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THE SYSTEMATICS OF SOUTHERN AFRICAN *PARABUTHUS* POCOCK (SCORPIONES, BUTHIDAE): REVISIONS TO THE TAXONOMY AND KEY TO THE SPECIES

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ABSTRACT. The southern African species of *Parabuthus* Pocock 1890 are reviewed. Twenty valid species are recognized and an illustrated key is provided for their identification. The diagnosis of each species is revised, its known distributional range summarized, and notes on its ecology and conservation provided. Three species are redescribed and their distributions mapped: *P. calvus* Purcell 1898; *P. capensis* (Ehrenberg 1831); *P. planicauda* (Pocock 1896). Six new synonyms are proposed: *Buthus brevimanus* var. β *segnis* Thorell 1876 = *P. granulatus* (Ehrenberg 1831); *Buthus villosus* var. β *dilutus* Thorell 1876 = *P. raudus* (Simon 1888); *P. granulatus strenuus* Hewitt 1918 = *P. granulatus* (Ehrenberg 1831); *P. capensis frenchi* Purcell 1901 = *P. planicauda* (Pocock 1889); *Scorpio teter* Müller 1828 = *P. transvaalicus* Purcell 1899; *P. brachystylus* Lawrence 1928 = *P. villosus* (Peters 1862). Two species, synonymized by previous authors, but subsequently resurrected, are returned to synonymy: *P. neglectus* Purcell 1899 = *P. capensis* (Ehrenberg 1831), first synonymized by Kraepelin (1908); *P. flavidus* Pocock 1899 = *P. mossambicensis* (Peters 1861), first synonymized by Kraepelin (1914).

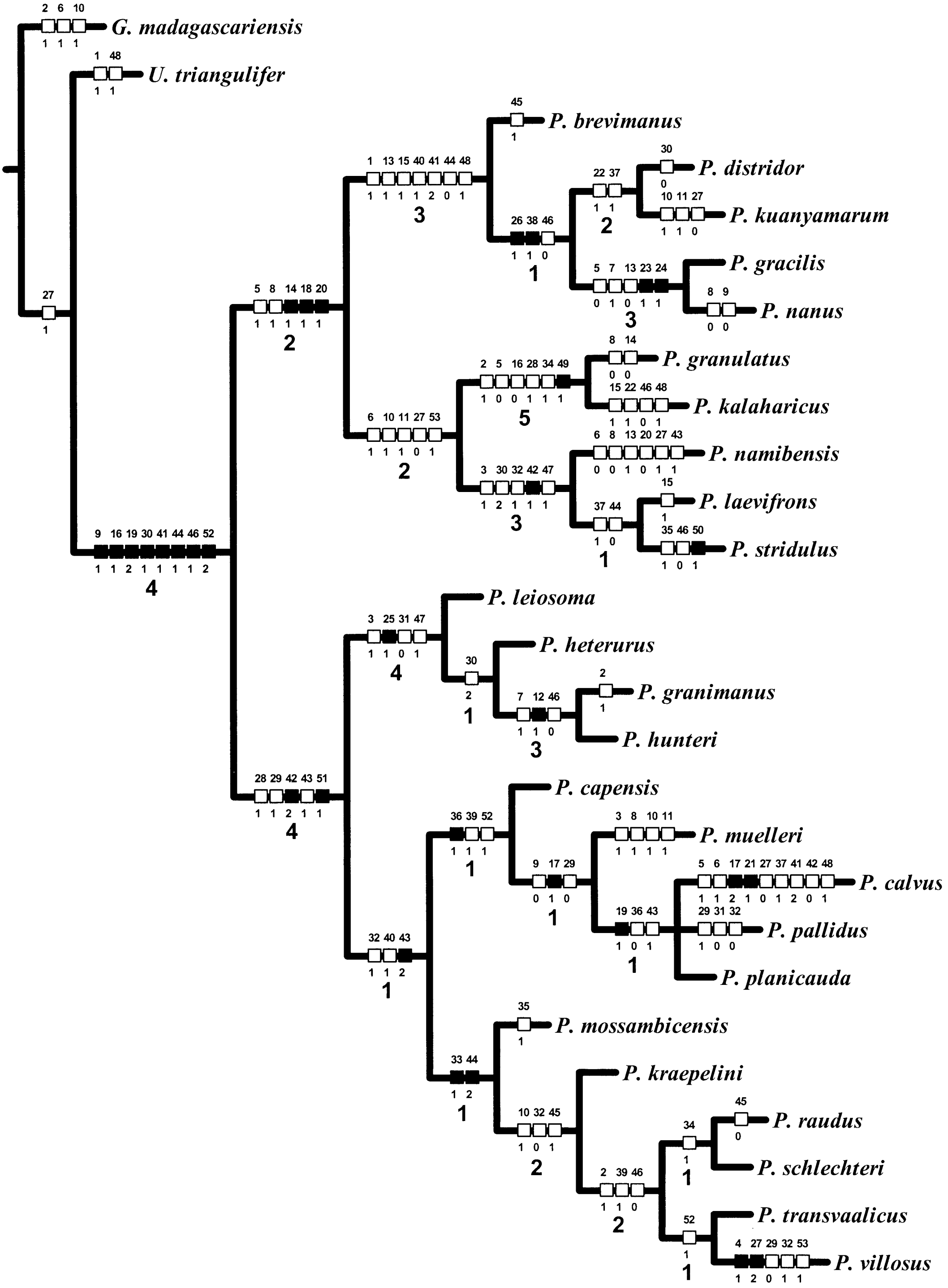
Keywords: Scorpiones, Buthidae, *Parabuthus*, taxonomy, identification, distribution, ecology

Parabuthus Pocock 1890 is an exclusively Old World genus of scorpions, one of 82 genera in the diverse, cosmopolitan family Buthidae (Fet & Lowe 2000; Kovařík 2001, 2002, 2003a). The genus includes the world's largest buthid scorpions, e.g., *P. granulatus* (Ehrenberg 1831), *P. schlechteri* Purcell 1899, *P. transvaalicus* Purcell 1899 and *P. villosus* (Peters 1862), which reach lengths of up to 140 mm and masses of up to 14 g (Newlands 1974a, 1978a). It also includes the world's only diurnal buthid, *P. villosus* (Newlands 1974a; Harington 1982).

