

Revision of *Karasbergia* Hewitt (Scorpiones: Buthidae), a monotypic genus endemic to southern Africa

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ABSTRACT

PRENDINI, L. 2004. Revision of *Karasbergia* Hewitt (Scorpiones: Buthidae), a monotypic genus endemic to southern Africa. *J. Afrotrop. Zool.* 1: 77-93. The monotypic scorpion genus *Karasbergia* Hewitt, 1913, endemic to Namibia and South Africa, was last revised by Lamoral (1979). A considerable number of new specimens, many representing new records and clarifying the diagnostic significance of previously documented geographical variation, have since accumulated. On the basis of these new data, the diagnosis and description of *Karasbergia* are revised, its known distributional range mapped, and notes on its ecology and conservation status provided.

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INTRODUCTION

Southern Africa contains a unique, and largely endemic scorpion fauna (Lawrence 1952; Prendini 1995, 2000a, 2001a). Six (50%) genera and more than 134 (96%) species of scorpions are endemic to the subregion (south of 15°S latitude), three (25%) of the genera and more than 97 (69%) of the species being endemic to Namibia, South Africa or both. One of the more interesting endemic scorpion genera is the monotypic *Karasbergia* Hewitt, 1913, created to accommodate a unique species of buthid. Described on the basis of three female specimens from two localities in southern Namibia, *Karasbergia methueni* Hewitt, 1913 was subsequently recorded from two additional localities, south of the Orange River, in the Northern Cape Province of South Africa (Hewitt 1918). A third locality record was added by Lawrence (1955), but the species remained poorly known, and the male undescribed, until it was revised by Lamoral (1979) in his treatise on the scorpion fauna of Namibia. A considerable number of new specimens, many representing new records and clarifying the diagnostic significance of geographical variation documented by Lamoral (1979), have accumulated in the 25 years since his revision. On the basis of these new data, the diagnosis and description of *Karasbergia* are revised, its known distributional range mapped, and notes on its ecology and conservation status provided.

MATERIAL AND METHODS

Most personally collected specimens were found at night using the ultraviolet (UV) light detection method (Honetschlager 1965; Stahnke 1972a; Sissom *et al.* 1990). A portable UV lamp, comprising two mercury-vapour tubes attached to a chromium parabolic reflector and powered by a rechargeable 7 Amp/hr, 12 V battery, was used for this purpose. A few specimens were also found by turning stones during the day. A portable Garmin™ GPS II Plus device was used for recording the geographical coordinates of collection localities in the field.

Material examined, including type specimens, is deposited in the following collections: National Museum of Namibia, Windhoek (NMNW); South African Museum, Cape Town (SAMC); National Museum, Bloemfontein, South Africa (NMB); Natal Museum, Pietermaritzburg, South Africa (NMSA); Transvaal Museum, Pretoria, South Africa (TMSA), some bearing accession numbers from the Sebastian Endrödy-Younga Collection (EY); American Museum of Natural History, New York (AMNH), some bearing accession numbers from the Alexis Harington Collection (AH); California Academy of Sciences, San Francisco (CASC); Naturhistoriska Riksmuseet, Stockholm, Sweden (NHRM), from the John Ferrer Collection (JF); Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany (ZMUH); Erich S. Volschenk Collection, Brisbane, Australia (ESV). Tissue samples of *K. methueni* have been stored (in the vapour phase of liquid nitrogen at -150°C) in the Ambrose Monell Collection for Molecular and Microbial Research (AMCC) at the AMNH. DNA

sequences from these will be used to test the phylogenetic position of the genus in a forthcoming analysis of the higher phylogeny of Scorpiones (L. Prendini & W.C. Wheeler, in prep.).

Photographs were taken in visible light as well as under long wave UV light using a Microptics™ ML-1000 digital photomicrography system. Measurements were taken using the ocular micrometer of a Nikon® SMZ-1500 stereomicroscope. Colour designation follows Smithe (1974, 1975, 1981), trichothrial notation follows Vachon (1974), sternum terminology follows Soleglad & Fet (2003a) and mensuration follows Stahnke (1970) and Lamoral (1979). Morphological terminology follows Couzijn (1976) for the segmentation of legs, Hjelle (1990) and Sissom (1990) for the segmentation of pedipalps, and Stahnke (1970), Lamoral (1979), Sissom (1990) and Prendini (2000b, 2001b, 2003, 2004) for remaining features. As in previous papers (Prendini 2000b, 2001b, 2003, 2004), the terms used by other authors on the southern African scorpion fauna for certain metasomal carinae have been replaced with terms implying specific homology statements between carinae on segment V and those on the preceding segments, e.g., the term 'dorsal' (segments I–IV only) is replaced with 'dorsosubmedian' (segments I–V).

A distribution map was produced using ArcView GIS Version 3.2 (Environmental Systems Research Institute [ESRI], Redlands, California), by superimposing point locality records on coverages depicting the political boundaries, topography (500 m contour interval) and major sand systems of southern Africa. A topographic contour coverage was created from the GTOPO30 raster grid coverage, obtained from the website of the U.S. Government Public Information Exchange Resource: <http://edc.daac.usgs.gov/gtopo30/gtopo30.html>. The coverage of sand systems was created by clipping and merging relevant polygons extracted from a coverage of the geology of Africa provided by the Department of Marine Geoscience, University of Cape Town, with polygons extracted from a coverage of Namibian landforms from the Namibian National Biodiversity Task Force (Barnard 1998), downloaded from their website: <http://www.dea.met.gov.na/programmes/biodiversity/countrystudy.htm>.

In order to create a point locality geographical dataset for mapping the distributional range of *Karasbergia*, all records of sufficient accuracy were isolated from the material examined. Only a small proportion of the records were accompanied by geographical coordinates or quarter-degree squares (QDS), usually entered by the collector or subsequently added by the curator or collections manager. These were checked for accuracy and an

attempt was made to trace coordinates for as many of the remaining records as possible, by reference to gazetteers, the official 1:250 000, 1:500 000 and 1:1000 000 topo-cadastral maps of South Africa and Namibia published by the Government Printer and the GEONet Names Server (GNS): http://164.214.2.59/ns/html/cntry_files.html. Names of provinces, regions and magisterial districts of countries listed in the material examined follow the most recent systems (post-1994).

Spatial analyses were conducted using ArcView in order to ascertain whether the distribution of *Karasbergia* is related to present environmental variables, to determine the specific ecological correlates of its distributional range, and to calculate statistics that could be used to define its conservation status. Coverages representing the topography, mean annual rainfall, Biomes, vegetation types and protected areas in Namibia and South Africa were used for these analyses. The GTOPO30 raster grid coverage was used for spatial analysis of topography. Polygon coverages representing the mean annual rainfall and vegetation types (as defined by Giess 1971) of Namibia, were obtained from the website of the Namibian National Biodiversity Task Force (Barnard 1998). A raster grid coverage of mean annual rainfall was obtained from the *South African Atlas of Agrohydrology and -Climatology* (Schulze 1997), produced by the Computing Centre for Water Research of the South African Water Research Commission: <http://www.wrc.org.za/wrcpublications/wrcreports/hydroclimatology.htm>. A polygon coverage of Low & Rebelo's (1998) *Vegetation of South Africa, Lesotho and Swaziland*, incorporating the Biomes defined by Rutherford & Westfall (1994), was obtained from the National Botanical Institute of South Africa.

The conservation status of *Karasbergia* was assessed using coverages of the existing protected areas in Namibia, also obtained from the Namibian National Biodiversity Task Force (Barnard 1998), and South Africa: a combination of three coverages obtained from Western Cape Nature Conservation and KwaZulu-Natal Nature Conservation Service. These were superimposed on the mapped distributional range of *Karasbergia* to determine whether any point locality records fall within the boundaries of protected areas. Number of known locality records, extent of the distributional range, occurrence inside and outside of protected areas, and prevailing land uses that might be construed as threats to the future survival of the species were then used as criteria for assigning *Karasbergia* to one of the IUCN Red List Categories (IUCN 2001).

SYSTEMATICS

Karasbergia Hewitt, 1913

Karasbergia Hewitt, 1913: 148 [type species by monotypy *Karasbergia methueni* Hewitt, 1913]; Hewitt, 1925: 250, 252, 255, 257; Werner, 1934: 271; Kästner, 1941: 232; Lawrence, 1955: 231; Stahnke, 1972b: 126; Vachon, 1974: 910, 936; Lamoral & Reynders, 1975: 509; Newlands, 1978: 688, 689; Lamoral, 1979: 555; Francke, 1985: 9, 15; Sissom, 1990: 94, 101; Nenilin & Fet, 1992: 15, 16; Kovarik, 1998: 112; Fet & Lowe, 2000: 154; Sologlad & Fet, 2003a: 3, 5, 12, 22, 26–29, table 2, figure 44; Sologlad & Fet, 2003b: 7, 33, 66–68, 72, 78, 79, 88, 157, table 3, table 4, table 9, figure 115.

