., Prendini et al., 2003), in addition to morphological evidence, the revised classification was not justified by a quantitative analysis. Prendini et al. (2003: 230) did not test the monophyly of the subgenera (each was represented by a single exemplar in the analysis) and indeed questioned their validity on first principles:

> the cladistic validity of the subgenera of *Pandinus*, which are defined solely on the basis of differences in the counts of pedipalp trichobothria, remains to be tested. Their dubious validity is evidenced by the obviously erroneous placement of species that, despite differing slightly in trichobothrial count, appear to be closely related on the basis of other morphological characters, as well as DNA sequence data. Examples include the West African species *P. dictator* and *P. imperator*, respectively placed in *Pandinopsis* Vachon, 1974 and the nominal subgenus, and the east African species *P. cavimanus* and *P. viatoris* (Pocock, 1890), respectively placed in *Pandinoides* Fet, 1997 and *Pandinurus* Fet, 1997.

Kovařík (2009: 50) did not cite Prendini et al. (2003) in his book, but his comments regarding the subgenera of *Pandinus* are rather similar:

> I accept the five subgenera as defined by Vachon (1974) on the numbers of internal and ventral trichobothria on the pedipalp chela .… However, the presented habitus photos alone show that the morphology and expressions of sexual dimorphism indicate relations across the subgeneric limits. Evident is for instance a close relationship of *P.* (*Pandinopsis*) *dictator* with *P.* (*Pandinus*) *gambiensis* and *P.* (*Pandinus*) *imperator*, although the latter two are currently placed together with *P.* (*Pandinus*) *phillipsii* and *P.* (*Pandinus*) *smithi*, whose morphology, sexual dimorphism and geographic distributions rather indicate closer relations with most species of the subgenus *Pandinurus*. In contrast, this [sic] subgenera do not very well fit the Arabian *P.* (*Pandinurus*) *arabicus* and *P.* (*Pandinurus*) *percivali*, and definitely not *P.* (*Pandinurus*) *viatoris* which has a unique sexual dimorphism. On the other hand, truly related appear to be species assigned to subgenus *Pandinops* Birula, 1913, which closely resemble each other in size, morphology and sexual dimorphism.

Rossi (2015a: 16) neglected to address the criticisms of Prendini et al. (2003) and Kovařík (2009), instead suggesting that because differences in trichobothrial counts formed the primary basis for distinguishing other scorpion genera, e.g., *Hoffmannihadrurus* Fet and Soleglad, 2004, from *Hadrurus* Thorell, 1876 (contested by Francke and Prendini, 2008), *Kolotl* Santibanez-Lopez et al., 2014, from *Diplocentrus* Peters, 1861, and *Kovarikia* Soleglad et al., 2014, from *Pseudouroctonus* Stahnke, 1974, and *Uroctonites* Williams and Savary, 1991, this should also be true of *Pandinus*:

> Recenti studi su altri scorpioni hanno dimostrato l'esistenza di due generi distinti, strettamente affini, all'interno di un dato genere, in molti casi distinguibili principalmente per differenze tricobotriali come nel caso di *Hoffmannihadrurus* Fet & Soleglad, 2004 o *Kolotl* Santibáñez-López, Francke & Prendini, 2014 (Fet et al., 2004; Santibáñez-López et al., 2014), separati rispettivamente da *Hadrurus* Thorell, 1876 e *Diplocentrus* Peters, 1861. Un altro recente caso di descrizione di un nuovo genere è rappresentato dal nordamericano *Kovarikia* Soleglad, Fet & Graham, 2014, la cui differenza principale dai due generi più affini (*Pseudouroctonus* Stahnke, 1974 ed *Uroctonites* Williams & Savary, 1991) è costituita dalla presenza di un tricobotrio ventrale della chela in più rispetto agli altri due generi (Soleglad et al., 2014).

This argument is not credible for the following reasons. To begin with, the differences in trichobothrial counts in the examples cited by Rossi (2015a) were bolstered by additional characters and, in two of the examples cited, the monophyly of the genera was tested (and in one analysis, refuted) by quantitative phylogenetic analysis. Furthermore, there are many scorpion genera in which the variation in trichobothrial counts is similar to or greater than that observed in *Pandinus*, sensu lato, even among closely related species, yet these genera have not been subdivided because there are few other convincing characters to support doing so. Examples include the genera *Anuroctonus* Pocock, 1893, *Hadogenes* Kraepelin, 1894, *Heteroscorpion* Birula, 1903, and *Urodacus* Peters, 1861, each in a different family (Prendini and Wheeler, 2005). Applying the approach of Vachon (1974) and Rossi (2015a) to *Hadogenes*, for example, would place *Hadogenes polytrichobothrius* Prendini, 2006, and *Hadogenes soutpansbergensis* Prendini, 2006, in different genera, despite the many characters that unite them, along with other species of the genus (Prendini, 2000b, 2001c, 2006). Whereas neobothriotaxic patterns with low counts may provide appropriate diagnostic characters for genera and species, in combination with other characters, this is generally inadvisable when trichobothrial counts are high, due to the greater instability of the patterns. This was recognized early on by Lamoral (1979: 658) when discussing the diagnostic utility of trichobothria in the species of *Hadogenes*: "External and ventral trichobothria of handback and tibia are numerous and numerically and distributionally too variable for diagnostic purposes." In a general discussion about trichobothriotaxy, Lamoral (1979: 519) stated:

> The frequency of … variations is higher in cases of marked (+) neobothriotaxies reaching levels where the trichobothriotaxies of certain segmental surfaces cease to be of interspecific value, e.g., the external trichobothria of the tibia in *Opisthophthalmus holmi* and the ventral trichobothria of the tibia in species of *Hadogenes* …. While trichobothria have proved to be of diagnostic value in many taxa, trichobothriotaxy must be used with caution. Its value varies from group to group and both intra- and interspecific variation needs to be studied.

The availability of large series, comprising both sexes and all stages, of the three *Pandinoides* species covered in the present contribution revealed considerable variation in the counts of pedipalp trichobothria, spiniform macrosetae on the leg telotarsi, and pectinal teeth, both within and among conspecific populations, and even from left to right on a single individual (tables 1–5). These data emphasize the importance of assessing both intra- and interspecific variation when delimiting scorpion species, especially neobothriotaxic forms, using such characters, as noted by Lamoral (1979). Unfortunately, many of Rossi's (2014a, 2014b; 2015a, 2015b, 2015c) putative new species were described on the basis of small samples or singletons (often females and immatures), from unique (and sometimes imprecise or dubious) localities, despite the prevalence of geographical variation, sexual dimorphism, and ontogenetic variation in Scorpionidae (Prendini, 2001a; Prendini et al., 2003; Tahir and Prendini, 2014) and many other scorpion taxa. Examples include *Pandinurus* (*Pandiborellius*) *vachoni* Rossi, 2014, based on an immature male from an indefinite locality in Chad, *Pandinurus* (*Pandipalpus*) *pygmaeus* Rossi, 2015, and *Pandinurus* (*Pandicaporiaccous*) *janae* Rossi, 2015, both based on immatures, and *Pandinurus* (*P.*) *prendinii* Rossi, 2015, based on a female from an erroneous locality in South Africa (see below). The criticism is not unique to Rossi's (2014a, 2014b; 2015a, 2015b, 2015c) contributions. For example, the description of *Pandinus* (*Pandinurus*) *somalilandus* Kovařík, 2012, was based on two immature females and a juvenile, *Pandinus* (*Pandinurus*) *awashensis* Kovařík, 2012, on an adult male, an immature female, and five juveniles. In all cases, the authors implied that the specimens here cited as immature were adult, despite abundant evidence (e.g., size, pigmentation, and surface macrosculpture) to the contrary (Kovařík, 2012: 4, 5, 7, 9–11, figs. 14–24, 29–34, 36; Rossi, 2015a: 63, fig. 122). Indeed, the holotype of *P. vachoni* was identified as a subadult male by the author in 1998 (Rossi, 2014b: 9, fig. 3; 2015a: 57, 61, 63, figs. 67–73, 99–105, 123).

A detailed reassessment of the species and supraspecific taxa of *Pandinus*, sensu lato, is beyond the scope of the study presented here. It is clear, however, that there are severe deficiencies with defining genera, subgenera, and even species of *Pandinus*, sensu lato, on trivial meristic differences between small samples of material examined (often singletons, and often female or immature), given the high variation among and even within individual conspecifics. In light of these considerations, 10 new synonyms are presented below concerning taxa with which the author is familiar.

TEN NEW SYNONYMS IN *PANDINUS*, SENSU LATO

Genus *Pandinus* Thorell, 1876

Subgenus *Pandinus* Thorell, 1876

Pandinus (*P.*) *imperator* (C.L. Koch, 1841)

Buthus imperator C.L. Koch, 1841: 1, 2, pl. CCLXXXIX, fig. 695.

Heterometrus roeseli Simon, 1872: 53, 54, pl. VI, fig. 4 (first synonymized by Thorell, 1893: 377), syn. nov.

Pandinus africanus Thorell, 1876b: 128, 202, 203 (synonymized by Fet, 2000: 466).

Scorpio simoni Becker, 1880: 137–140, pl. II, fig. 1 (synonymized by Thorell, 1893: 377).

Pandinus (*P.*) *camerounensis* Lourenço, 2014: 143–149, table 1, figs. 12–19, syn. nov.

Type Material: *Buthus imperator:* [types lost; type locality unknown]. *Heterometrus roeseli*: [types lost or not designated; type locality probably in coastal Guinea (Lourenço, 2014: 142)]. *Pandinus* (*P.*) *camerounensis*: Holotype ♂ (ZMH), 3 ♂, 2 ♀ paratypes (MNHN, ZMH), Sanguéré-Djoi/Kismatari/Djalingo regions (ca. 09°23.229′N–013°50.068′E), Cameroon, viii.2011–xi.2012, P. Prudent, cotton and tomato fields, some collected in termite mounds.