Parabuthus displays a classic ‘‘arid corridor’’ pattern of distribution (Balinsky 1962), occurring in two disjunct geographical regions: (1) arid southwestern Africa; (2) arid northeastern Africa and the Arabian Peninsula. During past periods of increased aridity, such as the Pliocene and the Upper Pleistocene (Tankard & Rogers 1978; Lancaster 1981, 1984; Ward et al. 1983), these two areas were contiguous, allowing dispersal or range expansion of arid-adapted taxa between them. As evidence for their arid requirements, the southern African species of *Parabuthus* are today restricted to areas receiving less than 600 mm of annual rainfall (Newlands 1978a, b).

The dependence of *Parabuthus* species on aridity has some fortunate implications for the geographical distribution of scorpionism in southern Africa, as *Parabuthus* includes some of the world's most dangerously venomous scorpions. Envenomation by these scorpions is a significant cause of morbidity and, in some instances, mortality, in the sparsely populated arid to semi-arid western regions of southern Africa (Müller 1993; Bergman 1997a, b). However, the more densely populated mesic eastern regions are devoid of *Parabuthus* (Prendini 1995) and the incidence of scorpion envenomation in southern Africa is therefore lower than might be expected, given the abundance of medically important scorpion species in the region.

The medical importance of *Parabuthus*, especially *P. granulatus* and *P. transvaalicus*, has received increasing attention during the past 25 years (Newlands 1974a, 1978a; Newlands & Martindale 1980; Petersen 1987; Hill 1990; Saunders & Morar 1990; Lee 1991; Müller 1993; Bergman 1995, 1997a, 1997b; Swerts et al. 1997; DeBont et al. 1998; Tytgat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P. distridor
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10 11 27
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P. kuanyamarum
26 38 46
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P. gracilis
5 7 13 23 24
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8 9
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5 8 14 18 20
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8 14
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2 5 16 28 34 49
1 0 0 1 1 1
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15 22 46 48
1 1 0 1
P. kalaharicus
6 10 11 27 53
1 1 1 0 1
2
6 8 13 20 27 43
0 0 1 0 1 1
P. namibensis
3 30 32 42 47
1 2 1 1 1
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15
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P. laevifrons
37 44
1 0
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35 46 50
1 0 1
P. stridulus
9 16 19 30 41 44 46 52
1 1 2 1 1 1 1 2
4
P. leiosoma
3 25 31 47
1 1 0 1
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P. heterurus
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P. granimanus
7 12 46
1 1 0
3
P. hunteri
28 29 42 43 51
1 1 2 1 1
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P. capensis
36 39 52
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3 8 10 11
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P. muelleri
9 17 29
0 1 0
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5 6 17 21 27 37 41 42 48
1 1 2 1 0 1 2 0 1
P. calvus
19 36 43
1 0 1
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29 31 32
1 0 0
P. pallidus
P. planicauda
32 40 43
1 1 2
1
35
1
P. mossambicensis
33 44
1 2
1
P. kraepelini
10 32 45
1 0 1
2
45
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P. raudus
34
1
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P. schlechteri
2 39 46
1 1 0
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P. transvaalicus
52
1
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4 27 29 32 53
1 2 0 1 1
P. villosus

et al. 1998; Dyason et al. 2002; Huys et al. 2002). In comparison, attention to the systematics of these scorpions has lagged behind. The most significant recent contribution to the taxonomy of *Parabuthus* was produced by Lamoral (1979), who revised eleven species occurring in Namibia, described three new species, and proposed eight synonyms. Probst (1973) reviewed the two species occurring in Kenya and Tanzania, and Vachon (1979) and Sissom (1994) reviewed the type species, *P. leiosoma* (Ehrenberg 1828), in the Arabian Peninsula. Newlands & Martindale (1980) and FitzPatrick (1994) reviewed the *Parabuthus* species occurring in Zimbabwe. Kovařík (2003b) reviewed the *Parabuthus* species of Djibouti, Eritrea, Ethiopia and Somalia, described a new species and proposed seven new synonyms. Additional contributions to *Parabuthus* systematics in southern Africa were produced by Newlands (1970), Eastwood (1977), Lamoral (1977, 1980), Harington (1984) and Prendini (2000, 2001a, 2003).

Parabuthus currently includes 27 species and eight subspecies, four of which are nominotypic (Lamoral & Reynders 1975; Fet & Lowe 2000; Kovařík 2003b). Twenty of these species and all eight subspecies are endemic to the southern African region. The recent discovery of a new species in Namibia (Prendini 2000), and the synonymy of *P. neglectus* Purcell 1899 with *P. capensis* (Ehrenberg 1831), proposed here, retains the total number of southern African species at 20.