Diagnosis *Karasbergia* is placed in the family Buthidae C.L. Koch, 1837 due to the presence of a type A trichobothrial pattern and a flagelliform hemispermatophore, among other characters. The genus is monotypic and differs from all other scorpion genera on the basis of the following character combination: pedipalps neobothriotaxic minor, type A, *a* configuration, with trichobothrium *d*₂ absent from femur and patella, *Eb*₃ often absent from chela manus, and *esb* often absent from fixed finger; chela with *it* situated submedially on fixed finger; legs III and IV with tibial spurs; sternum type I, subpentagonal, slightly longer than broad, with subcordate basal pit and without median longitudinal furrow; cheliceral fixed finger without denticles on the ventral surface; flagellum of ♂ hemispermatophore with a *pars recta* but without a *pars reflecta*.

The following additional characters, in combination, separate *Karasbergia* from all other buthid genera: usually only two pairs of lateral ocelli (a third, greatly reduced pair occasionally present); carapace, pedipalp chela and patella, dorsal and lateral surfaces of legs, acarinate; mesosomal tergites I–VI each with only a weakly developed median carina; granular rows of dentate margins on movable finger of pedipalp chela each flanked proximally by an internal accessory granule but without a flanking series of external accessory granules; genital aperture of ♂ without genital papillae; metasomal segments each with weakly developed dorsosubmedian carinae, usually represented by only a few granules proximally, segment I occasionally with weakly developed, granular dorsosubmedian and dorsolateral carinae extending full length of segment; metasomal segments I–III each without stridulatory region on dorsal surface, with numerous coarse, scattered granules on ventral surface, and with ventrolateral carinae and posteroventral margins composed of weakly to moderately elevated, crescent-shaped tubercles, forming a broad U-shaped

pattern posteriorly; segment V with paired ventrolateral carinae, reduced to a few lobate granules subdistally or absent altogether; all other metasomal carinae absent; metasomal segments I–V and telson punctate laterally, segments IV, V and telson also punctate ventrally, a seta (50 µm–1mm in length) arising from each punctation; telson without a subaculear tubercle ventrally; overall size very small, adults seldom exceeding 25mm in total length.

Phylogenetic placement Although *Karasbergia* is unquestionably placed in the Buthidae, its phylogenetic position within the family is uncertain. Hewitt (1913) considered the genus to be closely related to the Afrotropical buthid genus *Uroplectes* Peters, 1861, due to the absence of denticles on the ventral surface of the cheliceral fixed finger in both genera. However, Hewitt (1918, 1925) later remarked on the differences in sternum shape between *Uroplectes* and *Karasbergia* and suggested that *Karasbergia* is the 'most primitive member' of the South African Buthidae. Hewitt (1918, 1925) based this conclusion not only on the subpentagonal sternum, but also on the dentition of the chelicerae and the pedipalp chela fingers, the absence of carinae on the carapace and of submedian carinae on the tergites, and the low number of pectinal teeth, with the basal pectinal tooth of the female unmodified. However, Hewitt (1918, 1925) also noted that the disposition of the carinae on the ventral surfaces of the first three metasomal segments is greatly specialized.

Lamoral (1979) again noted the similar cheliceral dentition of *Uroplectes* and *Karasbergia* but refrained from suggesting a phylogenetic placement for the enigmatic genus. According to Lamoral (1979: 500): 'Because of the contradictory nature of the similarities between *Karasbergia methueni* and various other genera studied, no clearcut affiliation is possible at this stage. One can but suspect that *K. methueni* is probably a relic of a former forest-dwelling fauna that survived the advent of aridification by adopting a semi-endogean existence prior to its present infralapidicolous one.'

Several characters of *Karasbergia* (e.g., the absence of trichobothria in the *d* series of the femur and patella, the submedial position of trichobothrium *it* on the fixed finger, the absence of a *pars reflecta*, and the absence of genital papillae) appear to be autapomorphic and therefore uninformative about its phylogenetic placement. Other characters (e.g., the subpentagonal sternum) appear to be plesiomorphic in the Buthidae (Stockwell, 1989), suggesting a basal position for the genus and a possible relationship with the Indian genus *Charmus* Karsch, 1879 (also supported by similar habitus in both genera; E.S. Volschenk, pers. comm.). Still others (e.g., the absence of tibial spurs on legs I and II only) might

be synapomorphic for larger monophyletic groups within Buthidae, including other Afrotropical genera such as *Uroplectes*. Indeed, *Karasbergia* is in many respects so unique morphologically that it is futile to speculate about its phylogenetic placement until a cladistic analysis of relationships among the buthid genera, wherein all relevant characters are included and tested simultaneously, has been conducted. The recent analysis by Soleglad & Fet (2003b: 78, fig. 115), in which *Karasbergia* was placed as the sister taxon of a larger monophyletic group containing New World buthid genera (*Centruroides* Marx, 1890, *Microtityus* Kjellesvig-Waering, 1966 and *Tityus* C.L. Koch, 1836) and Old World buthid genera (*Grosphus* Simon, 1880, *Microcharmus* Lourenço, 1995 and *Uroplectes* Peters, 1861), failed to test the position of the genus adequately. Among numerous other problems (L. Prendini, in prep.), important taxa (e.g. *Charmus*) were omitted from the analysis as well as many characters essential for resolving the relationships among buthid genera.

Included taxa A single species, *Karasbergia methueni* Hewitt, 1913.

Distribution *Karasbergia methueni* is endemic to southern Namibia and northwestern South Africa (Fig. 1). All locality records from Namibia fall within the Hardap Region (Maltahöhe and Mariental districts) and the Karas Region (Bethanien, Karasburg, Keetmanshoop and Lüderitz districts). All records from South Africa fall within the Northern Cape Province (Calvinia, Gordononia, Kenhardt and Namaqualand districts).

At the time of Lamoral's (1979) revision, this species was recorded only from localities between 25° and 29°S. The easternmost record was approximately 21°E. The known distribution has been considerably extended by subsequent collections. The northernmost record is now 24°32'S 17°57'E, the southernmost record is 30°04'S 19°57'E, and the easternmost record is 28°20'S 21°24'E.

Known locality records fall within the following range of altitudes (percentage of locality records indicated in parentheses; Fig. 2): 0–500m (26%), 500–1000m (46%), 1000–1500m (24%), 1500–2000m (4%). All records fall in the region between the western escarpment and the Kalahari sand system (Fig. 1), which appear to represent natural boundaries to the western and eastern margins of the distributional range. The range of this species extends across the Orange River.

The distributional range of *K. methueni* falls mostly (69%) within the Nama Karoo Biome (Irish 1994; Rutherford & Westfall 1994), where locality records occur in the following vegetation zones (Giess 1971; Hoffman 1998a,b): Dwarf Shrub

Savanna (47%); Orange River Nama Karoo (16%); Bushmanland Nama Karoo (4%); Semi-desert and Savanna Transition (2%). However, 31% of records fall within the Succulent Karoo Biome (Irish 1994; Rutherford & Westfall 1994), in the following vegetation zones (Giess 1971; Hoffman 1998c): Upland Succulent Karoo (27%); Desert and Succulent Steppe (4%).

This species inhabits an extremely arid region, receiving less than 250mm of rainfall annually (Fig. 3), most of which falls in late Autumn and Winter (May to August). Known locality records fall within the following mean annual rainfall ranges: 0–50mm (37%), 50–100mm (23%), 100–150mm (21%), 150–200mm (18%), 200–250mm (1%).

Karasbergia methueni Hewitt, 1913

Figures 1, 4–24

Karasbergia methueni Hewitt, 1913: 148, plate XV, figure 2; Hewitt, 1918: 128, plate XXI, figure 22; Hewitt, 1925: 250, 252, 255, 257; Werner, 1934: 271; Lawrence, 1955: 231; Strahnke, 1972b: 126; Lamoral & Reynders, 1975: 509; Lamoral, 1979: 555–560, figures 72–86; Kovařík, 1998: 112; Fet & Lowe, 2000: 154; Prendini, 2001a: 137; Soleglad & Fet, 2003a: 5; Soleglad & Fet, 2003b: 7, 67. **Type material** *Karasbergia methueni* was described on the basis of three female syntypes (TMSA 1038, 1039 and 1041). At the time of Lamoral's (1979) revision, only two (TMSA 1870 [old 1041] and 1869 [old 1038]) remained. These were designated as lectotype and paralectotype, respectively. The remaining syntype was not rediscovered during the present study and is presumed lost.

Lectotype (desig. B.H. Lamoral, 1976): 1 ♀ (TMSA 1870 [old 1041]), 'Narudas Süd, South West Africa [Farm Narudas Süd 268, 27°22'S 18°51'E, Karasburg District, Karas Region, Namibia], 4.I.1913, P.A. Methuen, in rocks in river bed'. Paralectotype (desig. B.H. Lamoral, 1976): 1 ♀ (TMSA 1869 [old 1038]), 'Quibis, South West Africa [?Kuibus, 26°41'S 16°50'E, Lüderitz District, Karas Region, Namibia], 30.XI.1912, P.A. Methuen'.