Remarks: Lourenço (2014) revalidated *Pandinus roeseli* (Simon, 1872), originally synonymized by Thorell (1893) and described a new species of *Pandinus*, *P. camerounensis*, in a contribution he presumably considered to be "serious research." The justification for Lourenço's (2014: 143, 147, 149) decisions was based on the following argument (italics added):

> If the trichobothrial patterns for both *P. dictator* and *P. gambiensis* are clearly diagnostic, a number of *semi-distinct* populations from Western Africa can be associated to *P. imperator* (Lourenço & Cloudsley-Thompson 1999). The study of some *Pandinus* recently collected in the north of Cameroon (in a zone of transition between the Sahel and Savannas) showed a similar trichobothrial pattern but exhibited other distinctive characters to that of '*P. imperator*' collected from areas of rain forests. For this reason, I decided to explore the morphology of the hemispermatophores. This character has been largely used in many similar groups with great success (e.g. Lamoral, 1979, Lourenço 1987, 2009), but was largely neglected in the study of *Pandinus*. I also extended this analysis to male specimens of the Coastal region of Guinea (cf. *P. roeseli*) and to specimens from south of Togo/Ghana, 'a priori' cospecific with *P. imperator.* The results are presented in the key below (see also Figures 8–12). Since the hemispermatophore structure is quite distinct for these three populations, *P. roeseli* is reestablished here as a valid species, and a new species is described from the North of Cameroon. Further studies will be necessary to clarify the status of all West-African populations and future molecular investigation would contribute greatly to this subject …. *Pandinus camerounensis* sp. n., is here distinguished from *Pandinus imperator* (Koch, 1841) and from *Pandinus roeseli* (Simon, 1872), the two most geographically related species of the genus, mainly by their global size and structure of the hemispermatophores. The first two species are bigger in size, reaching total lengths of 150 to 180 mm. The structure of hemispermatophores are quite distinct in the three species (see Figs 8–12). In *P. imperator* the distal lamina is weakly curved and the basal portion larger than the distal one; a tubercular structure is present on its apex. In *P. roeseli* the distal lamina is shorter than in the other two species and globally large.

Lourenço's (2014: 145, 147) "serious" analysis appears to be based on five specimens, in addition to the six comprising the type series of *P. camerounensis*: a male *P. roeseli* from Kindia, Guinea; a male *P. imperator* from SE Notsé, southern Togo; a female *P. imperator* from Edéa, southern Cameroon; and two female *P. imperator* from Eboname [actually, Ebomane], northern Gabon. Aside from the small sample size, the identification of the alleged *P. imperator* specimens from Cameroon and Gabon is questionable, because there are no credible records of this species east of the Massif de l'Adamaoua, between Cameroon and Nigeria (Prendini, 2004). Neither Rossi (2014d: 49, fig. 1), who claimed that data were included from Lourenço (2014), nor Kovařík (2011: 15, fig. 42) before him plotted a single point for *P. imperator* in southern Cameroon or northern Gabon in the maps each author reproduced from Prendini's (2004: 255) fig. 13.

The putatively diagnostic difference in total body length between *P. camerounensis* (95–110 mm) vs. *P. imperator* and *P. roeseli* (150–180 mm), largely meaningless given the small sample size, breaks down when the raw data presented by Lourenço (2014: 147) are examined more closely. The specimen of *P. roeseli* from Kindia is cited as 115 mm in total length, the specimen of *P. imperator* from Notsé, 155 mm, and the specimen from Edéa, almost certainly referable to *P. dictator*, 163 mm. An assessment of size variation among the material examined for the present study suggests the existence of a north-south cline in body size, associated with an aridity gradient, across the entire range of *P. imperator*, such that individuals in the arid north, e.g., Mouvielo, Burkina Faso (NM 14004), are on average smaller than those in the humid south, e.g., Kakum National Park, Ghana (AMNH), rendering indistinct any populations thought to be "semi-distinct" based on the examination of a handful of specimens.

The putatively diagnostic differences in hemispermatophore structure between *P. imperator* and *P. roeseli* described by Lourenço (2014: 147, 149), which cannot be discerned from the superficial illustrations presented, must also be disregarded given the lack of quantification and, especially, the small sample size (although unspecified, it may be concluded that only three hemispermatophores were examined, one from each putative species). Finally, in response to Lourenço's (2014) comment regarding the need for molecular investigation, it may be noted that ongoing research has revealed low levels of genetic divergence between small-bodied and large-bodied populations of *P. imperator* from the rainforests and Sahel regions of West Africa, supporting the morphological evidence of a single panmictic population (L. Prendini, unpublished data).

In view of the above, *H. roeseli* is hereby returned to synonymy with *P. imperator* and *P. camerounensis* newly synonymized therewith: *Heterometrus roeseli* Simon, 1872 = *Pandinus* (*P.*) *imperator* (C.L. Koch, 1841), syn. nov.; *Pandinus* (*P.*) *camerounensis* Lourenço, 2014 = *Pandinus* (*P.*) *imperator* (C.L. Koch, 1841), syn. nov.

ADDITIONAL MATERIAL EXAMINED: 1 ♂ (AMNH). West Coast Africa, G.A. Perkins, 1 ♀ (MCZ). W. Africa, 1997, 1 juv. ♀ (NHRM [JF 68]), 1996, G. Alroth, 1 ♀ (NHRM [JF 69]). **BENIN: Alibori Dept.:** *Banikoara Commune*: Chutes de Koudou, 'W' Park, 11°40.43′N 003°18.51′E, 31.v.2005, V. Vignoli and S. Tchibozo, 229 m, 1 subad. ♂ (AMCC [LP 4837]), 1.vi.2005, V. Vignoli and S. Tchibozo, 258 m, 1 ♀ (AMCC [LP 4833]). *Karimama Commune*: near Djona on Alibory River, 11°40′N 002°50′E, v.1964, J.A. MacKallor, 1 juv. ♂ (USNM). **Atakora Dept.:** *Tanguiéta Commune*: Pendjari Park, 11°27.07′N 001°34.02′E, 8.vi.2005, V. Vignoli & S. Tchibozo, 171 m, 1 juv. ♂ (AMCC [LP 4832]). **Borgou Dept.:** *Bembèrèkè Commune*: Riviere Dere, Forêt Classée d'Ouenou-Benou, Gando village, 10°12.09′N 002°39.05′E, 3.vi.2005, V. Vignoli and S. Tchibozo, 420 m, 1 ♀ (AMCC [LP 4836]). **Collines Dept.:** *Dassa-Zoumè Commune*: 'La caverne,' 07°46.32′N 002°11.12′E, 13.vi.2005, V. Vignoli and S. Tchibozo, 187 m, 1 ♀ (AMCC [LP 4834]), 13.vi.2005, V. Vignoli and S. Tchibozo, 187 m, 1 juv. (AMCC [LP 4835]). *Savé Commune*: Ferme Founfoun à 1 km de Savacon [Savakon, 07°15′N 002°04′E], 30.iii.1997, D. Meirte, sous bois mort, 1 subad. ♂ (MRAC 208.379). **BURKINA FASO: Sud-Ouest Region:** *Bougouriba Prov.*: Mouviélo [10°46′N 003°08′W], Upper Volta, s/p Diébougou [10°58′N 003°15′W], 30.iv.1980, Dr Prost, de nuit au sol [at night on ground], 1 ♀ (NM 14004). **CÔTE D'IVOIRE:** Sismos, 13.ii.1963, J.F. Jezequel, 1 ♂ (MNHN RS 4149). SNB, 24.iii.1963, pres. Cpt. Tenko, J.F. Jezequel, 1 ♂ (MNHN RS