This contribution focuses on the southern African species of *Parabuthus* for the following reasons. (1) *Parabuthus* is more diverse in southern Africa than in northeastern Africa and Arabia. (2) The most venomous species occur in southern Africa. (3) A limited quantity of colonial-era material from the countries of greatest *Parabuthus* diversity in northeastern Africa (particularly Somalia), coupled with political instability, hampers an adequate revision of the *Parabuthus* fauna of that region.

No existing publication has synthesized the taxonomic status of all described southern African *Parabuthus* species and subspecies, or provided information on the whereabouts of type specimens. Two species, viz. *P. calvus* Purcell 1898 and *P. planicauda* (Pocock 1896), have not been revised since their original description. Confusion surrounds the status of *P. brachystylus* Lawrence 1928, *P. flavidus* Pocock 1899 and *P. neglectus*, the first two of which are currently regarded as subspecies of *P. villosus* and *P. mossambicensis* (Peters 1861), respectively. The status of the remaining subspecies is also uncertain.

This contribution addresses these gaps in the knowledge of southern African *Parabuthus* by updating the taxonomy and providing a key to the valid species of the region. The diagnosis of each species is revised, its known distributional range summarized, and notes on its ecology and conservation provided. *Parabuthus calvus*, *P. capensis* and *P. planicauda* are redescribed and their distributions mapped. A cladistic analysis of the southern African species, including five of the eight northeastern African and Arabian species, based on morphological data, has been published elsewhere (Prendini 2001a, 2003; Fig. 1). A larger study, involving a simultaneous analysis of morphological and molecular (DNA sequence) data, is underway (Prendini, Esposito & Wheeler in prep.).

METHODS

In the present contribution, nomenclatural emendations are based primarily upon the examination of type material. However, taxonomic decisions presented here are not derived solely from examination of the types. Additional specimens were examined in all

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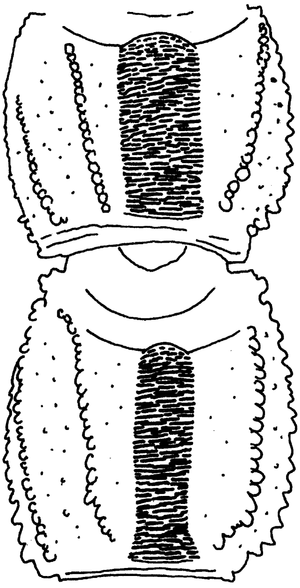
Figure 1.—The optimal tree obtained by an analysis (Prendini 2003) of 53 morphological characters scored for 25 species of *Parabuthus* Pocock 1890 (and two outgroup taxa). This topology was retrieved under weighting regimes that maximized fit and minimized length (length: 132 steps; fit: 59 %; CI: 44; RI 74). Zero-length branches are collapsed. Solid bars indicate uniquely derived apomorphic character states, whereas empty bars indicate parallel derivations of apomorphic states under ACCTRAN optimization. The number above each bar gives the character number, whereas the number below gives the character state. Branch support values of nodes are provided below branches. Refer to Appendix 1 for character descriptions.



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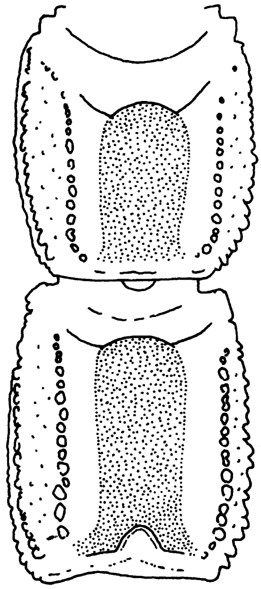

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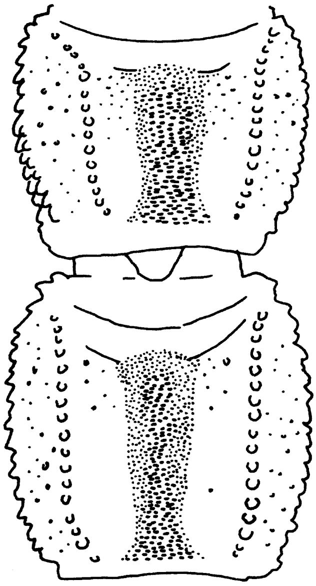

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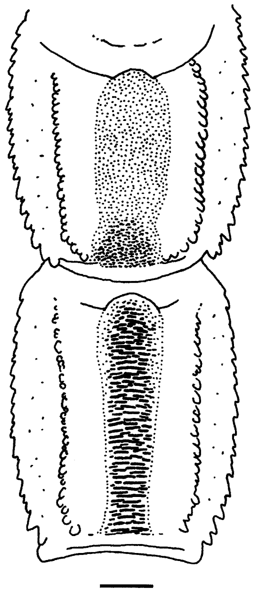

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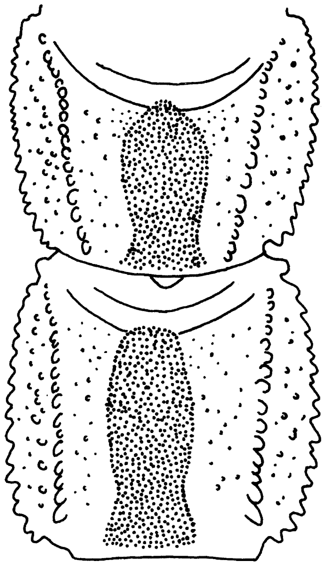

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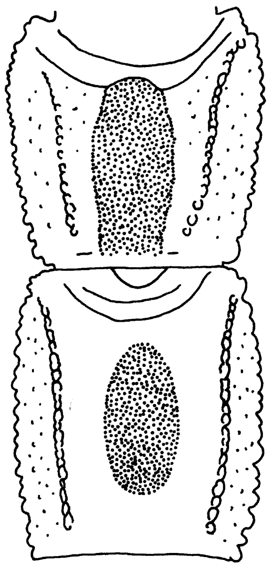