The location of 'Quibus' remains equivocal (Prendini, 2001c). Hewitt (1913) evidently named the genus *Karasbergia* after the Great Karasberg in southeastern Namibia, presumably because the collection localities of the type specimens were situated there (although this was not stated explicitly). However, according to Lamoral (1979), Quibus is presently Kuibus [26°41'S 16°50'E] on the Huib-Hoch Plateau, ca. 200 km WNW of the Great Karasberg. Narudas Süd is situated in the Great Karasberg, but it has not been possible to determine

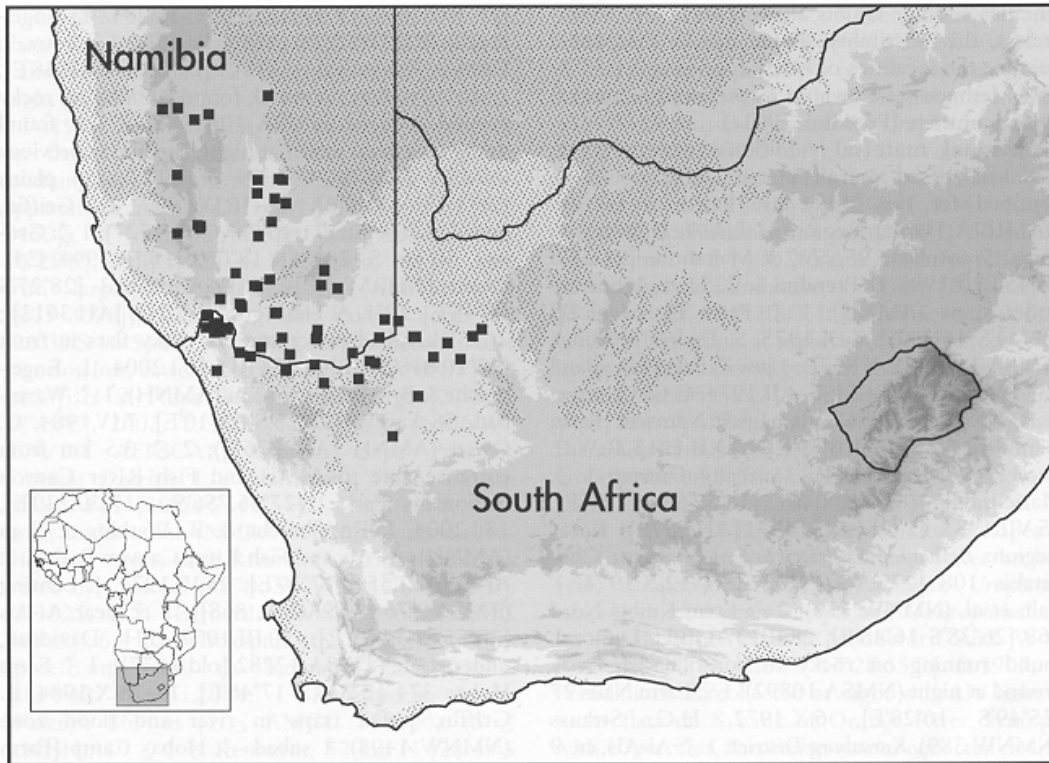
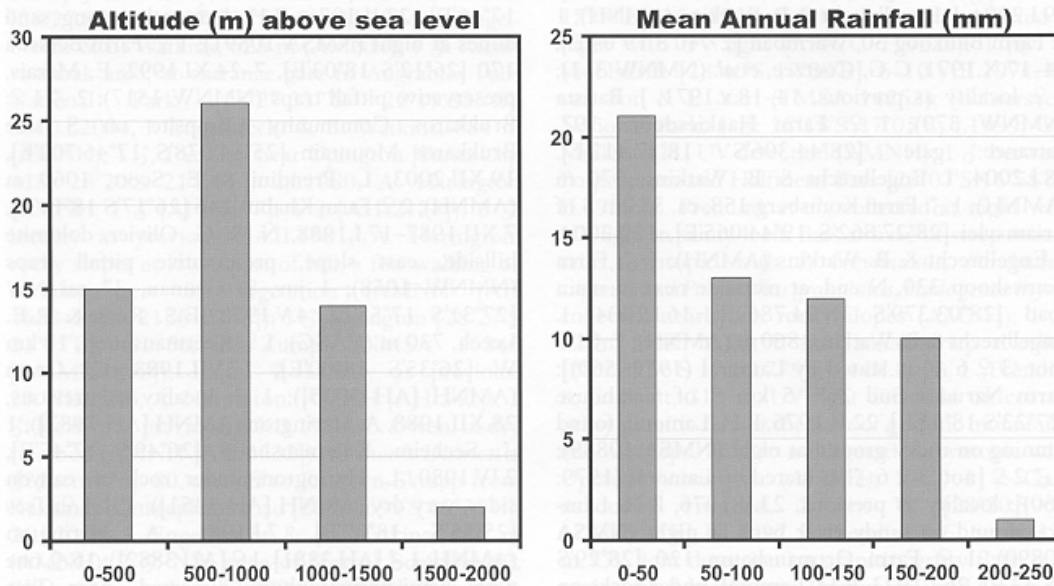


Fig. 1. The known distribution of *Karasbergia methueni* Hewitt, 1913 (■), which is endemic to Namibia and South Africa (contour interval 500 m; major sand systems stippled).



Figs 2-3. Environmental correlates of the distributional range of *Karasbergia methueni* Hewitt, 1913. The number of known locality records are grouped according to the gradients of altitude (2) and mean annual rainfall (3) occurring across its distributional range.

whether another Quibis also occurs there. Nevertheless, this possibility should not be discounted because the localities of other species collected by P.A. Methuen (after whom *K. methueni* is named) also occur there (Prendini, 2001c).

Additional material Additional records of *K. methueni*, based on all material that could be obtained for this study, are listed as follows. NAMIBIA: Hardap Region: *Maltahöhe District*: 1 ♀: Farm Grootplaats 95, SW of Maltahöhe [24°55'S 16°45'E], 1.I.1998, L. Prendini & E. Scott, in burrow under stone (AMNH); 1 ♂: Farm Hoheacht 98 [24°44'S 16°29'E], 7.IX.1975, S. Endrödy-Younga (TMSA 11463 [E-Y 867]); 1 juv. ♂: Farm Hoogland 132 [24°45'S 16°14'E], 1–4.II.1974, C.G. Coetzee, *et al.*, (NMNW 529); 1 ♀ (damaged): Namsem [Farm Namseb 24, 24°50'S 16°59'E], 22.XII.1915, R.W.E. Tucker (SAMC B1684); *Mariental District*: 1 ♂: Mariental, 19 km N [24°32'S 17°57'E], 15.VII.1983, C. Owen (AMNH [AH 3779]). Karas Region: *Bethanien District*: 1 ♂ 1 ♀: Farm Churutabis 108 [27°25'S 17°25'E], 4–12.X.1974, J. Balt, *et al.* (NMNW 526); 2 ♂: Farm Kuibis Nord 168 [26°38'S 16°48'E], 28.II.1976, B.H. Lamoral, found running on rocky to consolidated sandy ground at night (NMSA 10892); 1 ♀: Farm Naus 27 [25°49'S 16°28'E], 6.X.1972, H.C. Strauss (NMNW 389). *Karasburg District*: 1 ♂: Ai-Ais, ca. 9 km E [27°58'S 17°31'E], 4.II.1973, B.H. Lamoral, night collecting with U.V. (NMSA 10561 [old 10920]); 3 ♂: Farm Beenbreek 152 (N of Onseepkans), entrance gate [28°42.800'S 19°18.200'E], 19.I.2004, I. Engelbrecht & B. Watkins (AMNH); 1 ♀: Farm Blinkoog 30, Warmbad [27°40'S 19°04'E], 14–17.X.1971, C.G. Coetzee, *et al.* (NMNW 311); 1 ♀: locality as previous, 14–18.x.1971, J. Batista (NMNW 370); 1 ♀: Farm Haakiesdoorn 197, entrance gate [28°44.306'S 18°17.412'E], 18.I.2004, I. Engelbrecht & B. Watkins, 670 m (AMNH); 1 ♂: Farm Komsberg 158, ca. 55 km S of Ariamsvlei [28°27.862'S 19°44.065'E], 12.I.2004, I. Engelbrecht & B. Watkins (AMNH); 1 ♂: Farm Louwshoop 330, N end, at roadside next to main road [28°03.379'S 18°04.786'E], 16.I.2004, I. Engelbrecht & B. Watkins, 860 m (AMNH); 7 ♂ 1 ♀ [not '3 ♀ 6 ♂' as stated by Lamoral (1979: 560)]: Farm Narudas Süd 268, 5 km S of farmhouse [27°23'S 18°51'E], 22.II.1976, B.H. Lamoral, found running on rocky ground at night (NMSA 10889); 7 ♂ 2 ♀ [not '3 ♀ 6 ♂' as stated by Lamoral (1979: 560)]: locality as previous, 23.II.1976, B.H. Lamoral, found on sandy river bank at night (NMSA 10890); 1 ♀: Farm Ortmanbaum 120 [28°29'S 18°43'E], 26.I.1973, B.H. Lamoral, under rocks on banks of Ortman River (NMSA 10567); 3 ♂, 1 ♀: Farm Ukamas 69, 6 km S of Ariamsvlei