4150). **Abidjan Autonomous Distr:** Adiopo Doumé [05°20′N 004°07′W], 17.viii.1966, 1 ♀ (MRAC 130.708); Ivory Coast, Banco Forest [05°22′N 004°03′W], ii.1989, J. Visser, 2 ♀ (SAM C4509, C4510), 1 subad. ♂ (SAM C4508); Bingerville, 05°21′N 003°53′W, 1962, J. Decelle, 2 ♂ (MRAC 123.726), xii.1963, J. Decelle, 1 ♂ (MRAC 126.978). **Comoé Distr.:** *Indénié-Djuablin Region*: Appouessou, Forêt Classée Bossematie, Eco. Forest, 06°35′N 003°28′W, pitfall, Station 2E, 18.iii.1994, R. Jocqué and N. Séabé, 1 juv. ♀ (MRAC 205.479), Station 2B, 3.v.1994, R. Jocqué and N. Séabé, 1 juv. ♀ (MRAC 205.480), Station 2C, 9.iv.1995, Jocqué and Tanoh, 1 juv. ♀ (MRAC 205.309), Station 2B, 9.iv.1995, Jocqué and Tanoh, 1 juv. ♀ (MRAC 205.310). **Lagunes Distr.:** *Agnéby-Tiassa Region*: Lamto, station écologique, 06°13′N 005°02′W, 2.iv.1963, J.F. Jezequel, dans une case, 1 ♂ (MNHN RS 4148). **Montagnes Distr.:** *Cavally Region*: Toyébli [Tiobli, 06°37′N 008°29′W], 2–3.viii.1966, Verheyen and Thys v.d. Audenaerde, 7 ♂, 13 ♀ (MRAC 130.717), 29–30.viii.1966, Verheyen and Thys v.d. Audenaerde, 11 ♂, 9 ♀ (MRAC 130.718); Village km 7 route Toulépleu–Liberia [06°32′N 008°30′W], 2.viii.1966, Verheyen and Thys v.d. Audenaerde, 16 ♂, 6 ♀ (MRAC 130.719), 20 ♂, 9 ♀ (MRAC 130.720). *Tonkpi Region*: Flampleu, 07°17′N 008°03′W, 20–24.vii.1966, W. Verheyen and D. Thys van den Audenaerde, 2 juv. ♂ (MRAC 131.048, 131.049). **Sassandra-Marahoué Distr.:** *Marahoué Region*: Danangoro, 07°11′N 005°56′W, iii.1977, P.M. Elsen, 1 juv. ♂ (MRAC 160.473). **Vallée du Bandama Distr.:** *Gbêkê Region*: Bouaké Sessénoua (forêt), 07°41′N 005°09′W, 9.vii.1962, J.F. Jezequel, 1 ♀ (MNHN RS 4202), 1964, J.F. Jezequel, galeries forestieres et case, 1 ♂ (MNHN RS 4207), 1 ♂, 1 ♀ (MNHN RS 4208), 23.iii.1964, J.F. Jezequel, 1 ♂ (MNHN RS 4203). **Yamoussoukro Autonomous Distr:** Kossou, 06°57′N 004°58′W, 13.iv.1975, R. Jocqué, 1 subad. ♂ (MRAC 160.528), 13.v.1975, R. Jocqué, 2 juv. ♂ (MRAC 160.529), v.1975, R. Jocqué, 2 juv. ♂, 1 juv. ♀ (MRAC 161.991). **Vallée du Bandama Distr.:** *Gbêkê Region*: Bouaké, 07°41′N 005°02′W, vi.1977, P.M. Elsen, 1 juv. ♀ (MRAC 160.472), v.1977, P.M. Elsen, 1 juv. ♂ (MRAC 160.474). *Hambol Region:* Chaussée de Badika[ha], riv. Bandama blanc, 09°12′N 005°10′W, 22.viii.1985, G. Teugels, 1 juv. ♂ (MRAC 168.783). **GHANA:** F. Cotterill, 2 ♂, 1 subad. ♂, 1 juv. ♂ (NHMZ 13/27). Imported for pet trade: x.1997, ex D. Taylor, 1 ♂ (AMCC 101703 [LP 1601]). **Brong-Ahafo Region:** Mive, Brongh Ahafo, 26.iv.1991, Tyle, 1 ♂ (NHRM [JF 48]). **Central Region:** *Cape Coast Distr.*: Cape Coast [05°06′N 001°14′W], Univ. Cape Coast Collection, J. Boggs, 1 ♂, ♀, 5 juv. (AMNH); Cape Coast, 15.vi.1969, 1 subad. ♂ (USNM). *Twifo/Heman/Lower Denkyira Distr.*: Kakum National Park: 05°21.359′N 001°23.016′W, 24.i.2014, S.M. Mwangi, 654 ft, UV in deep burrow, 1 subad. ♀, 2 juv. ♂, 10 juv. ♀ (AMNH); Abrafu village, 05°20.175′N 001°22.689′W, 27.i.2014, S.M. Mwangi, 403 ft, 1 ♂, 2 subad. ♀, 1 juv. ♀ (AMNH), 3 juv. ♂, 2 juv. ♀ (AMNH), 1 juv. ♂ (AMCC [LP 12326]); 05°20.480′N 001°22.661′W, 27.i.2014, S.M. Mwangi, 540 ft, at night with UV, 1 ♂, 2 subad. ♂, 2 subad. ♀ (AMNH). Kakum Regeneration Forest, Abrafu village, 05°18.918′N 001°22.552′W, 28.i.2014, S.M. Mwangi, 451 ft, 1 ♂, 3 subad. ♂, 3 subad. ♀, 1 juv. ♀ (AMNH). **Eastern Region:** *East Akim Distr.*: Tafo [06°13′N 000°22′W], residential area, in garden of bungalow, at base of dead plantain, excavated chambers in soil terrarium, iii–iv.1946, R.G. Donald, 2 ♂, 1 juv. (AMNH). **Volta Region:** *South Dayi Distr.*: Wegbe [07°07′N 000°27′E], Togoland, W. Innes, 1899, 1 ♀ (SAM 6353). **Western Region:** *Jomoro Distr.*: Ankasa National Park, 05°12.928′N 002°39.557′W, 30.i.2014, S.M. Mwangi, 228 ft, collected in casava farm, killed by farmer, 1 ♂ (AMNH). *Juabeso-Bia Distr.*: Bia National Park (Kunkumso Park): 06°37.327′N 003°03.342′W, 3.ii.2014, S.M. Mwangi, 823 ft, during day in cocoa farm adjacent to park, 1 ♀, 1 subad. ♂, 3 juv. ♂ (AMNH), 1 ♀, 17 juv. ♂, 10 juv. ♀ (AMNH), 1 juv. ♂ (AMCC [LP 12325]); near Appa So Twin wells, 06°36.526′N 003°04.449′W, 3.ii.2014, S.M. Mwangi, 733 ft, at night with UV near the burrow, 1 subad. ♂ (AMNH); camp 15, 06°32.665′N 003°01.965′W, 3.ii.2014, S.M. Mwangi, 767 ft, on ground, killed by villager in forest, 1 ♂ (AMNH). **LIBERIA:** Colonization Society, J.O. Wilson, 1 ♂ (USNM 30467). **Bong Co.:** *Fuamah Distr.*: Dobli Island [06°53′N 010°23′W], Bequaert, 1 ♂ (MCZ). *Jorquelleh Distr.*: Gibanga [Gbanga, 07°00′N 009°28′W], Harvard Exped., 3 ♂, 2 ♀, 1 subad. ♂, 1 juv. ♂ (MCZ). **Grand Bassa Co.:** *Distr. 4*: Ganta [05°38′N 009°48′W], 1932, 2 ♀ (AMNH 32332). **Gbarpolu Co.:** *Belleh Distr.*: Bell[e] Yella [Beliyela, 07°23′N 010°00′W], iii.1940, W.M. Mann, Smithsonian Institution-Firestone Expedition, 1 ♂ (USNM). **Grand Gedeh Co.:** *Tchien Distr.*: Zwedru (Tchien) [06°04′N 008°08′W], Eastern Prov., J.J. Baldwin Jr., 1 ♂ (USNM 177246); Zwedru [06°01′N 008°09′W], 6.vi.1947, Jensen, 1 juv. ♀ (USNM). **Margibi Co.:** *Gibi Distr.*: Gibi [06°40′N 010°00′W], 1940, W.M. Mann, Smithsonian Institution-Firestone Expedition, 1 ♂, 1 subad. ♂ (USNM). **Montserrado Co.:** *Careysburg Distr.*: Mt. Coffee [06°30′N 010°36′W], 1896, O.F. Cook, 5 ♂, 1 ♀ (USNM), 1899–1900, Rev. George P. Goll, 1 ♀ (USNM). *Greater Monrovia Distr.*: Monrovia [06°18′N 010°48′W], 1 ♂ (MCZ), 29.vii.1963, R.N. Nilson, 2 ♂ (CAS), 06°19′N 010°48′W, 1975, W.G. Johnson, 8 ♂, 5 ♀ (MRAC 147.335). **Nimba Co.:** *Sanniquelleh-Mahn Distr.*: Oldtown Gobonwea, 225 mi from Monrovia, 40 miles E Mt. Nimba [07°33′N 008°37′W], Charles D. Miller III, at night, with aid of light, they frequent rocky outcrops in the bush, frequently come out during the day after heavy rains, 2 ♂, 2 ♀ (AMNH), 4 ♂, 3 ♀ (USNM); Yekepa Nimba, 07°35′N 008°32′W, 15.iii.1980, M. Louette and P. Rigaux, 1 ♂ (MRAC 155.160). **NIGERIA:** x.1996, 1 ♂ (NHRM [JF 49]). **Kaduna State:** *Kaduna Local Government Area* (*LGA*): Kaduna [10°36′N 007°27′E], N Nigeria, ii.1958, W. McDonald, 1 ♀ (AMNH); Randa [09°07′N 008°29′E], N Nigeria, Rev. Judd, 1 ♂, 1 ♀, 1 subad. ♀ (AM 4657). **Kogi State:** *Idah LGA*: Iyale, 60 miles S [N] Idah [07°39′N 007°17′E], Kwara State, i.1970, L. Dick, 1 juv. ♀ (AMNH). **Nassarawa State:** *Keana LGA*: Keana [08°08′N 008°48′E], N Nigeria, 2 ♀ (AM 4008, 4050), 1 subad. ♂ (AM 4268). *Lafia LGA*: Wana [08°50′N 008°28′E], N Nigeria, 1 ♂, 2 ♀ (AM 8481), 1 juv. ♂ (AM 6644). **Ogun State:** *Odeda LGA*: Oloke Meji [07°25′N 003°32′E], Ibadan, 2 ♀ (USNM). **Oyo State:** *Ibadan LGA*: Ibadan, 07°14′N 003°50′E, ix.1968, S. Afolabi Toye, 1 ♂, 1 ♀ (MRAC 134.308). **Plateau State:** *Jos LGA*: Jos, 09°55′N 008°54′E, 7–26.iv.1963, Meussen and Bouguiaux, 1 juv. ♀ (MRAC 123.774), x–xii.1965, E. Bot Gwong, 1 juv. ♂, 2 juv. ♀ (MRAC 130.639). **SIERRA LEONE: Northern Region:** *Port Loko Distr.*: Pepel Town, 08°35′N 013°03′W, ix.1976, D. Olu-Pitt, 1 juv. ♂ (MRAC 148.502). **Western Region:** *Western Area Urban Distr.*: Freetown, 08°30′N 013°15′W, Pepel Town, iv.1977, D. Olu-Pitt, 1 juv. ♀ (MRAC 159.087). **TOGO:** 1 ♂, 3 ♀, 1 juv. (AMNH); viii.2004, B.R. Tomberlin, 1 ♀ (AMCC [LP 3082]). **Centrale Region:** *Soutouboua Prefec.*: Fazao [08°42′N 000°46′E], 20–24.viii.1969, F. Puylaert, 1 ♂, 2 ♀ (MRAC 200.957 ex 135.994). **Kara Region:** *Assoli Prefec.*: Bafilo, Aledje [Alédjo], 09°15′N 001°12′E, 19.vii.1969, F. Puylaert, 1 subad. ♀ (MRAC 136.007). *Doufelgou Prefec.*: Niamtougou, 09°46′N 001°06′E, 21–24.vii.1969, F. Puylaert, 2 ♂, 1 ♀ (MRAC 136.005). **Maritime Region:** *Lacs Prefec.*: Togoville, 06°14′N 001°29′E, 11–17.ix.1969, F. Puylaert, 1 ♂ (MRAC 136.006), 1 ♀ (MRAC 200.958 ex 135.995), 2 juv. ♂, 2 juv. ♀ (MRAC 136.008). **Plateaux Region:** *Ogou Prefec.*: Atakpamé, Kolekepe [Kolokopé], 07°28′N 001°19′E, 26–31.viii.1969, F. Puylaert, 1 ♂ (MRAC 136.004); Badou, 07°37′N 000°37′E, 17.vii.1968, W. Verheyen and coll., 1 ♂ (MRAC

134.644). **Savanes Region:** *Kpendjal Prefec.*: Nanergou, 10°55′N 000°09′E, 17.viii.1968, W. Verheyen and coll., 7 ♂, 11 ♀ (MRAC 134.642).