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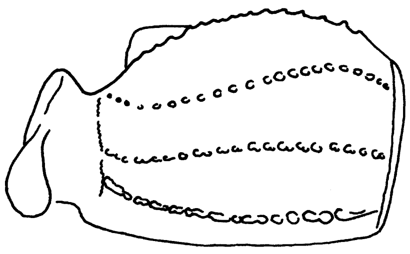

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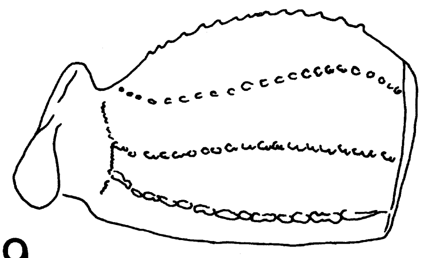

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cases, in order to assess the extent of geographical variation and identify characters that are consistent across the distributional range.

Species are delimited here in accordance with the phylogenetic species concept, where a species is defined as a minimum diagnosable unit (Nelson & Platnick 1981; Cracraft 1983, 1989; Wheeler & Nixon 1990; Nixon & Wheeler 1990; Davis & Nixon 1992; De Pinna 1999). As such, all subspecies are considered junior synonyms of their respective species unless they can be consistently separated based on somatic characters. In that case, they represent valid species in the diagnostic sense and are elevated accordingly. Note that this view differs from traditional usage of the subspecies category in scorpion systematics, in which the biological species concept, according to which species are defined based on reproductive isolation (Dobzhansky 1937; Mayr 1963), still prevails. Unlike most insects and spiders, scorpion genitalia seldom provide sufficient characters at the species level (although there are notable exceptions, e.g., Bothriuridae). For example, Lamoral (1979) and FitzPatrick (1994) found no discrete diagnostic differences in the hemispermatophores of ten species of *Parabuthus*, all of which are diagnosable based on consistent somatic differences. Presumably, differences in the specific-mate recognition system (Paterson 1985), i.e., pre-mating isolation mechanisms (Mayr 1963), of scorpions occur at the behavioral or chemical level (e.g., see Gaffin & Brownell 1992) rather than at the genitalic level. Because of this common paucity of genitalic variation, taxonomists have often resorted to subspecies for delimiting somatic variation in complexes of closely related scorpion species. For example, Harington (1984:404–405) regarded *P. brachystylus* as a subspecies of *P. villosus* on the grounds that morphology ‘‘has a strictly secondary role as a criterion of species rank’’, while acknowledging that this ‘‘is a partly arbitrary decision’’. In reality, many (probably most) scorpion subspecies are diagnosable based on somatic characters, and thus represent valid species in the diagnostic sense. A classic example is *Scorpio maurus* Linnaeus 1758 (family Scorpionidae Latreille 1802), with 19 currently accepted subspecies, each allopatric or parapatric, without intermediates. Neither Vachon (1952) nor Levy & Amitai (1980) were able to perceive diagnostic characters for species delimitation in *S. maurus*. Nonetheless, these authors were able to differentiate subspecies and describe them in the absence of more ‘‘reliable’’ characters. Vachon (1952) even provided a key to the subspecies, by means of which they may be consistently diagnosed. Levy & Amitai (1980) provided conclusive evidence that *Scorpio maurus fuscus* (Ehrenberg 1829) and *S. maurus palmatus* (Ehrenberg 1828) are ecological species (sensu Van Valen 1976), each adapted to slightly different substrata. No evidence has thus far been presented to suggest that the morphological variation in *S. maurus* is clinal, a basic tenet of the hypothesis that this is a widespread polymorphic species. The distribution of the subspecies of *S. maurus* conforms to the typical distributional pattern of localized endemics exhibited by other speciose African scorpionid genera such as *Pandinus* Thorell 1876 and *Opistophthalmus* C.L. Koch 1837.

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

Depositories for specimens are abbreviated as follows: AMGS = Albany Museum (Grahamstown, South Africa); AMNH = American Museum of Natural History (New York,

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Figures 2–9.—Diagnostic characters of *Parabuthus* species. 2–7. Metasomal segments I and II, dorsal aspect, illustrating stridulatory surface. 2. *Parabuthus mossambicensis* (Peters 1861). 3. *Parabuthus capensis* (Ehrenberg 1831). 4. *Parabuthus kraepelini* Werner 1902. 5. *Parabuthus stridulus* Hewitt 1913. 6. *Parabuthus transvaalicus* Purcell 1899. 7. *Parabuthus villosus* (Peters 1862). 8–9. Metasomal segment I, lateral aspect. 8. *Parabuthus villosus*. 9. *Parabuthus transvaalicus*. Scale bars = 1 mm.

NY); BMNH = The Natural History Museum (London, UK); CASC = California Academy of Sciences (San Francisco, CA); GNME = Göteborgs Naturhistoriska Museet (Göteborg, Sweden); MCZ = Museum of Comparative Zoology, Harvard University (Cambridge, MA); MHNC = Musée d'Histoire Naturelle (La-Chaux-de-Fond, Switzerland); MMKZ = McGregor Museum (Kimberley, South Africa); MNHN = Museum National d'Histoire Naturelle (Paris, France); NHMB = Naturhistorisches Museum Basel (Basel, Switzerland); NHMW = Naturhistorisches Museum Wien (Vienna, Austria); NHRS = Naturhistoriska Riksmuseet (Stockholm, Sweden); NMNW = National Museum of Namibia (Windhoek, Namibia); NMSA = Natal Museum (Pietermaritzburg, South Africa); SAMC = South African Museum (Cape Town, South Africa); TMSA = Transvaal Museum (Pretoria, South Africa); ZMHB = Zoologisches Museum, Universität Humboldt (Berlin, Germany).