[28°10.578'S 19°49.532'E], 11.I.2004, I. Engelbrecht & B. Watkins (AMNH); 15 ♂ 3 ♀ 2 juv. ♀: Farm Vredenhof 301 [27°37'S 18°48'E], 21.II.1976, B.H. Lamoral, found running on rocky ground at night (NMSA 10888); 1 ♂ 1 ♀: found doing courtship dance at night, further as previous (NMSA 10887); 4 ♂: N of RT2 camp plains [28°37'S 17°49'E], 13–16.IV.1997, E. Griffin, gravel plains, pitfall trap (NMNW 1727); 1 ♂: Grünau, 50 km S [28°04'S 18°03'E], 6.III.1994, C.R. Owen (NHRM [JF]); 1 ♀: Warmbad [28°27'S 18°44'E], 2.V.?, A. Harington (AMNH [AH 3613]); 2 ♂: Warmbad police station, rocky flats in front [28°20.818'S 18°44.274'E], 13.I.2004, I. Engelbrecht & B. Watkins, 732 m (AMNH); 1 ♂: Warmbad, 58 km W [28°28'S 18°10'E], 7.IV.1984, C. Owen (AMNH [AH 3765]); 2 ♂: 3.5 km from entrance gate to Ai-Ais and Fish River Canyon National Park [27°56.756'S 17°30.230'E], 15.I.2004, I. Engelbrecht & B. Watkins, 279 m (AMNH); Ai-Ais and Fish River Canyon Park: 1 ♀: Ai-Ais [27°55'S 17°29'E], 25.VI.1974, J. Lensing (TMSA 17666 [SAIMR 868]); 1 ♂: near Ai-Ais [27°55'S 17°29'E], 30.III.1977, I.H. Davidson, under stone (TMSA 17282 [old 1077]); 1 ♂: Farm Hobas 374 [27°38'S 17°46'E], 16–28.X.1984, E. Griffin, pitfall traps in river and flood zone (NMNW 1498); 1 subad. ♂: Hobas Camp [Farm Hobas 374, 27°37.227'S 17°42.873'E], 6.XII.2001, L. Prendini & C. Holmes, UV collecting on rocky bank of dry riverbed (AMNH). *Keetmanshoop District*: 2 ♂ 2 ♀ 2 juv. ♂: Berseba, 10 km S [26°07'S 17°46'E], 27.II.1976, B.H. Lamoral, among sand dunes at night (NMSA 10891); 1 ♀: Farm Berseba 170 [26°12'S 18°03'E], 7–24.XI.1992, E. Marais, preservative pitfall traps (NMNW 1517); 2 ♂ 1 ♀: Brukkaros Community Campsite on S side Brukkaros Mountain [25°54.078'S 17°46.702'E], 19.XII.2003, L. Prendini & E. Scott, 1060 m (AMNH); 2 ♀: Farm Khabus 146 [26°17'S 18°14'E], 7.XII.1987–17.I.1988, N. & G. Olivier, dolomite hillside, east slope, preservative pitfall traps (NMNW 1058); 1 juv. ♀: Grünau, 37 mi NW [27°31'S 17°58'E], 4.V.1958, E.S. Ross & R.E. Leech, 730 m (CASC); 1 ♀: Keetmanshoop, 10 km W [26°35'S 18°00'E], 17.VII.1983, C. Owen (AMNH [AH 3735]); 1 ♂: locality as previous, 28.XII.1988, A. Harington (AMNH [AH 3987]); 1 ♂: Seeheim, Keetmanshoop [26°49'S 17°47'E], 2.IV.1980, L. Harington, under rock on canyon sides, very dry (AMNH [AH 1451]); 1 ♂ 1 ♀: Tses [25°53'S 18°07'E], 7.I.1981, A. Harington (AMNH: 1 ♂ [AH 3881], 1 ♀ [AH 3882]); 16 ♂, one with hemispermatophore dissected, near Tses [25°54'S 18°11'E], 24.II.1973, B.H. Lamoral, caught at night on hard ground adjacent to sand

- dunes (NMSA 10566). Lüderitz District: 7 ♂ 1 ♀: Farm Aar 16 [26°46'S 16°28'E], 29.II.1976, B.H. Lamoral, found on rocky to consolidated ground at night (NMSA 10893); 1 ♂, 1 ♀: locality as previous, 4.IV.1980, A. Harington, one under medium rock on flats, isolated sparse rocks, another under medium rock on top of high hill, black rock, no apparent scrapes (AMNH: 1 ♂ [AH 1449], 1 ♀ [AH 1450]); 5 ♂: Farm Aar 16, near Aus [26°46'S 16°28'E], 11.II.1982, A. Harington, on flat area with large and small rocks (AMNH [AH 3095–3098]); 1 juv. ♂: Farm Kuibis Nord 168 [26°39'S 16°51'E], 3.IV.1980, A. Harington, under stone on low, extremely rocky hillside (AMNH [AH 1453]); 1 ♀: Huns Beacon, Hunsberge [27°50'S 17°10'E], 2003, T. Bird & N. Krone (NMNW). SOUTH AFRICA: Northern Cape Province Calvinia District: 1 ♀ (damaged): Farm T'Boop Noord 144 [30°04'S 19°57'E], 25.X.1990, L.N. Lotz, under stone (NMBA 12610). Gordonia District: 1 ♀: Aries, Brak River [not 'Arigap River' as stated by Lamoral (1979: 560), 28°12'S 20°03'E], IX.1925, K.H. Barnard (NMSA 9968 [SAMC B6788]); 6 ♂: Farm Bokspuits 462, 25 km SE of Lutsputz on road to Keimoes [28°33.368'S 20°50.427'E], 8.I.2004, I. Engelbrecht & B. Watkins, 869 m (1 ♂ AMCC 138990), (5 ♂ AMNH); 10 ♂ 1 ♀: Kenhardt, 57 km N [28°49'S 21°03'E], 9.XII.1984, C. Owen (AMNH: 10 ♂ [AH 3219–3223, 3395, 3396, 3527, 3612], 1 ♀ [AH 3397]); 3 ♂ 1 ♀: Augrabies Falls National Park, Molopo River valley, ca. 2 km NW of Riemvasmaak [28°27.350'S 20°17.595'E], 9–10.I.2004, I. Engelbrecht & B. Watkins, 625 m (AMNH); 4 ♂: Riemvasmaak area, at entrance gate to Augrabies Falls National Park [28°27.337'S 20°19.835'E], 9–10.I.2004, I. Engelbrecht & B. Watkins, 684 m (AMNH); 1 ♂, 1 ♀: Uap near Upington [Farm Uap 418, 28°20'S 21°24'E], 2.I.1980, A. Harington (AMNH: 1 ♂ [AH 2177], 1 ♀ [AH 2178]); 6 ♂: locality as previous, 14.II.1981, A. Harington, rocky slopes at lower part of hill, a few walking or running, rest on vegetation (AMNH [AH 1623–1625, 2156–2158]); 1 ♂: Upington [28°27'S 21°15'E], I.1956, F. Zumpt (NMSA 16340 [SAIMR 858]); 1 juv. ♀: locality as previous, 28.VIII.1976, A. Harington (AMNH [AH 342]); 1 ♂: locality as previous, 8.XII.1984, C. Owen, in dry riverbed (AMNH [AH 3732]). Kenhardt District: 4 ♂: Farm Oup 80, turnoff to Raap en Skraap from Kakamas–Onseepkans road [28°50.699'S 19°35'E], 26.I.2004, I. Engelbrecht & B. Watkins, 786 m (AMNH); 2 ♂: NW edge of [Farm] Scuitklip 92, S[E] of Onseepkans [28°53'S 19°40'E], 30.I.1995, A. Harington (AMNH [AH 2443, 2444]); 1 ♀: Onderstedoring [?Onderste Doringknie, 29°25'S 20°22'E], 11.IV.1984, C. Owen (AMNH [AH 3861]); 2 ♂: Pofadder [29°08'S 19°24'E], 30.I.1995, A. Harington, under rocks in flat area near town, soil gritty, low rocky hills in distance, sympatric with *Parabuthus brevimanus* and *Uroplectes gracilior* (AMNH [AH 2450, 2451]); 2 ♂ 1 ♀: Vuurdoodberg, at T-junction of Pofadder–Goodhouse road [28°59.999'S 18°13.436'E], 22–24.I.2004, I. Engelbrecht & B. Watkins, 464 m (AMNH). Namaqualand District: 1 ♀ 1 juv. ♀: Farm Aggeneys 56, rocky flats behind old farmhouse, N of town [29°12.381'S 18°50.519'E], 19.II.2003, L. Prendini, *et al.*, 988 m, UV light detection at night, succulent karoo, granite-quartzite blocks on gravelly riverbank, sympatric with *P. brevimanus*, *U. gracilior*, *Opisthophthalmus gigas* and *Opisthophthalmus lornae* (AMNH); 6 ♂: Farm Goodhouse 23, ca. 1 km W of turnoff to Goodhouse on Pella–Concordia road [28°58.847'S 18°13.298'E], 21–22.II.2003, L. Prendini & E. Scott, 470 m, UV light detection on lower slopes of hill (ironstone and granite), Orange River broken veld, sympatric with *P. brevimanus*, *Uroplectes schlechteri*, *Hadogenes zumpti* and *Opisthophthalmus* sp. (AMNH); 1 ♂: Farm Modderdrif-Suid, W of Kotzeshoop [28°42.39'S 17°28.55'E], II.1997, L. Prendini, *et al.*, collected at night with UV light in rocky flats on S bank of Orange River, syntopic with *U. gracilior*, *Parabuthus raudus* collected nearby on alluvial sand dunes (AMNH); 2 ♀: Farm Witbank 30, E of Dabenoris mountains [28°54.306'S 18°41.455'E], 20.I.2004, I. Engelbrecht & B. Watkins, 569 m (AMNH); 1 ♂: Lekkersing [29°00'S 17°06'E], 16.I.1999, G.J. Müller, *et al.*, collected at night with UV light (AMCC 119229); 1 juv. ♂: Vioolsdrift [28°46'S 17°39'E], 6–10.VIII.1971, G. van Son & L. Vari (TMSA 14253); Richtersveld National Park: 1 ♂: 28°18'S 17°05'E, I.1999, G.J. Müller, *et al.*, UV detection (AMNH); 1 ♂: between Potjiespram and Halfmens Pass [28°07'S 16°58'E], II.1997, L. Prendini, *et al.*, collected at night with UV light in sandy-loam flats at base of steep mountains, syntopic with *P. brevimanus*, *Parabuthus capensis* and *Parabuthus granulatus*, *Hadogenes tityrus* collected nearby on rocky slopes (AMNH); 1 ♂: Claim Peak, 1 km E in Gannakouriep riverbed [28°22.156'S 17°09.779'E], 4.III.2003, L. Prendini & E. Scott, 313 m, UV light detection on coarse, gritty granitic flats at the base of granitic mountains and outcrops, little to no vegetation, syntopic with *Opisthophthalmus* sp. (AMNH); 13 ♂ 1 ♀: Gannakouriep riverbed, 2 km W [28°20.596'S 17°08.992'E], III.1997, L. Prendini & E. Scott, 335 m, UV light detection on granitic, gritty flats, syntopic with *P. brevimanus*, *P. granulatus* and *Opisthophthalmus* sp. (11 ♂ AMNH), [alleged data: 'South Africa, Region of Narudas Süd' falsified on label] (2