Erroneous Records: Kenya, 1 ♂ (AMNH). Lake Mary, 5 mi. SW Sanford, Seminole Co., Florida, U.S.A., v.1984, sent by D. Viekers, Univ. Central Florida, Orlando, 1 ♂ (AMNH 32816).

Genus *Pandinurus* Fet, 1997

Subgenus *Pandinurus* Fet, 1997

Pandinurus (*P.*) *sudanicus* Hirst, 1911

Pandinus exitialis sudanicus Hirst, 1911: 219.
Pandinurus (*P.*) *prendinii* Rossi, 2015a: 20, 21, 53, figs. 29–37, syn. nov.

Type Material: *Pandinus exitialis sudanicus*: Holotype ♀ (BMNH), Gebel Mts., S of Obeid [North Kordofan], Sudan. *Pandinurus* (*P.*) *prendinii*: Holotype ♀ (HNHM 1443), Messina [Musina], Transvaal [Limpopo Province], South Africa, 1976, A. Héjja.

Distribution: The two new records from South Sudan presented here, while a considerable distance south of the type locality and Kovařík's (2012: 12) additional record (Lagowa, Kordofan)—both situated in Sudan, not South Sudan, as stated by Kovařík (2012)—are clearly conspecific with the latter based on similar size, coloration, macrosculpture (anastomosing tubercles) on the retrodorsal surface of the pedipalp chela manus in the adult male and female, and counts of pedipalp trichobothria and pro- and retroventral spiniform macrosetae on the telotarsi.

Remarks: *Pandinus exitialis sudanicus* Hirst, 1911, was synonymized with *Pandinus magrettii* Borelli, 1901, by Birula (1927: 85). Kovařík (2012: 3, 6) revalidated the taxon and elevated it to the rank of species, a move that appears to be reasonable, based on material examined for the present contribution. The retrodorsal surface of the pedipalp chela manus in the adult male and female of *P. sudanicus* comprises anastomosing tubercles, as in *P. magrettii*, rather than conspicuously pointed granules, as in *P. exitialis*, and the medial lobe on the chela movable finger of the adult male is considerably larger than the other lobes on the finger, as in *P. exitialis*, which is not the case in *P. magrettii*.

Rossi (2015a: 20, 21) described *Pandinurus* (*P.*) *prendinii* on the basis of a single female, allegedly from Messina in the Limpopo Province of South Africa, noting its close morphological similarity to *P. sudanicus* including, for example, the macrosculpture on the retrodorsal surface of the pedipalp chela manus in the adult female, which comprises anastomosing tubercles, evident in Rossi's (2015a: 53) figures 32 and 33. Two other workers (F. Kovařík, in 1996; B.F. Striffler, in 2002) previously examined the specimen and identified it as "*Pandinus* sp.," probably on account of the erroneous locality data. The meristic data (total body length, pedipalp trichobothrial counts, pectinal tooth counts and counts of spiniform macrosetae in the pro- and retroventral rows of the telotarsi) listed as diagnostic for *P. prendinii* by Rossi (2015a: 20) fall entirely within the ranges given for *P. sudanicus* two pages later (table 6). The suggestion that *P. prendinii* may represent a relictual population of *Pandinus,* sensu lato in southern Africa, and that, because the putative type locality is 5000 km from the known localities of *P. sudanicus*, this could justify its recognition as distinct from the latter rests entirely on the grossly mistaken assumption that the locality data are trustworthy, an assumption doubted by others (Kovařík, 1997). Despite extensive surveys of scorpions throughout southern Africa, including the vicinity of Messina, by the author, there are no credible records of *Pandinus,* sensu lato, from south of the Zambezi River, as noted by Prendini et al. (2003; also see Prendini, 2005), and especially not south of the Limpopo River. In view of the evidence, the following new synonym is presented: *Pandinurus* (*P.*) *prendinii* Rossi, 2015 = *Pandinurus* (*P.*) *sudanicus* (Hirst, 1911), syn. nov.

TABLE 6
Putatively diagnostic meristic data for species of *Pandinurus* Fet, 1997, provided by Rossi (2015a): total body length (mm); counts of trichobothria in *V* series of pedipalp chela manus; pectinal tooth counts; counts of spiniform macrosetae in pro- and retrolateral rows of telotarsi I–IV.

	Total length	Chela *V*	Pectines	Telotarsi			
				I	II	III	IV
Pandinurus (*P.*) *sudanicus*	85–110	10–12	16–22	5/4	6–7/4	6–7/4–5	6–7/4–5
Pandinurus (*P.*) *prendinii* [= *P. sudanicus*]	86	11–12	18–17	6/4	6/4	7/5	7/5
P. (*Pandiborellius*) *percivali*	100	8	21–22	7/5	7/5	8/5	8/5
P. (*Pandicaporiaccous*) *janae* [= *P. percivali*]	80–90	7	19–21	4/3	4–5/3	5/3	5/3
P. (*Pandipalpus*) *viatoris*	97	9–10	14–14	4/3	4/3	4/3	4/3
P. (*Pandipalpus*) *bartolozii* [= *P. viatoris*]	100–110	8	13–15	4/3	4/3	4/3	5/3
P. (*Pandipalpus*) *flagellicauda* [= *P. viatoris*]	100–125	7–9	13–15	4/3	4–5/3	5/3	5–6/3–4
P. (*Pandipalpus*) *lorenzoi* [= *P. viatoris*]	110	8	14–15	4/3	4/3	5/3	5/3
P. (*Pandipalpus*) *pantinii* [= *P. viatoris*]	97	9	14–15	4/3	4/3	4/3	4/3
P. (*Pandipalpus*) *pygmaeus* [= *P. viatoris*]	83	8	14	4/3	4/3	4–5/3	5/3

ADDITIONAL MATERIAL EXAMINED: **SOUTH SUDAN: Boma State:** Boma National Park [06°29′N 033°55′E], base camp, 8.iv.1983, T. Tear, 2 ♂ (AMNH). **Eastern Equatoria State:** Torit [04°25′N 032°34′E], Equatoria, Anglo-Egyptian Sudan, 2000 ft, xii.1949, H. Hoogstraal, 2 ♂, 6 ♀, 2 subad. ♂, 3 juv. ♂, 2 juv. ♀ (FMNH). **SUDAN: Blue Nile State:** Ingessana Hills, SW of Roseires, 11°27′N 033°59′E, xii.1968, J.L. Cloudsley-Thompson, 1 ♀ (MRAC 134.601).

Subgenus *Pandiborellius* Rossi, 2015

Pandiborellius Rossi, 2015a: 10, 11, 13, 15, 17, 18, 31–35, 38, 40, 42, 62, 63, 66, figs. 106–123, 126, type species: *Pandinus magrettii* Borelli, 1901 [= *Pandinurus* (*Pandiborellius*) *magrettii* (Borelli, 1901)].

Pandicaporiaccous Rossi, 2015a: 10, 11, 13, 15, 17, 18, 29–31, 35, 36, 39, 41, 43, 57, 65, table 1, figs. 67–73, 125, type species: *Pandinurus* (*Pandicaporiaccous*) *janae* Rossi, 2015, syn. nov.

REMARKS: In accordance with the synonymy of *Pandinurus* (*Pandicaporiaccous*) *janae* Rossi, 2015, with *Pandinurus* (*Pandiborellius*) *percivali* (Pocock, 1902) below, the following new synonym is presented: *Pandinurus* (*Pandicaporiaccous*) Rossi, 2015 = *Pandinurus* (*Pandiborellius*) Rossi, 2015, syn. nov.

Pandinurus (*Pandiborellius*) *percivali* (Pocock, 1902)

Pandinus percivali Pocock, 1902: 368–370.

Pandinurus (*Pandicaporiaccous*) *janae* Rossi, 2015a: 10, 11, 13, 29–31, 35, 36, 39, 41–43, 57, 65, table 1, figs. 67–73, 125, syn. nov.

TYPE MATERIAL: *Pandinus percivali*: Holotype ♀ (BMNH 1899.12.2.5) [examined], Al-Khaur, Abian country, 80 mi. E of Aden, Arabia [Yemen]. *Pandinurus* (*Pandicaporiaccous*) *janae*: Holotype ♀ [immature] (HNHM 1442), paratype ♀ (ARPC 0253 ex HNHM), Wadi Zabid, Yemen, xi.1969, A. Szalay-Marzsó.