Illustrations were produced using a Leica MZ16 stereomicroscope and camera lucida. Photographs were taken using a digital photomicrography system (Microptics™ ML-1000). Measurements were made with Mitutoyo® digital calipers (model NTD12-6″C). Color designation follows Smithe (1974, 1975, 1981), trichobothrial notation follows Vachon (1974), sternum terminology follows Soleglad & Fet (2003) and measurements follow Stahnke (1970), Eastwood (1977) and Lamoral (1979). Morphological terminology follows Couzijn (1976) for the segmentation of legs, Hjelle (1990) and Sissom (1990) for the segmentation of pedipalps, Prendini (2000, 2001a, 2003) for metasomal carinae, and Stahnke (1970), Lamoral (1979), Sissom (1990) and Prendini (2001a) for remaining characters.

Distribution maps for *P. calvus*, *P. capensis* and *P. planicauda* were produced using ArcView GIS Version 3.2 (Environmental Systems Research Institute [ESRI], Redlands, CA), by superimposing point locality records on coverages depicting the topography (500 m contour interval), major sand systems and political boundaries 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://edcdaac.usgs.gov/gtopo30/gtopo30.html. A 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 distributional ranges, 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 and 1:500 000 topo-cadastral maps of South Africa and neighboring countries published by the Government Printer, and the GEOnet Names Server: http://164.214.2.59/gns/html/cntry_files.html. Names of Namibian regions and magisterial districts and South African provinces and magisterial districts listed in the material examined follow the most recent system (post-1994).

Genus *Parabuthus* Pocock 1890

Buthus (*Parabuthus*) Pocock 1890: 124, 125; type species by original designation *Androctonus leiosoma* Ehrenberg 1828 [= *Parabuthus leiosoma* (Ehrenberg 1828)].

Heterobuthus Kraepelin 1891: 63–68; type species by subsequent designation (Kraepelin 1895: 78), *Androctonus leiosoma* Ehrenberg 1828 [= *Parabuthus leiosoma* (Ehrenberg 1828)] (synonymized by Thorell 1893: 366).

Parabuthus: Kraepelin 1895: 82; Pocock 1895: 309; Laurie 1896: 131; Lönnberg 1897; 194; Kraepelin 1899: 28; Birula 1917a: 164; Birula 1917b: 55; Pavlovsky 1924: 77; Werner 1934: 269; Kästner 1941: 232; Bücherl 1964: 57; Stahnke 1972b: 130; Lamoral 1979: 560, 561; Francke 1985: 11, 16; Sissom 1990: 102; Nenilin & Fet 1992; Kovařík 1998: 116; 117; Fet & Lowe 2000: 200; Prendini 2001a: 13–35; Dyason et al. 2002: 768–773; Prendini 2003: 5, 19–22.

Diagnosis.—The genus *Parabuthus* is most closely related to the Afrotropical buthid genera *Grosphus* Simon 1888 and *Uroplectes* Peters 1861 (Prendini 2001a, 2004). All species of *Parabuthus*, with one exception (viz. *P. distridor* Lamoral 1980), are readily distinguished from *Grosphus*, *Uroplectes* and other buthid genera by the presence of a distinct stridulatory surface, composed of fine to coarse granules, sometimes forming transverse ridges, on the dorsal surfaces of tergite VII, and metasomal segments I, II and, to a lesser extent, III (Newlands 1974a, 1978a; Lamoral 1977, 1979, 1980; Figs. 2–7). This stridulatory surface is used to make an audible sound (stridulation) when the scorpion is alarmed by repeatedly scraping the aculeus across the granules or ridges (Dumortier 1964; Newlands, 1974a, 1978a; McCormick & Polis 1990). Additionally, all species of *Parabuthus* (including *P. distridor*) are characterized by the following unique combination of characters: carapace without granular carinae; mesosomal tergites with only a single, weakly developed median carina; proximal median lamella of pectines, enlarged and lobate (dilate) in female (Fig. 11; *P. granulatus* and *P. kalaharicus* Lamoral 1977 are exceptions in this regard); basitarsi of legs I and II with macrosetal combs (Fig. 12); metasomal segment IV, ventrosubmedian carinae becoming obsolete distally (Figs. 14, 15); metasomal segment V, ventrolateral carinae comprising distinct spinose or lobate processes subdistally (Figs. 22, 29, 31).

Remarks.—Prior to the present contribution, all but two of the southern African species had been revised to some extent. In contrast, only one of the northeastern African and Arabian species, *P. leiosoma* has been partially revised (Sissom 1994). The limited quantity of material available for most northeastern African species (except *P. leiosoma*) remains an obstacle for revising the species in that region, given the extent of geographical variation in *Parabuthus* species.

Distribution.—Angola, Botswana, Djibouti, Egypt, Ethiopia, Kenya, Mozambique, Namibia, Saudi Arabia, Somalia, South Africa, Sudan, Tanzania, Yemen, Zambia, Zimbabwe. Twenty-eight species are currently recognized, 20 of which are endemic to the southern African region, whereas eight are endemic to northeastern Africa and the Arabian Peninsula.