♂ 1 ♀ ZMUH); 3 ♂: Gannakouriep riverbed, N of Claim Peak [28°20'S 17°10'E], II.1997, L. Prendini, *et al.*, collected at night with UV light in granitic, gritty flats, syntopic with *P. brevimanus* and *P. granulatus* (AMNH); 2 ♂: Koeroegab plains, 2 km N of Domerog Pass [28°15'S 17°04'E], II.1997, L. Prendini, *et al.*, collected at night with UV light in granitic gravel flats, succulent karoo, syntopic with *P. brevimanus*, *P. granulatus*, and *Opisthophthalmus* sp. (AMNH); 1 ♂: Kokerboomkloof, near Tatasberg [28°18.50'S 17°16.00'E], 12.I.1999, G.J. Müller, *et al.*, collected at night with UV light (AMNH); 2 ♂ (hemispermatophores dissected): Kokerboomkloof, 24.XII.1994, J. Leeming (ESV 3676, 3677); 1 subad. ♂: Noemesberg [28°18'S 16°56'E], 14.IX.1985, A.V. Evans, in burrow under rock (shale), syntopic with *P. brevimanus* (AMNH [AH 4271]); 7 ♂: Potjiespram [28°06'S 16°57'E], 23.I.1995, A. Harington, sloping gravelly riverbed-like area between hills, sympatric with *P. brevimanus*, *P. capensis*, *P. granulatus* and *U. gracilior* (AMNH [AH 2739–2745]); 1 ♂ (hemispermatophore dissected): Potjiespram, I.1997, L. Prendini, *et al.*, collected at night with UV light in sandy-loam flats at base of steep mountains, syntopic with *P. brevimanus*, *P. capensis* and *P. granulatus*, *H. tityrus* collected nearby on rocky slopes (ESV 2459); 1 ♂: Potjiespram [28°07'S 16°56'E], III.1997, L. Prendini & E. Scott, collected at night with UV light, sympatric with *P. brevimanus*, *P. granulatus*, *U. gracilior*, *U. schlechteri*, *H. tityrus* and *Opisthophthalmus haackei* (AMCC 119230); 2 ♂: Potjiespram (Pokkiespram), 1 km S [28°05.327'S 16°56.863'E], 2.III.2003, L. Prendini & E. Scott, 70 m, UV light detection on rocky mountain slopes on E side of gravel road, coarse, gritty granitic soil, syntopic with *P. brevimanus*, *U. gracilior* and *Opisthophthalmus* sp. (AMNH); 1 ♂: S of Maerpoort [28°13.626'S 17°07.464'E], II.1997, L. Prendini, *et al.*, 370 m, collected at night with UV light in granitic gravel flats, succulent karoo with large clumps of *Psilacaulon*, syntopic with *P. brevimanus*, *P. granulatus*, and *Opisthophthalmus* sp. (AMNH); 3 ♂ [not '1 ♀ 2 ♂' as stated by Lamoral (1979: 560)]: Springbok Vlakte [28°23'S 17°04'E], 21.II.1978, B.H. Lamoral (NMSA 10919); 3 ♂: Tatasberg [28°19.75'S 17°16.76'E], II.1997, L. Prendini, *et al.*, collected at night with UV light in granitic, gritty flats, sympatric with *P. brevimanus*, *P. capensis*, *P. granulatus*, *U. gracilior* and *U. schlechteri* (AMNH).

The following specimen(s) is confirmed lost (M. Cochrane, pers. comm.): Kakamas [28°47'S 20°37'E], 1926, K.H. Barnard (SAMC B7327), det. J. Hewitt. The following specimens, cited by Hewitt (1918: 128) could not be traced: Kakamas, Miss H.C. Olivier; Upington [28°27'S 21°15'E], R.G.D.

Steyn. The specimen(s), on which Lawrence's (1955: 231) record from Pofadder [29°08'S 19°24'E] was based, could not be located either. *Karasbergia methueni* has been collected at Upington (NMSA 16340; AMNH [AH 342, 3732]) and Pofadder (AMNH [AH 2450, 2451]) subsequently.

Diagnosis

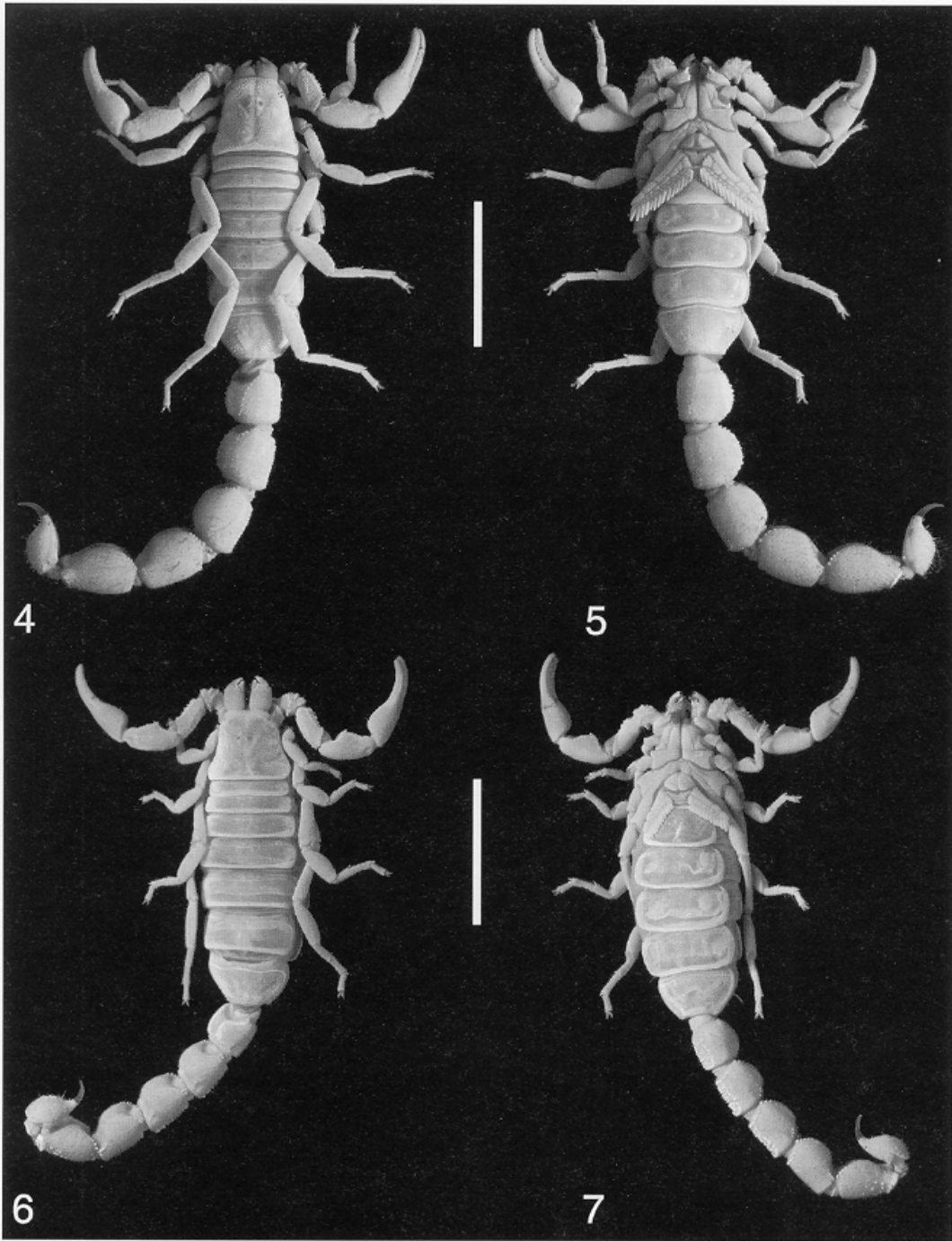
As for genus. **Description** The following description supplements Hewitt's (1913) description and Lamoral's (1979) redescription. It is based on the lectotype ♀, paralectotype ♀, and several other ♂ and ♀ specimens (AMNH; NMSA 10567, 10892; TMSA 17666).