REMARKS: Rossi (2015a) based *P. janae* and the new monotypic subgenus into which it was placed, on a single female from the general vicinity of the type locality of *P. percivali*, the species to which it was previously determined by other workers (F. Kovařík, in 1996; B.F. Striffler, in 2002). Rossi (2015a: 31) mistakenly regarded the specimen from Wadi Zabid to be adult, an assumption that formed the basis of his conclusion that it was misidentified by Kovařík (1997, 2009) and his justification for its description as a new species and subgenus:

> le uniche citazioni di questa specie sono di Kovařík (1997, 2009), come misidentificazioni di *P.* (*Pandiborellius*) *percivali* comb. n., che, come precedentemente esposto, costituisce una specie nettamente diversa ed appartenente ad un altro sottogenere. Kovařík cita due esemplari femmina di Wadi Zabid nelle collezioni di HNHM (Kovařík, 1997) e curiosamente cita una femmina della medesima località presente nella sua collezione privata (Kovařík, 2009). La femmina in questione viene accreditata di una lunghezza di 115 mm, ma la cosa non trova conferma nella diagnosi pubblicata poche righe prima (Kovařík, 2009) dove la specie viene data con una lunghezza massima di 110 mm. Il materiale tipico esaminato, invece, ha una lunghezza compresa fra 80 e 90 mm circa. Un altro fatto insolito è il dimorfismo sessuale menzionato da Kovařík (2009) per questa specie (misidentificata come *Pandinurus percivali* comb. n.), espresso da una maggior grandezza del telson nel maschio. In realtà né di *P. janae* n. sp. né di *P. percivali* comb. n. sono noti esemplari maschi (Kovařík, 2012).

It is, however, clear from Rossi's (2015a: 36, 57, table 1) meristic data and figures 67–73, that the holotype of *P. janae* is immature and, based on the distinctive shape of the pedipalp chela and the prominent costate carinae on the manus, as well as the metasoma and habitus, that it is indeed conspecific with *P. percivali* as F. Kovařík and B.F. Striffler surmised. The putatively diagnostic differences in total body length between *P. janae* and *P. percivali* may be dismissed on account of the immaturity of the holotype of the former. The pedipalp trichobothrial and pectinal counts of *P. janae* are close to those of *P. percivali* (table 6). In the absence of other significant differences, the lower counts of spiniform macrosetae in the pro- and retroventral rows of the telotarsi of *P. janae* cannot justify its recognition as distinct from *P. percivali*, because the sample sizes (*n* = 2 for *P. janae*; *n* = 1 for *P. percivali*) are far too small to assess the variation, and anomalous telotarsal setal counts are not uncommon in scorpionids, based on thousands of specimens examined by the author. In view of the evidence, the following new synonym is presented: *Pandinurus* (*Pandicaporiaccous*) *janae* Rossi, 2015 = *Pandinurus* (*Pandiborellius*) *percivali* (Pocock, 1902), syn. nov.

Subgenus *Pandipalpus* Rossi, 2015

Pandinurus (*Pandipalpus*) *viatoris* (Pocock, 1890)

Scorpio viatoris Pocock, 1890: 100, 101, pl. I, fig. 1.
Pandinurus (*Pandipalpus*) *bartolozii* Rossi, 2015a: 10, 11, 22–26, 28, 37, 40, 42, 55, 65, table 2, figs. 46–56, 125, syn. nov.
Pandinurus (*Pandipalpus*) *flagellicauda* Rossi, 2015a: 10, 11, 22–25, 28, 29, 34, 37, 39, 41, 56, 65, table 2, figs. 57–66, 125, syn. nov.
Pandinurus (*Pandipalpus*) *lorenzoi* Rossi, 2015a: 10, 11, 13, 23, 25, 26, 29, 37, 40, 42, 58, 65, table 2, figs. 74–80, 125, syn. nov.
Pandinurus (*Pandipalpus*) *pantinii* Rossi, 2015a: 10, 11, 26, 27, 37, 39, 41, 60, 65, table 2, figs. 90–98, 125, syn. nov.
Pandinurus (*Pandipalpus*) *pygmaeus* Rossi, 2015a: 10, 11, 26, 28, 29, 36, 39, 41, 61, 65, table 1, figs. 99–105, 125, syn. nov.

Type Material: *Scorpio viatoris*: Holotype ♂ (BMNH 1890.4.15.1) [examined], "East Africa" [probably Malawi or Zambia]. *Pandinurus* (*Pandipalpus*) *bartolozii*: Holotype ♂ (MZUF 1059), allotype ♀ (MZUF 1456), Kolwezi, Shaba, Democratic Republic of the Congo (D.R.C.), ii.1990, D. Mosca. *Pandinurus* (*Pandipalpus*) *flagellicauda*: Holotype ♂ (MZUF 1457), allotype ♀, 4 ♀ paratypes (MZUF 1458), 1 ♂, 1 ♀ paratypes (ARPC 0251, 0252 ex MZUF), Kolwezi, Shaba, D.R.C., ii.1990, D. Mosca. *Pandinurus* (*Pandipalpus*) *lorenzoi*: Holotype ♂ (ARPC 0024), Morogoro, Kigulunyembe, Mt. Uluguru, Tanzania, 18-31.iii.2008. *Pandinurus* (*Pandipalpus*) *pantinii*: Holotype ♂ (MSNB), Balaka, Malawi, xii.2004, E. Ferrario. *Pandinurus* (*Pandipalpus*) *pygmaeus*: Holotype ♀ [subad.] (MSNB), Likasi, S.-E. Shaba, D.R.C., ii.1986, K. Tshikamba.

The type locality of *P. viatoris* is unknown, but the holotype described by Pocock (1888) probably originated from former British colonial territory, either Northern Rhodesia (now Zambia) or Nyasaland (now Malawi), rather than former German colonial territory (Tanganyika, now Tanzania) as suggested by Rossi (2015a: 65, fig. 125). There are at present no confirmed records of *P. viatoris* from Kenya (former British East Africa).

Distribution: Prendini et al. (2003: 234) discussed putative records of *P. viatoris* from Zimbabwe, demonstrated that these records actually occur in Zambia, and noted that there are no credible records of *Pandinus* south of the Zambezi River. Kovařík (2012: 19, fig. 64) did not cite Prendini et al. (2003) and erroneously plotted three points for *P. viatoris* south of the Zambezi River, one in the extreme north of Zimbabwe (presumably, the specimen erroneously labelled "Mashonaland" [ZMB 35310]) and two in Mozambique, corresponding to the approximate locations of Tete and Beira, where this species does not appear to occur based on surveys by the author. Rossi (2015a: 29) discussed the reliability of Kovařík's (2012) Zimbabwean record, but apparently missed the point about the Zambezi River, as he did not mention the other two localities, and went on to describe a new *Pandinurus* species allegedly from Messina, in the Limpopo Province of South Africa (see above).

Remarks: Rossi (2015a) described five new species in a new subgenus *Pandipalpus*, three based on singletons, among them an immature specimen, two from the same locality in the Democratic Republic of the Congo, and one from a locality nearby. With one exception, the meristic data (total body length, pedipalp trichobothrial counts, pectinal tooth counts and counts of spiniform macrosetae in the pro- and retroventral rows of the telotarsi) listed as diagnostic for the five species by Rossi (2015a: 23–25, 27, 28, 36, 37, table 1, 2) overlap entirely with one another and with the ranges given for *P. viatoris* (reproduced here in table 6) with which they are evidently conspecific. The putatively diagnostic difference in total body length between *P. pygmaeus* and the other species may be dismissed on account of the immaturity of the holotype of the former. As with *P. janae*, discussed above, Rossi (2015a: 29) mistakenly regarded the holotype of *P. pygmaeus* to be adult and this assumption formed the basis of his justification for its recognition as a new species: "*Pandinurus* (*Pandipalpus* subgen. n.) *pygmaeus* n. sp. ha dimensioni minori, 83 mm, contro 100–125 mm." It is, however, clear from Rossi's (2015a: 28, 36, 61, table 1) meristic data and figures 99–105 that the holotype of *P. pygmaeus* is immature and that it is conspecific with *P. viatoris*. The holotypes of *P. bartolozii* and *P. flagellicauda*, originally part of the same series of specimens, were previously examined by F. Kovařík (in 1997), considered conspecific, and identified as *P. viatoris* (Kovařík and Whitman, 2005: 114; Kovařík, 2012: 21). Curiously, Rossi (2015a: 25) appears to have regarded the sympatric occurrence of these specimens as evidence for their distinctiveness, despite the lack of data supporting any possible ecological difference:

> *Pandinurus* (*Pandipalpus* subgen. n.) *flagellicauda* n. sp. vive in simpatria con la specie *Pandinurus* (*Pandipalpus* subgen. n.) *bartolozzii* n. sp. dalla quale differisce in modo netto. Purtroppo il raccoglitore non ha allegato informazioni ecologiche ai campioni raccolti per cui possiamo solo ipotizzare che le due specie condividano lo stesso ambiente della foresta pluviale.

In view of the evidence, the following new synonyms are presented: *Pandinurus* (*Pandipalpus*) *bartolozii* Rossi, 2015 = *Pandinurus* (*Pandipalpus*) *viatoris* (Pocock, 1890), syn. nov.; *Pandinurus* (*Pandipalpus*) *flagellicauda* Rossi, 2015 = *Pandinurus* (*Pandipalpus*) *viatoris* (Pocock, 1890), syn. nov.; *Pandinurus* (*Pandipalpus*) *lorenzoi* Rossi, 2015 = *Pandinurus* (*Pandipalpus*) *viatoris* (Pocock, 1890), syn. nov.; *Pandinurus* (*Pandipalpus*) *pantinii* Rossi, 2015 = *Pandinurus* (*Pandipalpus*) *viatoris* (Pocock, 1890), syn. nov.; *Pandinurus* (*Pandipalpus*) *pyg-*

maeus Rossi, 2015 = *Pandinurus* (*Pandipalpus*) *viatoris* (Pocock, 1890), syn. nov. Ongoing research has revealed low levels of genetic divergence between populations of *P. viatoris* in Malawi and Tanzania, further supporting the conclusion that *P. viatoris* is a single, panmictic species (L. Prendini, unpublished data).