Ecology.—All species of *Parabuthus* are adapted for a burrowing existence (Newlands 1974b, 1978a, b). The thickened metasoma, especially the processes on the ventrolateral carinae of metasomal segment V, is used to loosen the soil, whereas the anterior two pairs of legs are used to scrape and rake the loosened soil out of the burrow (Eastwood 1977, 1978b; Lamoral 1979; Prendini 2001b). Burrows are constructed in open ground, at the base of shrubs or under stones (Newlands 1974b, 1978a, b; Eastwood 1977, 1978b; Lamoral 1979; Newlands & Martindale 1980; Harington 1984; Prendini 2000, 2001a, 2001b).

Many *Parabuthus* species are morphologically specialized for life on particular substrata. Some (e.g., *P. distridor*, *P. kalaharicus* and *P. kuanyamarum* Monard 1937) are restricted to the sand dune systems of the Namib and Kalahari deserts, and exhibit ecomorphological adaptations to facilitate locomotion and burrowing in the soft sand (Lamoral 1977, 1979, 1980; Prendini 2001b). Others (e.g., *P. planicauda* and *P. villosus*) appear to be morphologically specialized for inhabiting rocky areas (Prendini 2001b).

Adaptive radiation in *Parabuthus* may be related to the evolution of burrowing behavior in the genus. According to the ‘‘Effect Hypothesis of macroevolution’’ (Vrba 1980), repeated allopatric speciation in *Parabuthus* is the predicted outcome of vicariance, promoted by stenotopic habitat requirements, in this case ‘‘substratum specialization’’ (Prendini 2001b).

ILLUSTRATED KEY TO IDENTIFICATION OF THE SOUTHERN AFRICAN SPECIES OF *PARABUTHUS* POCOCK 1890

1. Metasomal segment IV, ventrosubmedian and ventrolateral carinae absent (Fig. 13) 2
   Metasomal segment IV, ventrosubmedian and ventrolateral carinae present, but ventrosubmedian carinae becoming obsolete distally (Figs. 14, 15) 7
2. Pedipalp chela asetose; trichobothrium *dt* in line with or distal to *et* (Figs. 55, 56) . . . . *P. calvus*
   Pedipalp chela covered in setae; trichobothrium *dt* proximal to *et* (Figs. 42–45) 3

3\. Metasomal segments I and II, dorsal stridulatory surface absent, ventrosubmedian and ventrolateral carinae absent (Fig. 28) . . . . *P. distridor*

Metasomal segments I and II, dorsal stridulatory surface present (Figs. 2–7), ventrosubmedian and ventrolateral carinae present (Figs. 25–27) 4

4\. Metasomal segments II and III, distal section of ventrolateral carinae composed of strongly elevated, crescent-shaped tubercles, forming a broad U-shaped pattern (Fig. 27); metasomal segment V, ventrolateral carinae with lobate processes (broad and presenting a flat surface apically) subdistally (Fig. 29) . . . . *P. brevimanus*

Metasomal segments II and III, distal section of ventrolateral carinae costate or composed of isolated, round granules, not forming a U-shaped pattern (Figs. 25, 26); metasomal segment V, ventrolateral carinae with spinose processes (narrow, conical or flattened, and tapering apically) subdistally (Fig. 30) 5

5\. Pedipalp chela smooth and shiny (Fig. 46); carapace (female) with smooth areas . . . . *P. kuanyamarum*

Pedipalp chela granular (Figs. 43–45); carapace (female) entirely granular 6

6\. Pedipalp chela movable finger, short, compared with manus (measured along ventroexternal carina), length finger/length carina: ± 1.50 (Fig. 43); chela manus (adult male) incrassate (bulbous or swollen) (Fig. 43) . . . . *P. gracilis*

Pedipalp chela movable finger, long, compared with manus (measured along ventroexternal carina), length finger/length carina: 1.70–2.00 (Figs. 44, 45); chela manus (adult male) slender (Fig. 44) . . . . *P. nanus*

7\. Metasomal segment IV, median lateral carina absent or more weakly developed than dorsolateral and ventrolateral carinae (Figs. 16, 17) 8

Metasomal segment IV, median lateral carina as strongly developed as dorsolateral and ventrolateral carinae (Fig. 18) 12

8\. Metasomal segment II, dorsal stridulatory surface reaching posterior margin (Figs. 2–6); width of telson vesicle equal to distal width of metasoma V (Figs. 29, 30, 32) 9

Metasomal segment II, dorsal stridulatory surface not reaching posterior margin (Fig. 7); telson vesicle narrower than distal width of metasoma V (Fig. 31) 11

9\. Pedipalp chela manus covered in setae; metasomal segment V, dorsosubmedian carinae present but weakly developed (Figs. 20, 23) . . . . *P. namibensis*

Pedipalp chela manus asetose; metasomal segment V, dorsosubmedian carinae absent (Figs. 19, 22) 10

10\. Metasomal segment II, dorsal stridulatory surface composed of granules (Figs. 3, 4, 6, 7); telson vesicle dorsoproximal surface very shallowly excavated along longitudinal half (Fig. 34) . . . . *P. laevifrons*

Metasomal segment II, dorsal stridulatory surface composed of granular ridges (Fig. 5); telson vesicle dorsoproximal surface deeply excavated along longitudinal half (Fig. 33) . . . . *P. stridulus*

11\. Pedipalp chela, trichobothrium *dt* in line with or distal to *et* (Figs. 39, 40); metasomal segment IV, ventrosubmedian carinae becoming obsolete in distal third of segment (Fig. 15) . . . . *P. granulatus*