Color Carapace, tergites and metasoma: Buff-Yellow No. 53 to Yellow Ocher No. 123C. Chelicerae, pedipalps, legs, sternites and telson: Cream Color No. 54 to Chamois No. 123D. Pectines: Pale Horn Color No. 92. Aculeus: Jet Black No. 89. Chelicerae, pedipalps, legs, and telson are slightly lighter than carapace, tergites and metasoma. Metasomal segments are uniformly shaded, but segments IV and V are slightly darker in some specimens.

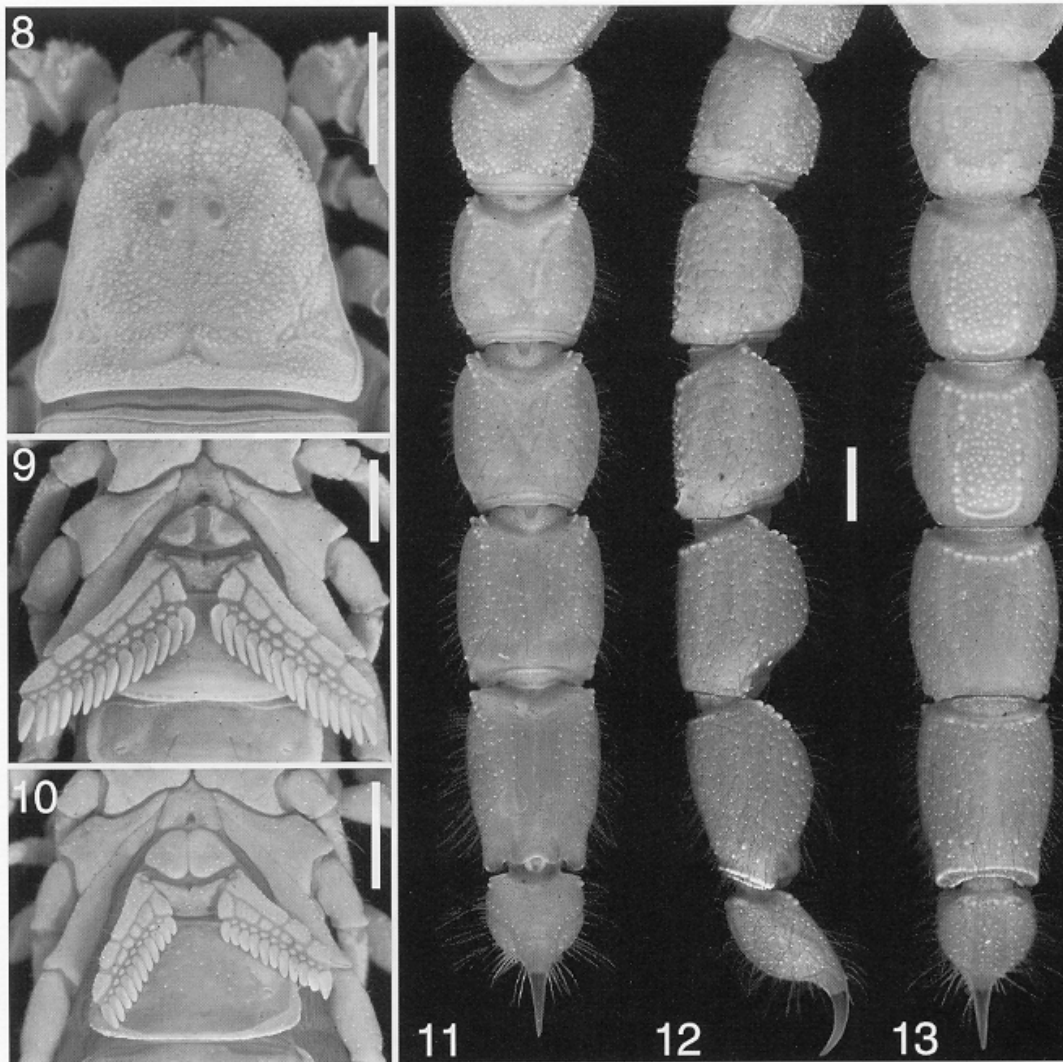
Carapace Carapace covered entirely by uniform, coarse granulation; acarinate. Anterior margin straight or slightly procurved; posterior margin straight (Fig. 8). Usually two pairs of lateral ocelli (a third, greatly reduced pair occasionally present). Median ocelli considerably larger than lateral ocelli, situated anteromedially. Ocular tubercle with pair of smooth to weakly granular superciliary carinae, not protruding above median ocelli. Anteromedian furrow shallow; posteromedian furrow shallow anteriorly, becoming deeper posteriorly; posterolateral furrows shallow, wide, curved; posteromarginal furrow narrow, shallow.

Chelicerae Movable finger with distal external and distal internal teeth subequal, opposable. Ventral aspect of fingers and manus with long, dense macrosetae. Fixed finger without denticles on the ventral surface.

Pedipalps Pedipalps sparsely covered in short macrosetae to almost apilose. Femur dorsal, internal and dorsoexternal surfaces finely and uniformly granular (Figs 14–22); tricarinate, dorsoexternal and dorsointernal carinae distinct, granular, internomedian carina comprising spiniform granules, other carinae absent. Patella finely and uniformly granular on dorsal (♂) and internal (♂, ♀) surfaces; carinae absent or obsolete, except for dorsointernal and ventrointernal carinae, each comprising a few granules proximally, and internomedian carina, comprising a large spiniform granule, proximally, and a few smaller granules, distally (Figs 17, 18). Chela smooth to granular dorsally (Figs 19–22); acarinate. Chela short, stout, length along ventroexternal carina 35.5% (26–45%) greater than chela



Figs 4–7. *Karasbergia methueni* Hewitt, 1913, habitus of ♂ (AMNH [AH 2739]) and ♀ (NMSA 10888). 4, Dorsal aspect, ♂; 5, Ventral aspect, ♂; 6, Dorsal aspect, ♀; 7, Ventral aspect, ♀. Scale bars = 5 mm.