Additional Material Examined: 1 subad. ♀ (AMNH). **DEMOCRATIC REPUBLIC OF CONGO: Haut-Katanga Prov.:** Lukafu, 10°31′S 027°33′E, 1930, G.F. de Witte, 1 ♀ (MRAC 61.608 old 23.806), 6–22.xii.1930, G.F. de Witte, 3 juv. ♀ (MRAC 23.970–972), 1 juv. ♂, 2 juv. ♀ (MRAC 23.973–975); Monasterie N.O. de Béthanie [04°24′S 019°19′E], Katanga, 10°00′S 027°00′E, 1947, R.R. Soeurs, 1 ♂ (MRAC 57.722). **Haut-Lomami Prov.:** Bukama, 09°12′S 025°51′E, 1937, P. Brien, 1 ex. (MRAC 168.782); Kabongo, 07°20′S 025°35′E, 1952, Dierkx, 1 ♀ (MRAC 73.615); Kamina [08°44′S 024°59′E], Luabo [09°03′S 024°47′E], 1949, Ecole Normale, 1 ♀ (MRAC 65.801); Kisanga [06°51′S 024°10′E], Kele [06°55′S 023°10′E], Katanga, 1959, R.F.A. van Oost, 5 ex. (MRAC 207.425). **Lualaba Prov.:** Muema, 10°25′S 024°49′E, 1927, A. Bayet, 3 ♂, 2 juv. (MRAC 130.812), 3 ex. (MRAC 130.813). Zilo [10°30′S 025°28′E], Shaba, v.1991, 1 ♂ (NHRM [JF, 57]). **Maniema Prov.:** Misosa [?Musasa, 03°53′S 026°49′E], vii.1939, H.J. Bredo, 13 ex. (MRAC 57.597–610), 19 ex. (MRAC 57.611–630), 19 ex. (MRAC 57.631–650). **North Kivu Prov.:** Beni, 00°29′N 029°28′E, Lisfrane, 1 ♂, 1 ♀ (MRAC 57.743). **Tanganyika Prov.:** Tanganika, J. Hecq, 1 ♂ (MRAC 130.814); Baudouinville [Kirungu], 07°02′S 029°47′E, iii.1954, H. Bomans, 1 juv. (MRAC 78.968). **KENYA: Rift Valley Prov.:** *Narok Distr.:* S Guaso Nejiro, Toita plains, 1 subad. ♀ (USNM). **MALAWI: Southern (Blantyre) Region:** *Mangochi Distr.*: Fort Johnston [Mangochi, 14°29′S 035°16′E], Sir Alfred, 1 ♂ (TM 17462 ex AM 2179); Mangochi [14°28′S 035°16′E], Rift Valley 1 ♂ (AMNH); Monkey Bay [14°03′S 034°55′E], 14.vii.1975, D. Eccles, 1 ♀ (AMNH [AH 204]), 3 juv. ♂ (AMNH [AH 191, 192, 230]), 2 juv. ♀ (AMNH [AH 229, 231]), 19.vi.1975, D. Eccles, found in burrow with mother, 1 juv. ♂, 1 juv. ♀ (AMNH), 23.xii.1993, C.R. Owen, 1 juv. ♂, 1 juv. ♀ (NHRM [JF 140]); Monkey Bay, ca. 1 km S on road S128 to Mangochi, 14°06′25″S 034°55′01″E, 13.xii.2007, L. Prendini & W.R. Schmidt, 485 m, mesic savanna (Miombo Woodland) on flat plain with low granite/dolerite koppies (plains in between), coarse sandy-loam soils, UV light detection on warm, dark (overcast), humid night after rain, sitting motionless on soil surface near base of tree, 1 ♂ (AMNH), [leg] (AMCC [LP 8025]). *Zomba Distr.*: Chinsewu Village, 20.5 km W Zomba on Namadidi Road, 15°19′20″S 35°11′28″E, 11–14.xii.2007, L. Prendini, W.R. Schmidt & R. Mbaya, 584 m, mesic savanna (Miombo Woodland) remnants on flat plain in old lands (subsistence agriculture/hoed fields of maize) in between freshly-hoed lands, well-drained sandy/clayey-loam soil, excavated from burrows in open ground and at base of bushes, burrows often multi-entranced, with several individuals (mixed sex and age) occupying same burrow, 13 ♂, 14 ♀, 6 subad. ♂, 9 subad. ♀, 21 juv. ♂, 20 juv. ♀ (AMNH), 2 juv. ♀ (AMCC [LP 8026]). **MOZAMBIQUE:** Chifurubasi, iv–v.1905, W. Tiesler, 1 ♂ (ZMB 1092/05). **Nampula Prov.:** *Nampula Distr.*: Nampula Mountain [Nampula, 15°07′S 39°16′E, iii.1976, K. Groseh, 1 ♀ (NM 10984). **Zambézia Prov.:** *Gurué Distr.*: Lioma [15°10′S 036°48′E], 22.ii.2001, C.R. Owen, 1 ♀ (NHRM [JF 110]), 1 subad. ♂ (NHRM [JF 112]), 28.ii.2001, C.R. Owen, 1 ♀ (NHRM [JF 111]). **TANZANIA:** Imported for pet trade, probably Serengeti area, 1994, ex M. Scharmach, 2 ♂, 1 subad. ♀, 1 juv. ♂ (AMNH [LP 332]), 2 ♂ (AMNH [LP 337]), 1 ♂ (AMCC 101704 [LP 1557]). **Arusha Prov.:** *Karatu Distr.*: Karatu, 03°21.177′S 035°48.871′E, 6.viii.2015, M. Roppo, 1264 m, 1 juv. [leg] (AMCC [LP 13453]). **Dodoma Prov.:** *Kondoa Distr.*: Kath Mission, Kwa Mtoro [05°14′S 035°26′E], Ussandawi, i–ii.1912, Dr. E. Obst, 1 ♂, 2 ♀, 1 subad. ♀ (ZMH). **Lindi Prov.:** *Kilwa Distr.*: Mbarawala Plateaux, 09°02.374′S 039°07.206′E, 29.ii–4.iii.2008, P. Hawkes, 270 m, 1 ♂ (AMNH). *Liwale Distr.*: Liwale [09°08′S 038°17′E], iv.1948, C.P.J. Iomides, 1 ♂ (NMK 295). **Mara Prov.:** *Serengeti Distr.*: Serengeti, 1 ♀ (NMK 298), x.1949, 1 ♂ (NMK 296), ii.1959, 1 juv. ♂ (NMK 297 old 42). Serengeti National Park, Wandamu Kopjes, 02°29.441′S 034°55.367′E, 1.viii.2015, M. Roppo, 1523 m, 1 juv. [leg] (AMCC [LP 13452]). **Rukwa Prov.:** *Mpanda Distr.*: Lake Tanganyika, Smithsonian Institution African Expedition, 1 ♂ (USNM 156/396); Mpanda town, 06°30′S 031°30′E, xii.1980, K.M. Howell, 1 ♀ (MRAC 159.310). **Singida Prov.:** *Singida Distr.*: Mangasini [04°53′S 034°09′E], 14.xii.1929, A. Loveridge, 2 ♂, 1 ♀ (MCZ 15573); Usandawi, 1929–1930, Fliegner, 1 ♀ (ZMB 146D/33); Usandawi, Mangasini [04°53′S 034°09′E], 13.xii.1929, A. Loveridge, 1 juv. ♀ (MCZ 15572). **ZAMBIA: Eastern Prov.:** *Chipata Distr.*: Chief Sayiri area, 30 mi. from Fort Jameson [Chipata, 13°38′S 032°39′E], 6–18.i.1965, V.J. Wilson, 2 ♂, 2 subad. ♂, 2 subad. ♀, 1 juv. ♂ (NM 9090); Fort Jameson, V.L. Wilson, 2 ♂, 2 ♀ (NM 18772), i.1965, V.J. Wilson, 1 ♂ (TM 17461). **Northern Prov.:** *Mpulungu Distr.*: Mpulungu, 08°46′S 031°08′E, 1994, P.D. Plisnier, 1 ♂ (MRAC 209.525).

Erroneous Record: Mashonaland [Zimbabwe], 1893, R. Bartels, 1 ex. (ZMB 35310 old 1247/1911).

ACKNOWLEDGMENTS

I thank the past and present curators and collection managers at the following institutions for loans of material from the collections in their care and/or for assisting the author during personal visits to the collections: Sarah Gess and John Midgley (AM), Janet Beccaloni, Paul Hillyard, and Erica McAlister (BMNH), Charles Griswold, Darrell Ubick, and Lauren Esposito (CAS), Petra Sierwald (FMNH), G.B. Edwards (FSCA), Gonzalo Giribet and Laura Liebensperger (MCZ), Mark Judson and the late Christine Rollard (MNHN), Rudy Jocqué and Didier van den Spiegel (MRAC), Moira FitzPatrick and Francis Nyathi (NHMZ), Torbjorn Kronestedt and Julio Ferrer (NHRM), Michelle Hamer, Dai Herbert, and Chrizelda Stoffels (NM), Laban Njoroge (NMK), Dawn Larsen and Simon van Noort (SAM), Martin Krüger and Audrey Ndaba (TM), Jonathan Coddington, Scott Larcher, Dana de Roche, and Hannah Wood (USNM), Jason Dunlop and Shahin Nawai (ZMB), Hieronymus Dastych (ZMH), and Nikolaj Scharff (ZMUC); Joe Beraducci, Peter Hawkes, and Massimiliano Roppo for material from Tanzania; Samuel Mwangi for material from Kenya; Asel Zhetigenova (AMNH) for recording the measurement data in this contribution; Michelle and Peter Bradshaw for preparing the map; Randy Mercurio and Corwin Trent for live habitus photographs; Steve Thurston (AMNH) for preparing the plates; and Tharina Bird and Ricardo Botero-Trujillo for constructive comments on the manuscript.

REFERENCES

Becker, L. 1880. Études sur les scorpions. Annales de la Société Entomologique de Belgique 24: 134–145.

Belfield, W. 1956. A preliminary check list of the West African scorpions and key for their identification. Journal of the West African Science Association 2: 41–47.

Birula, A.A. 1913. Arachnologische Beiträge II–IV. (II. Ueber einige *Scorpiops*-Arten von dem Südabhange des Himalaya. III. Ueber *Pandinus* (*Pandinops*) *peelei* Poc. und seine Verwandten. IV. Ueber das Vorkommen der gemeinen Perlmutterzecke (*Dermacentor reticulatus* [Fabr.] - Ixodidae) in den mittleren Teilen Westrusslands). Revue Russe d'Entomologie 13: 416–423.