Pedipalp chela, trichobothrium *dt* proximal to *et* (Figs. 37, 38); metasomal segment IV, ventrosubmedian carinae becoming obsolete in proximal third of segment (Fig. 14) . . . . *P. kalaharicus*

12\. Metasomal segment II, posterodorsal edge extended forwards in V-shape (Fig. 3) 13

Metasomal segment II, posterodorsal edge straight (Figs. 2, 4–7) 14

13\. Pedipalp chela fingers fit together with distinct proximal gap, when closed (Fig. 41); telson aculeus short, sharply curved (Fig. 36); chela manus (adult male) slender (Figs. 44, 55, 83) . . . . *P. muelleri*

Pedipalp chela fingers fit together without gap, when closed (Figs. 69, 70); telson aculeus long, gently curved (Fig. 35); chela manus (adult male) incrassate (Fig. 69) . . . . *P. capensis*

14\. Metasomal segment V, ventrolateral carinae with lobate processes (Figs. 22, 29, 31) . . . 15

Metasomal segment V, ventrolateral carinae with spinose processes (Figs. 24, 30, 32) . . 17

15. Metasomal segment II, dorsal stridulatory surface composed of ridges (Fig. 2) . . . . *P. mossambicensis*
    Metasomal segment II, dorsal stridulatory surface composed of granules (Figs. 3, 4, 6, 7) 16
16. Metasomal segments I and II, dorsal stridulatory surface extended anteriorly (Fig. 8); chela manus (adult male) slender (Fig. 83) . . . . *P. planicauda*
    Metasomal segments I and II, dorsal stridulatory surface truncated anteriorly (Fig. 9); chela manus (adult male) incrassate (Figs. 37, 39, 43, 46, 69) . . . . *P. kraepelini*
    Metasomal segment V, ventrolateral carinae converging distally (Fig. 30); coloration pale, although metasomal segments IV and V and telson may be infuscated . . . . *P. raudus*
    Metasomal segment V, ventrolateral carinae subparallel to diverging distally (Figs. 29, 31, 32); coloration dark (pedipalps and legs may be pale) 18
17. Metasomal segments I and II, dorsal stridulatory surface extended anteriorly (Fig. 8); metasoma densely setose; metasoma I wider than IV . . . . *P. villosus*
    Metasomal segments I and II, dorsal stridulatory surface truncated anteriorly (Fig. 9); metasoma moderately setose; metasoma I narrower than IV 19
18. Metasomal segment II, dorsal stridulatory surface reaching posterior margin (Fig. 6); coloration of pedipalps and legs dark, not contrasting markedly with dark pro-, meso- and metasoma . . . . *P. transvaalicus*
    Metasomal segment II, dorsal stridulatory surface not reaching posterior margin of segment (Fig. 7); coloration of pedipalps and legs pale, contrasting markedly with dark pro-, meso- and metasoma . . . . *P. schlechteri*

Parabuthus brevimanus (Thorell 1876)
Figs. 27, 29

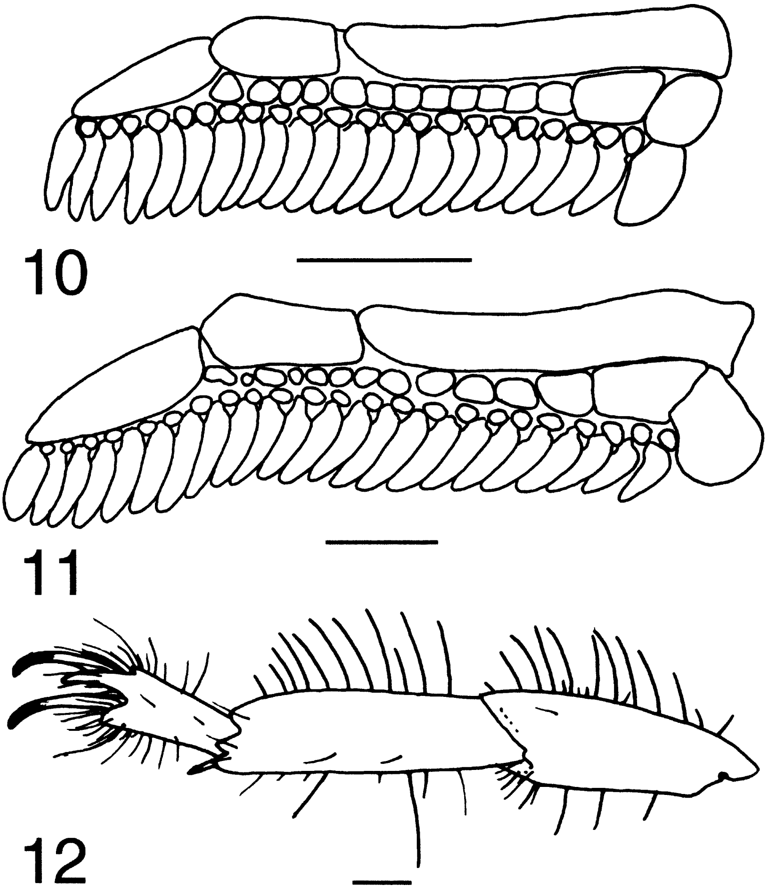
Buthus brevimanus Thorell 1876b: 110–113.
Heterobuthus brevimanus: Kraepelin 1891: 69.
Parabuthus brevimanus: Pocock 1895: 309; Kraepelin 1899: 32; Purcell 1901: 149–151; Kraepelin 1908: 250; Hewitt 1913: 146; Kraepelin 1914: 111, 112; Hewitt 1918: 104, 176; Fage 1925: 189; Lawrence 1927: 72; Lawrence 1928: 269; Werner 1936: 177; Monard 1937: 256, 257; Lawrence 1955: 225; Lawrence 1959: 383; Lawrence 1962: 220; Lamoral & Reynders 1975: 514, 515; Lamoral 1979: 561–566, figs. 87–94, 97–99; Kovařík 1998: 116; Fet & Lowe 2000: 201; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 20.
Parabuthus cristatus Pocock 1901: 284, 285 (synonymized by Kraepelin 1908: 250; Lamoral 1979: 561); Pocock 1902: 367, 368.