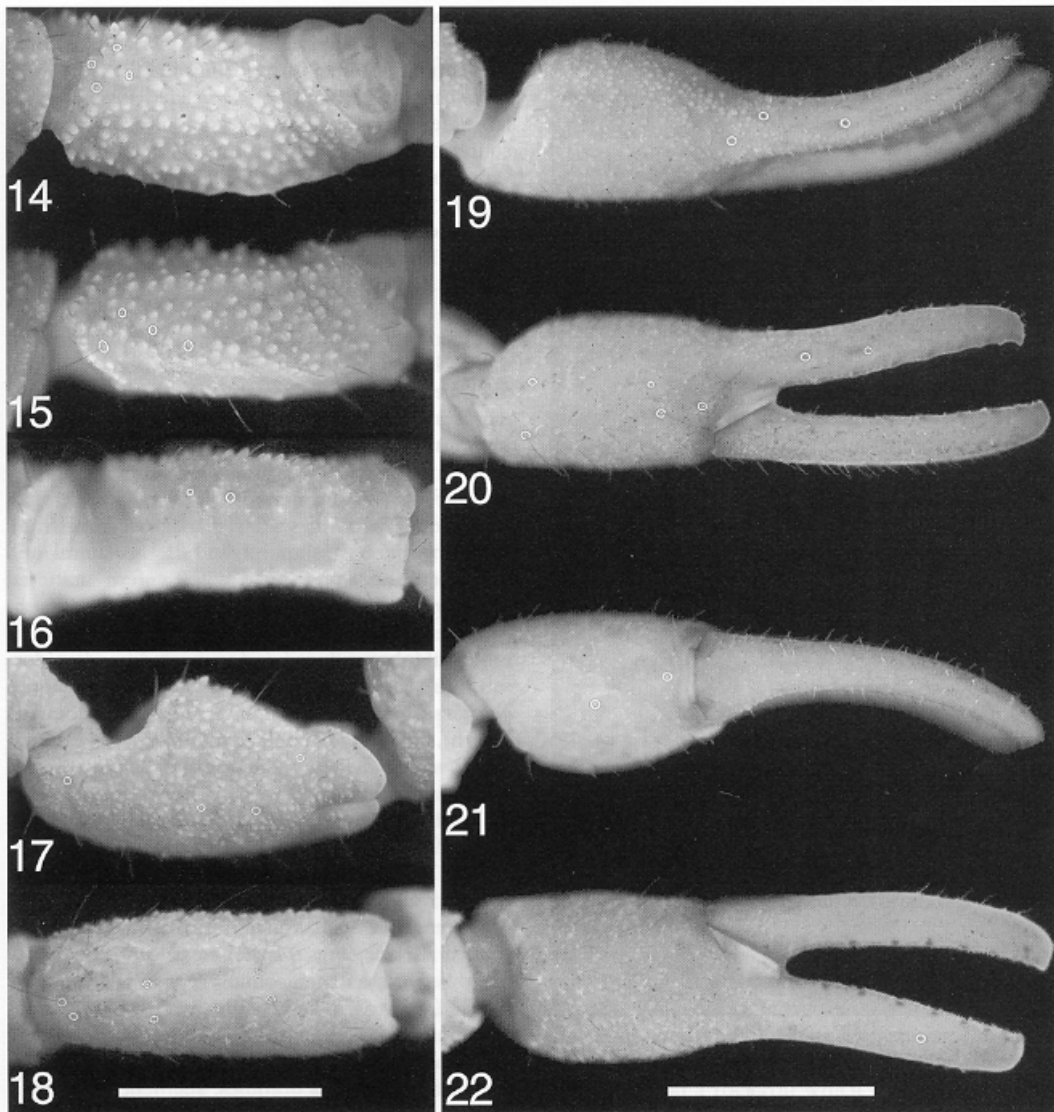


Figs 8–10. *Karasbergia methueni* Hewitt, 1913, diagnostic characters of ♂ and ♀. 8, Carapace (♂, NMSA 10919). 9, Sternum and pectines (♂, AMNH). 10, Sternum and pectines (♀, NMSA 10888). 11–13, Metasomal segments I–V and telson (♂, NMSA 10919). 11, Dorsal aspect. 12, Lateral aspect. 13, Ventral aspect. Scale bars = 1 mm.

width and 35.5% (22–49%) greater than chela height (Table 1); length of movable finger 48.5% (34–63%) greater than length along ventroexternal carina. Chela fixed and movable fingers straight, such that proximal dentate margin linear when fingers closed (no proximal 'gap' is evident). Dentate margins of chela fixed and movable fingers with 6 and 7 oblique granular rows, respectively (Fig. 22); each row comprising several small granules and a large proximal granule (absent from the basal row); all except the basal row (comprising two fused rows) flanked proximally by one internal granule

but no external accessory granule; basal row flanked medially by a single internal accessory granule; two granules, proximal to the enlarged terminal denticle, flank the first row of each finger; supernumerary granules absent.

Trichobothria Neobothriotaxic minor, type A, *a* configuration (Figs 14–22), with following segment totals: femur, 10 (4 dorsal, 4 internal, 2 external), patella, 12 (4 dorsal, 1 internal, 7 external) and chela, 13–15 (7 or 8 manus, 6 or 7 fixed finger). Total number of trichobothria per pedipalp, 35–37. Femur and patella both with d_2 absent. Chela manus



Figs 14–22. *Karasbergia methueni* Hewitt, 1913, distribution of trichobothria on dextral pedipalp of ♂ (NMSA 10919). 14, Femur, internal aspect. 15, Femur, dorsal aspect. 16, Femur, external aspect. 17, Patella, dorsal aspect. 18, Patella, external aspect. 19, Chela, dorsal aspect. 20, Chela, external aspect. 21, Chela, ventral aspect. 22, Chela, internal aspect. Scale bars = 1 mm.

often with Eb_3 absent; fixed finger often with esb absent. Chela with eb located proximal to basal dentate margin of fixed finger; dt located proximal to et ; db located in line with esb , if esb present; it situated submedially on fixed finger. Patella with esb_2 slightly distal to esb_1 . Femur with d_4 equidistant between d_3 and d_5 .

Vachon (1974: 910, 936) first reported the absence of Eb_3 in *Karasbergia*; it was later used as a diagnos-

tic character in the key to buthid genera by Sissom (1990: 94). However, Lamoral (1979: 557) noted that, with the exception of a few specimens in which Eb_3 was absent from one chela and present on the other, Eb_3 was present in all material that he examined, although its small areola and short trichium made it difficult to detect except under high magnification. Eb_3 was absent in many specimens observed for this study, as was esb .



Figs 23–24. *Karasbergia methueni* Hewitt, 1913, paraxial organ, cleared to show hemispermatophore (NMSA 10566). 23, Ectal aspect. 24, Ental aspect. Scale bar = 1 μ m.

Mesosoma Pre-tergites smooth and shiny. Post-tergites I–VI smooth (\varnothing) to entirely coarsely granular proximally, becoming more coarsely granular distally (δ); VII entirely coarsely granular; I–VII each with weakly developed, granular median carina (Figs 4, 6); VII additionally with very weakly developed pairs of granular dorsosubmedian and dorso-lateral carinae. Sternites acarinate and entirely smooth, except for sternite VII, which is coarsely granular posteromedially and often also posterolaterally (Figs 5, 7); lateral and distal margins each with row of sparsely distributed macrosetae.

Sternum Type I, subpentagonal, slightly longer than broad, with subcordate basal pit and without median longitudinal furrow (Figs 9, 10).

Pectines Three marginal lamellae. Five median lamellae, proximal two rectangular, distal two round or ovoid. Fulcra present. Pectinal teeth present along entire posterior margin of each pecten (δ , \varnothing), the first proximal median lamella carrying 1 or 2 teeth (Figs 9, 10). Pectinal tooth count: 14–17/13–16 (δ), 12–13/11–12 (\varnothing). First proximal median lamella and basal pectinal tooth unmodified (δ , \varnothing).

Genital operculum Completely divided longitudinally. Genital papillae absent (δ , \varnothing).

Legs Legs I and II respectively 30% and 50% of metasoma length; legs III and IV both as long as metasoma. Femoral external surfaces and patellar ventromedian surfaces finely granular; other surfaces of leg segments smooth. Tibiae I and II retrolateral margins with scattered macrosetae; III and IV with spurs. Basitarsi I and II, prolateral and retrolateral margins each with a few scattered macrosetae. Telotarsi each with paired ventrosu-bmedian rows of fine macrosetae. Telotarsal laterodistal lobes reduced and truncated; median dorsal lobe very short (ca. 10% of telotarsus length). Telotarsal ungues short (ca. 50% of telotarsus length), distinctly curved, equal in length.

Metasoma and telson Metasomal segments I–V width/length ratio progressively decreasing (Table 1), width percentage of length 100.5% (88–113%) for I, 89% (81–97%) for II, 87% (83–91%) for III, 83% (77–89%) for IV, and 74.5% (66–83%) for V. Telson oval, globose, height 53–56% (δ) to 56–60% (\varnothing) of length, with flattened dorsal surface, rounded ventral surface (Figs 11–13); vesicle not distinctly narrower than metasomal segment V, width 68–73% (δ) to 79–85% (\varnothing) of metasomal segment V. Metasomal segments each with weakly developed dorsosubmedian carinae, usually represented by only a few proximal granules; segment I (δ) occasionally with weakly developed, granular dorsosubmedian and dorsolateral carinae extending full length of segment (Fig. 11); segments I–III each with ventrolateral carinae and posteroventral margins composed of weakly to moderately elevated, crescent-shaped tubercles, converging posteriorly to form a broad U-shaped pattern (Fig. 13); segment V with paired ventrolateral carinae, reduced to a few lobate granules subdistally or absent altogether; all other carinae absent. Metasomal segments I–III each without stridulatory region on dorsal surface; smooth (\varnothing) to densely coarsely granular (δ , \varnothing) on dorsal surface and densely coarsely granular on ventral surface; segment V sparsely coarsely granular on posterior half of ventral surface. Meta-

somal segments I–V and telson punctate laterally, a short microseta (50 µm in length) usually arising from each punctation (Figs 11–13); segments IV, V and telson also punctate ventrally. Aculeus short, sharply curved, 35.5% (33–38%) of vesicle length; without a subaculear tubercle ventrally.

Hemispermatothore Flagelliform, with a *pars recta* but without a *pars reflecta* (Figs 23, 24).

Geographic variation *Karasbergia methueni* exhibits geographic variation in surface ornamentation and setation across its distributional range (Lamoral, 1979). The U-shaped rows of crescent-shaped tubercles along the lateral and posterior margins of the ventral surfaces of metasomal segments I–III are weakly developed and occasionally almost entirely absent on segment I in some specimens, and the coarse, scattered granules on the ventral surfaces of these segments are often similarly reduced. The punctations on the lateral surfaces of metasomal segments I–III and the lateral and ventral surfaces of segments IV, V and telson are also subject to local variation in number and distribution. The most conspicuous variation is the considerably more setose metasoma and telson observed in specimens originating from the Richtersveld and Hunsberg regions in the southwest of the distributional range. Typical specimens are almost apilose, except for a sparse vestiture of fine macrosetae on the ventral surfaces of the basitarsi and telotarsi, and microsetae arising from punctations in the metasoma and telson. However, as noted by Lamoral (1979: 556, 557, 560):

‘specimens ... from Springbok Vlakte in the Richtersveld in the north-western Cape and ... Ai Ais in the south-western part of Namibia have strikingly pilose cauda and telson. The numerous fine setae present on these segments are long (1 mm) and inserted in the shallow punctations ... replacing the microsetae typical of all other specimens ... Another specimen from Ai Ais ... does not have this striking pilosity and the caudal segments have the normal vestiture described for typical forms. Were it not for this, one could speculate that specimens from Ai Ais and the Richtersveld are possibly samples of populations deserving species status. Only access to new material from intermediate and marginal localities along the Fish River and between Ai Ais and the Richtersveld will elucidate this striking variation.’