Birula, A.A. 1915a. Arachnologische Beiträge. V. Weitere Bemerkungen über die Skorpionen-Fauna Britisch Ost-Afrikas. Revue Russe d'Entomologie 15: 50–65.

Birula, A.A. 1915b. A general list of the scorpions of British East Africa. Scientific results of the zoological expedition to British East Africa and Uganda made by Prof. V. Dogiel and I. Sokolow 1: 1–31.

Birula, A.A. 1927. Wissenschaftliche Ergebnisse der mit Unterstützung der Akademie der Wissenschaften in Wien aus der Erbschaft Treitl von F. Werner unternommenen zoologischen Expedition nach dem Anglo-Aegyptischen Sudan (Kordofan) 1914. XXV. Skorpione. Denkschriften der Akademie der Wissenschaften in Wien, Mathemathisch-naturwissenschaftliche Klasse 101: 79–88.

Borelli, A. 1901. Materiali per la conoscenza della fauna Eritrea raccolti dal Dott. Paolo Magretti.

Bollettino dei Musei di Zoologia ed Anatomia Comparata della Reale Università di Torino 16: 1–5.

Borelli, A. 1919. Missione per la frontiera italo etiopica sotto il comando del Capitano Carlo Citerni. Risulti Zoologici. Scorpioni. Annali del Museo Civico di Storia Naturale di Genova (3) 8: 359–381.

Borelli, A. 1925a. Scorpioni nuovi o poco noti della Somalia italiana. Annali del Museo Civico di Storia Naturale di Genova 52: 9–16.

Borelli, A. 1925b. Di alcuni scorpioni della Somalia italiana. Annali del Museo Civico di Storia Naturale di Genova 51: 317–326.

Caporiacco, L. di. 1937. Su alcuni scorpioni dell'Africa orientale italiana del Civico Museo di Milano. Atti della Società Italiana di Scienze Naturali 76: 355–362.

Donaldson Smith, A. 1896. Expedition through Somaliland to Lake Rudolf. Geographical Journal 8: 120–137.

Donaldson Smith, A. 1897. Through unknown African countries; the first expedition from Somaliland to Lake Lamu. London: Edward Arnold.

El-Hennawy, H.K. 1992. A catalogue of the scorpions described from the Arab countries (1758–1990) (Arachnida: Scorpionida). Serket 2: 95–153.

Fet, V. 1997. Notes on the taxonomy of some Old World scorpions (Scorpiones: Buthidae, Chactidae, Ischnuridae, Scorpionidae). Journal of Arachnology 25: 245–250.

Fet, V. 2000. Family Scorpionidae Latreille, 1802. *In* V. Fet, W.D. Sissom, G. Lowe, and M.E. Braunwalder, Catalog of the scorpions of the world (1758–1998): 427–486. New York: New York Entomological Society.

Fet V., M.E. Soleglad, D.P.A. Neff, and I. Stathi. 2004. Tarsal armature in the superfamily Iuroidea (Scorpiones: Iurida). Revista Ibérica de Aracnología 10: 17–40.

Francke, O.F. 1985. Conspectus genericus scorpionorum 1758–1982 (Arachnida: Scorpiones). Occasional Papers of the Museum, Texas Tech University 98: 1–32.

Francke, O.F., and L. Prendini. 2008. Phylogeny and classification of the giant hairy scorpions, *Hadrurus* Thorell (Iuridae Thorell): a reappraisal. Systematics and Biodiversity 6: 205–223.

Hirst, S. 1911. Scorpions and solifugae collected by Captain S.S. Flower in the Anglo-Egyptian Sudan. Annals and Magazine of Natural History 8: 217–222.

Karsch, F. 1879. Scorpionologische Beiträge. Part I. Mitteilungen des Münchener Entomologischen Vereins 3: 6–22.

Koch, C.L. 1841. Die Arachniden. Nürnberg: C.H. Zeh'sche Buchhandlung 9: 1–11.

Koch, L. 1875. Aegyptische und abyssinische Arachniden gesammelt von Herrn C. Jickeli beschrieben und abgebildet. Nürnberg: Bauer & Raspe. 96 pp.

Kovařík, F. 1992. A check list of scorpions (Arachnida: Scorpiones) in the collections of the zoological department, National Museum in Prague. Acta Societatis Zoologicae Bohemoslovenicae 56: 181–186.

Kovařík, F. 1997. A check-list of scorpions (Arachnida) in the collection of the Hungarian Natural History Museum, Budapest. Annales Historico-Naturales Musei Nationalis Hungarici 89: 177–185.

Kovařík, F. 1998. Štíři [Scorpions]. Jihlava, Czech Republic: Madagaskar, 176 pp. [in Czech].

Kovařík, F. 2000. *Pandinus* (*Pandinops*) *pococki* sp. n. from Somalia, and *Pandinus pugilator*, a junior synonym of *Pandinus* (*Pandinops*) *bellicosus* comb. n. (Scorpiones, Scorpionidae). Serket 7: 1–7.

Kovařík, F. 2002. A checklist of scorpions (Arachnida) in the collection of the Forschungsinstitut und Naturmuseum Senckenberg. Serket 8: 1–23.

Kovařík, F. 2003. Scorpions of Djibouti, Eritrea, Ethiopia, and Somalia (Arachnida: Scorpiones), with a key and descriptions of three new species. Acta Societatis Zoologicae Bohemicae 67: 133–159.

Kovařík, F. 2009. Illustrated catalog of scorpions. Part I. Introductory remarks; keys to families and genera; subfamily Scorpioninae with keys to *Heterometrus* and *Pandinus* species. Prague: Clairon Production, 170 pp.

Kovařík, F. 2011. A review of the subgenus *Pandinus* Thorell, 1876 with descriptions of two new species from Uganda and Ethiopia (Scorpiones: Scorpionidae). Euscorpius 129: 1–18.

Kovařík, F. 2012. Review of the subgenus *Pandinurus* Fet, 1997 with descriptions of three new species (Scorpiones, Scorpionidae, *Pandinus*). Euscorpius 141: 1–22.

Kovařík, F. 2013a. Family Buthidae. *In* F. Kovařík and A.A. Ojanguren Affilastro (editors), Illustrated catalogue of scorpions Part II. Bothriuridae; Chaerilidae; Buthidae I. Genera *Compsobuthus*, *Hottentotta*, *Isometrus*, *Lychas* and *Sassanidotus*: 145–212. Prague: Clarion Production.

Kovařík, F. 2013b. *Pandinus* (*Pandinus*) *trailini* sp. n. from Ethiopia (Scorpiones: Scorpionidae), with data on localities and life strategy. Euscorpius 163: 1–14.

Kovařík, F., and S. Whitman. 2005. Cataloghi del Museo di Storia Naturale dell'Università di Firenze – sezione di zoologia «La Specola» XXII. Arachnida Scorpiones. Tipi. Addenda (1998–2004) e checklist della collezione (Euscorpiinae esclusi). Atti della Società Toscana di Scienze Naturali, Memorie 111: 103–119.

Kovařík, F., G. Lowe, D. Hoferek, J. Plíšková, and F. Šťáhlavský. 2016. Scorpions of Ethiopia. Part IV. Genus *Uroplectes* Peters, 1861 (Scorpiones: Buthidae). Euscorpius 217: 1–14.

Kraepelin, K. 1899. Scorpiones und Pedipalpi. *In* F. Dahl (editor), Das Tierreich 8 (Arachnoidea): 1–265. Herausgegeben von der Deutschen Zoologischen Gesellschaft. Berlin: R. Friedländer und Sohn Verlag.

Kraepelin, K. 1901. Catalogue des scorpions des collections du Muséum d'Histoire Naturelle de Paris. Bulletin du Muséum National d'Histoire Naturelle, Paris 7: 265–273.

Kraepelin, K. 1908. Die sekundären Geschlechtscharaktere der Skorpione, Pedipalpen und Solifugen. Mitteilungen aus dem Naturhistorischen Museum (2. Beiheft zum Jahrbuch der Hamburgischen wissenschaftlichen Anstalten) 25: 181–225.

Kraepelin, K. 1913. Neue Beiträge zur Systematik der Gliederspinnen. III. A. Bemerkungen zur Skorpionenfauna Indiens. B. Die Skorpione, Pedipalpen und Solifugen Deutsch-Ost-Afrikas. Mitteilungen aus dem Naturhistorischen Museum (2. Beiheft zum Jahrbuch der Hamburgischen wissenschaftlichen Anstalten, 1912) 30: 123–196.

Lamoral, B.H. 1979. The scorpions of Namibia (Arachnida: Scorpionida). Annals of the Natal Museum 23: 497–784.

Lamoral, B.H., and S.C. Reynders. 1975. A catalogue of the scorpions described from the Ethiopian faunal region up to December 1973. Annals of the Natal Museum 22: 489–576.

Lourenço, W.R. 1987. Révision systématique des scorpions du genre *Opisthacanthus* (Scorpiones, Ischnuridae). Bulletin du Muséum National d'Histoire Naturelle, Paris (4) 9: 887–931.

Lourenço, W.R. 2009. Reanalysis of the genus *Scorpio* Linnaeus 1758 in sub-Saharan Africa and description of one new species from Cameroon (Scorpiones, Scorpionidae). Entomologische Mitteilungen aus dem Zoologischen Museum Hamburg 15: 99–113.

Lourenço, W.R. 2014. Further considerations on the identity and distribution of *Pandinus imperator* (C.L. Koch, 1841) and description of a new species from Cameroon (Scorpiones: Scorpionidae). Entomologische Mitteilungen aus dem Zoologischen Museum Hamburg 17: 139–151.

Lourenço, W.R., and J.L. Cloudsley-Thompson. 1996. Recognition and distribution of the scorpions of the genus *Pandinus* Thorell, 1876 accorded protection by the Washington Convention. Biogeographica, Paris 72: 133–143.