Additional material from the Richtersveld and along the Fish River, collected since Lamoral’s (1979) revision, confirms that the increased pilosity is associated with occurrence on sandier substrata, as has also been observed in southern African *Parabuthus* species (Prendini, 2004). As such, it cannot be considered diagnostic.

Ontogenetic variation Male and female *Karasbergia* resemble one another very closely until the final instar. However, juveniles and subadults may be readily sexed on the basis of their pectinal tooth count.

Sexual dimorphism Male *Karasbergia* are remarkable in exhibiting no genital papillae, thereby presenting problems in sexing specimens (Lamoral, 1979). Specimens may be sexed on the basis of their pectinal tooth count. In addition, the adult male is proportionally longer and more slender than the adult female, as reflected by the percentage of metasomal length to total length in the two sexes: 61–64% (♂) vs. 57–58% (♀).

Distribution As for genus.

Ecology Most specimens of *K. methueni* have been collected by UV light detection at night, and were either sitting or walking on the surface. However, a few specimens were found in burrows under stones, and the species is clearly fossorial and pelophilous (Prendini, 2001a), rather than lapidicolous as suggested by Lamoral (1979). All specimens for which habitat data are available were collected in flat, rocky areas (often at the base of rocky hills or outcrops) with hard, usually gritty substrata. As noted by Lamoral (1979), this species has never been collected on sandy substrata within these areas. It is still not known whether it excavates burrows or scrapes in open ground, but this seems likely.

The fact that the majority of *Karasbergia* specimens have been collected at night with UV light detection can be attributed as much to the fossorial habit of the species as to its small size (cf. Lamoral, 1979). The strongly biased sex and age ratios of the material examined (164 ♂, 38 ♀ and 11 subadult or juvenile specimens) suggests that adult females, subadults and juveniles are more sedentary than adult males. Courtship behaviour in this species has been observed in the field and laboratory (Lamoral, 1979; pers. obs.). In all cases, the *promenade à deux* took place on a rock, on which the spermatophore was deposited. Other behaviour was similar to that reported for *Parabuthus* by Alexander (1959). When kept in laboratory terraria, mixed sex and age groups of *Karasbergia* were found to cohabit with minimal aggression or cannibalism (pers. obs.).

Karasbergia methueni has been collected in sympatry with several other scorpion species, including the buthids, *Parabuthus brevimanus* (Thorell, 1876), *P. capensis* (Ehrenberg, 1831), *P. granulatus* (Ehrenberg, 1831), *P. raudus* (Simon, 1888), *Uroplectes gracilior* Hewitt, 1914 and *U. schlechteri* Purcell, 1901; the liochelids, *Hadogenes tityrus* (Simon, 1888) and *H. zumpti* Newlands in Newlands & Cantrell, 1985; the scorpionids, *Opisthophthalmus gigas* Purcell, 1898; *O. haackei* Lawrence, 1966, *O. lornae* Lam-

oral, 1979, and three undescribed species of *Opisthophthalmus* C.L. Koch, 1837. Although sympatric, *K. methueni* was not syntopic with *U. schlechteri*, *H. tityrus*, *H. zumpti* or *O. haackei*, which occurred on rocky slopes, or with *P. raudus* or *O. lornae*, which occurred on sandy substrata. It was most often syntopic with *P. brevimanus*. Both species share similar substratum preferences and, despite the larger size of *P. brevimanus*, appear to have converged on a similar morphology for burrowing in the hard, gritty substrata they inhabit. The most striking convergence, first noted by Hewitt (1918, 1925), is the disposition of the ventrolateral carinae and posteroventral margin of the first three metasomal segments, which are composed of strongly elevated, crescent-shaped tubercles, forming a broad U-shaped pattern in both species (Lamoral, 1979; Prendini, 2004). Presumably, these modifications represent an adaptation for burrowing in the gritty substrata that these scorpions inhabit, perhaps assisting to loosen granular soil particles during tail-scraping operations, but this remains to be observed.

Conservation *Karasbergia methueni* is presently known from ca. 75 localities, falling within 53 QDS. The species inhabits a region of extremely low agricultural potential (Barnard 1998; Fairbanks *et al.* 2000). Besides diamond mining and agriculture along the northern and southern banks of the Orange River, there are few other threats to its survival. Furthermore, a reasonable portion of its range falls within a major transfrontier park, viz. the Ai-Ais and Fish River Canyon National Park (with three confirmed records) and the Richtersveld National Park (with 14 confirmed records), on the Namibian and South African sides of the Orange River, respectively. One record is confirmed from the Augrabies Falls National Park in the Northern Cape Province of South Africa. *Karasbergia* is likely to also occur in the Nababeep Nature Reserve, also in the Northern Cape Province, South Africa, as well as the Naute Recreation Area in the Karas Region of Namibia. For these reasons, it has been assigned the Least Concern IUCN Red List Category.

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Table 1 Meristic data for *Karasbergia methueni* Hewitt, 1913. Measurements (mm) follow Stahnke (1970) and Lamoral (1979). ¹Sum of carapace, tergites I–VII, metasomal segments I–V, and telson; ²sum of tergites I–VII; ³sum of metasomal segments I–V and telson; ⁴measured from base of condyle to tip of fixed finger.

Specimen	sex collection number	♂	♂	♂	♀	♀	♀
		AMNH AH 2178	NMSA 10889	NMSA 10893	AMNH AH 2177	NMSA 10889	NMSA 10893
Total length ¹		20.03	21.23	24.15	20.80	24.63	24.30
Carapace	length	2.21	2.24	2.60	2.20	2.60	2.65
	anterior width	1.50	1.40	1.62	1.54	1.70	1.88
	posterior width	2.70	2.40	2.76	2.63	3.03	3.20
Mesosoma	total length ²	5.10	5.81	6.74	6.64	7.64	7.72
Sternite VII	length	1.40	1.46	1.60	1.40	1.70	1.84
	width	2.42	2.36	2.81	2.40	3.15	3.08
Metasoma	total length ³	12.72	13.18	14.81	11.96	14.39	13.93
Metasoma I	length	1.76	1.98	2.10	1.75	2.15	1.88
	width	1.84	1.81	2.14	1.60	1.90	2.13
	height	1.54	1.46	1.92	1.34	1.50	1.75
Metasoma II	length	1.90	2.12	2.40	1.90	2.24	2.20
	width	1.80	1.80	2.15	1.54	1.90	2.14
	height	1.64	1.50	1.77	1.40	1.55	1.73
Metasoma III	length	2.10	2.10	2.45	1.90	2.20	2.35
	width	1.83	1.85	2.12	1.57	1.90	2.14
	height	1.60	1.55	1.73	1.40	1.60	1.74
Metasoma IV	length	2.28	2.12	2.50	2.07	2.34	2.40
	width	1.80	1.88	2.12	1.59	1.85	2.13
	height	1.55	1.58	1.76	1.28	1.53	1.70
Metasoma V	length	2.34	2.50	2.75	2.10	2.70	2.50
	width	1.75	1.78	2.04	1.50	1.78	2.08
	height	1.45	1.48	1.60	1.18	1.40	1.65
Telson	total length	2.34	2.36	2.61	2.24	2.76	2.60
	aculeus length	0.64	0.62	0.65	0.60	0.70	0.70
	vesicle length	1.70	1.74	1.96	1.64	2.06	1.90
	vesicle width	1.27	1.24	1.38	1.28	1.48	1.64
	vesicle height	0.90	0.95	1.10	0.93	1.15	1.14
Pedipalp	total length ⁴	7.09	7.44	8.58	7.17	8.10	8.86
Femur	length	1.43	1.56	1.70	1.42	1.50	1.76
	width	0.64	0.64	0.75	0.65	0.74	0.80
Patella	length	1.80	1.82	2.08	1.81	2.00	2.24
	width	0.92	0.91	1.08	0.94	1.04	1.18
Chela	length	2.86	3.04	3.60	2.84	3.40	3.67
	width	0.86	0.84	1.00	0.84	0.98	1.04
	height	0.82	0.85	1.03	0.90	0.98	1.14
	length ventroexternal carina	1.22	1.15	1.26	1.22	1.26	1.42
	length movable finger	1.70	1.60	2.05	1.63	2.06	2.21
Pectines	total length	1.98	2.16	2.31	1.43	1.66	1.82
	length dentate margin	2.46	2.20	2.40	1.36	1.48	1.50
	tooth count (left/right)	14/13	15/15	17/16	12/11	12/11	12/11