Loveridge, A. 1925. Notes on East African scorpions and Solifugae, collected 1916–23. Proceedings of the Zoological Society of London 1925: 303–309.

Moriggi, M. 1941. Gli scorpioni dell'Africa orientale italiana. Rivista di Biologia Coloniale 4: 77–103.

Pocock, R.I. 1888. On the African specimens of the genus *Scorpio* (Linn.), contained in the collection of the British Museum. Annals and Magazine of Natural History (6) 2: 245–255.

Pocock, R.I. 1890. Descriptions of two new species of scorpions brought by Emin Pasha from the inland parts of East Africa. Annals and Magazine of Natural History (6) 6: 98–101.

Pocock, R.I. 1896. On the scorpions, centipedes and millipedes obtained by Dr. Gregory on his expedition to Mount Kenia, East Africa. Annals and Magazine of Natural History (6) 17: 425–444.

Pocock, R.I. 1897a. Descriptions of two new species of scorpions from East Africa. Annals and Magazine of Natural History (6) 19: 116–119.

Pocock, R.I. 1897b. Solifugae, Scorpiones, Chilopoda and Diplopoda (Appendix C). *In* A. Donaldson Smith, Through unknown African countries; the first expedition from Somaliland to Lake Lamu: 392–407. London: Edward Arnold.

Pocock, R.I. 1898a. The Arachnida from the regions of Lake Nyassa and Tanganyika contained in the collection of the British Museum. Annals and Magazine of Natural History (7) 2: 429–448.

Pocock, R.I. 1898b. On the scorpions, spiders and solpugas, collected by Mr C. Stewart Betton in British East Africa. Proceedings of the Zoological Society of London 1898: 497–524.

Pocock, R.I. 1899. On the scorpions, pedipalps and spiders from Tropical West Africa represented in the collection of the British Museum. Proceedings of the Zoological Society of London 1899: 833–885.

Pocock, R.I. 1900a. On a collection of insects and arachnids made in 1895 and 1897, by Mr C.A.V. Peel, F.Z.S., in Somaliland, with descriptions of new species. 9. The Chilopoda and Arachnida. Proceedings of the Zoological Society of London 1900: 48–55.

Pocock, R.I. 1900b. On a collection of insects and arachnids made in 1895 and 1897, by Mr C.V.A. Peel, F.Z.S., in Somaliland, with descriptions of new species. 10. General list of the scorpions of Somaliland and the Boran Country. Proceedings of the Zoological Society of London 1900: 55–63.

Pocock, R.I. 1902. A contribution to the systematics of scorpions. I. Some corrections in nomenclature. II. Notes on some species of *Parabuthus* contained in the British Museum. III. Descriptions of some new and old species. Annals and Magazine of Natural History (7) 10: 364–380.

Prendini, L. 2000a. Chelicerata (Scorpiones). *In* A.H. Kirk-Spriggs and E. Marais (editors), Dâures – Biodiversity of the Brandberg Massif, Namibia. Cimbebasia Memoir 9: 109–120.

Prendini, L. 2000b. Phylogeny and classification of the superfamily Scorpionoidea Latreille 1802 (Chelicerata, Scorpiones): an exemplar approach. Cladistics 16: 1–78.

Prendini, L. 2001a. A review of synonyms and subspecies in the genus *Opistophthalmus* C.L. Koch (Scorpiones: Scorpionidae). African Entomology 9: 17–48.

Prendini, L. 2001b. Substratum specialization and speciation in southern African scorpions: the Effect Hypothesis revisited. *In* V. Fet and P.A. Selden (editors), Scorpions 2001. In memoriam Gary A. Polis: 113–138. Burnham Beeches, Buckinghamshire, UK: British Arachnological Society.

Prendini, L. 2001c. Two new species of *Hadogenes* (Scorpiones, Ischnuridae) from South Africa, with a redescription of *Hadogenes bicolor* and a discussion on the phylogenetic position of *Hadogenes*. Journal of Arachnology 29: 146–172.

Prendini, L. 2004. On the scorpions of Gabon and neighbouring countries, with a reassessment of the synonyms attributed to *Babycurus buettneri* Karsch and a redescription of *Babycurus melanicus* Kovařík. *In* B.L. Fisher (editor), Monts Doudou, Gabon. A floral and faunal inventory with reference to elevational variation. Memoirs of the California Academy of Sciences 28: 235–267.

Prendini, L. 2005. Scorpion diversity and distribution in southern Africa: pattern and process. *In* B.A. Huber, B.J. Sinclair, and K.-H. Lampe (editors), African biodiversity: molecules, organisms, ecosystems. Proceedings of the 5th International Symposium on Tropical Biology, Museum Alexander Koenig, Bonn: 25–68. New York: Springer Verlag.

Prendini, L. 2006. New South African flat rock scorpions (Liochelidae: *Hadogenes*). American Museum Novitates 3502: 1–32.

Prendini, L., and W.C. Wheeler. 2005. Scorpion higher phylogeny and classification, taxonomic anarchy, and standards for peer review in online publishing. Cladistics 21: 446–494.

Prendini, L., T.M. Crowe, and W.C. Wheeler. 2003. Systematics and biogeography of the family Scorpionidae Latreille, with a discussion of phylogenetic methods. Invertebrate Systematics 17: 185–259.

Probst, P.J. 1973. A review of the scorpions of East Africa with special regard to Kenya and Tanzania. Acta Tropica 30: 312–335.

Roewer, C.F. 1943. Über eine neuerworbene Sammlung von Skorpionen des Natur-Museums Senckenberg. Senckenbergiana 26: 205–244.

Rossi, A. 2014a. Notes on the distribution of *Pandinus* (*Pandinus*) Thorell, 1876 and *Pandinus* (*Pandinurus*) Fet, 1997 with the descriptions of two new species from Central African Republic and Djibouti (Scorpiones: Scorpionidae). Onychium 10: 10–31.

Rossi, A. 2014b. The fragmented peri-Saharan distribution of the subgenus *Pandinurus* Fet, 1997 with the description of a new species from Chad (Scorpiones, Scorpionidae, Pandinus). Serket 14: 6–14.

Rossi, A. 2014c. New data on the rare species *Pandinus nistriae* Rossi, 2014 (Scorpiones: Scorpionidae). Arachnides 72: 3–12.

Rossi, A. 2014d. Clarification of the type locality of *Pandinus ulderigoi* Rossi, 2014 with notes on the scorpions protected by CITES (Scorpiones: Scorpionidae). Arachnologische Mitteilungen 49: 47–54.

Rossi, A. 2015a. Sui sottogeneri di *Pandinus* Thorell, 1876 con revisione del genere *Pandinurus* Fet, 1997 stat. n. e descrizione di sette nuove specie e tre nuovi sottogeneri (Scorpiones: Scorpionidae). Onychium 11: 10–66.

Rossi, A. 2015b. Due ulteriori nuove specie del sottogenere *Pandiborellius* Rossi, 2015 dal Corno d'Africa (Scorpiones, Scorpionidae). Arachnida 1: 2–36.

Rossi, A. 2015c. Una revision preliminare del genere *Pandinus* Thorell, 1876 con la descrizione du un nuovo sottogenere e due nuove specie dall'Etiopia (Scorpiones, Scorpionidae). Arachnida 3: 37–52.

Santibáñez-López, C.E., O.F. Francke, and L. Prendini. 2014. *Kolotl,* n. gen. (Scorpiones: Diplocentridae), a new scorpion genus from Mexico. American Museum Novitates 3815: 1–28.

Schiøtz, A. 2003. Alexander Duff-Mackay: in memoriam. 30 December 1939–6 March 2003. Journal of East African Natural History 92: 1–2.

Simon, E. 1872. Études sur les scorpions. Revue et Magasin de Zoologie Pure et Appliquée (2) 23: 51–59, 97–101.

Soleglad, M.E., V. Fet, and M. Graham. 2014. *Kovarikia*, a new scorpion genus from California, USA (Scorpiones: Vaejovidae). Euscorpius 185: 1–22.

Spawls, S., K. Howell, R. Drewes, and J. Ashe. 2004. A field-guide to the reptiles of East Africa. London: A & C Black, 543 pp.

Tahir, H.M., and L. Prendini. 2014. Redescription of *Heterometrus latimanus* and confirmation of the genus *Heterometrus* (Scorpiones: Scorpionidae) in Pakistan. American Museum Novitates 3805: 1–23.

Thorell, T. 1876a. On the classification of scorpions. Annals and Magazine of Natural History 4: 1–15.

Thorell, T. 1876b. Études scorpiologiques. Atti della Società Italiana di Scienze Naturali 19: 75–272.

Thorell, T. 1893. Scorpiones exotici R. Musei Historiae Naturalis Florentini. Bollettino della Società Entomologica Italiana 25: 356–387.

Vachon, M. 1967. Le grand scorpion du Sénégal: *Pandinus gambiensis* Pocock, 1899 doit être considéré comme une véritable espèce et non comme une sous-espèce de *Pandinus imperator* C.L. Koch, 1842. Bulletin de l'Institut Fondamental d'Afrique Noire (A) Sciences Naturelles 29: 1534–1537.

Vachon, M. 1973 [1974]. Étude des caractères utilisés pour classer les familles et les genres de scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie, Sigles trichobothriaux et types de trichobothriotaxie chez les scorpions. Bulletin du Muséum National d'Histoire Naturelle, Paris (3) 140: 857–958.

Werner, F. 1916. Ueber einige Skorpione und Gliederspinnen des Naturhistorischen Museums in Wiesbaden. Jahrbücher des Nassauischen Vereins für Naturkunde 69: 79–97.

Werner, F. 1934. Scorpiones, Pedipalpi. *In* H.G. Bronns Klassen und Ordnungen des Tierreichs. Akademische Verlaggesellschaft, Leipzig. 5, IV, 8, Lief. 1–2 (Scorpiones): 1–316.

Werner, F. 1936. Neu-Eingänge von Skorpionen im Zoologischen Museum in Hamburg. Festschrift zum 60. Geburtstage von Professor Dr. Embrik Strand 2: 171–193.