Type material.—*Buthus brevimanus:* Lectotype ♀ (GNME) [designated by Lamoral (1979)], ‘‘S. Afrika’’, 28.xi.1864 [not 23.xi.1864], C.J. Andersson. Paralectotype ♂ (NHRS) [designated by Lamoral (1979)], ‘‘Caffraria’’, 1840–1845, J. Wahlberg.

Parabuthus cristatus: Holotype ♀ (BMNH), ‘‘Congo’’ [probably Angola].

Diagnosis.—*Parabuthus brevimanus* is basal to the clade comprising the *P. distridor*–*P. kuanyamarum* and *P. gracilis*–*P. nanus* sister groups (Fig. 1). The five species may be separated from all other species of *Parabuthus* by means of the following combination of characters: small adult size, carapace length 2.5–5.0 mm; pedipalp chela with trichobothrium *dt* situated proximal to *et*; metasomal segments slender (length IV/width IV: 1.7–2.11); metasomal segment IV with median lateral, ventrolateral and ventrosubmedian carinae absent; metasomal segment V with dorsosubmedian, dorsolateral and ventromedian carinae absent.

Parabuthus brevimanus is most easily confused with *P. gracilis*, with which it is sympatric in the northwestern part of its distributional range (Erongo and Kunene regions, Namibia). However, *P. brevimanus* may be separated from *P. gracilis*, as well as *P. distridor*, *P. kuanyamarum* and *P. nanus*, on the basis of the following combination of characters: surface of median ocular tubercle (male, female) and surrounding surfaces of carapace (female), smooth and shiny; pedipalp chela manus smooth; metasomal segments I–IV with dorsosubmedian carinae present, but obsolete; metasomal segments II and III, distal section of ventrolateral carinae, and posteroventral margin composed of strongly elevated, crescent-shaped tubercles, forming a broad U-shaped pattern; metasomal segment IV, anteroventral margin demarcated by a transverse



Figures 10–12.—Diagnostic characters of *Parabuthus* species [modified from Lamoral (1979)]. 10, 11. Dextral pecten of ♀, ventral aspect. 10. *Uroplectes carinatus* (Pocock 1890). 11. *Parabuthus gracilis* Lamoral 1979. 12. *Parabuthus stridulus* Hewitt 1913, distal segments of dextral leg I, dorsal aspect, illustrating macrosetal combs along retrolateral edge. Scale bars = 1 mm.

row of 5–6 strongly elevated crescent-shaped tubercles; metasomal segment V with distally diverging ventrolateral carinae, each comprising several prominent lobate processes subdistally.

Remarks.—Purcell (1901) listed *P. cristatus* as a junior synonym of *P. brevimanus,* but placed a question mark next to the synonymy, as he had not examined the type specimens. Kraepelin (1908) confirmed the synonymy by comparing the type specimens. Most subsequent authors adopted the synonymy (Kraepelin 1914; Hewitt 1918; Lawrence 1955), but Lamoral & Reynders (1975) continued to regard *P. cristatus* as a distinct species. Lamoral (1979) later revised *P. brevimanus,* re-examined the type specimens of *P. brevimanus* and *P. cristatus,* and erroneously claimed that *P. cristatus* was a new synonym.

Distribution.—Recorded from Angola, Namibia, and South Africa. The distribution of this species extends across the Orange River.

Ecology.—*Parabuthus brevimanus* is a semi-psammophilous species, inhabiting semi-consolidated to consolidated sandy and gritty substrata, where it excavates burrows in open ground and at the base of shrubs and grass tufts. Comb-like rows of long macrosetae (‘‘sand combs’’) on the retrolateral margins of the basitarsi of legs I and II indicate a semi-psammophilous ecomorphotype. Metasomal segments IV and V are mostly lacking carinae.

Parabuthus brevimanus is syntopic with *P.*

granulatus throughout its distributional range. *Parabuthus brevimanus* is less often syntopic with *P. laevifrons*, *P. schlechteri*, *P. villosus* and the closely related *P. gracilis*. *Parabuthus brevimanus* occupies a distinctly harder range of substrata than the sand dunes inhabited by *P. kuanyamarum* and *P. nanus* and, although Lamoral (1979) reports that these species are often sympatric, no records document their occurrence as such.

Material examined.—NAMIBIA: *Erongo Region*: Karibib District: Farm Kranzberg 59 [21°58′S 15°39′E], 23.iii.1976, B. Lamoral & L. Ferguson, 20 ♂, 5 ♀, 2 subad. ♂, 2 juv. ♂, 8 juv. ♀ (NMSA 10819); Farm Sandamap 64, 21°56′S 15°16′E, 13.ii.1969, B.H. Lamoral, 1 ♀ (NMSA 10010) [homotype designated by Lamoral (1979)]. SOUTH AFRICA: *Northern Cape Province*: Namaqualand District: Richtersveld, Springbokvlakte [28°23′S 17°04′E], 20–21.ii.1973, B. Lamoral, 3 ♂, 1 ♀, 1 juv. ♀ (NMSA 10442).

Parabuthus calvus Purcell 1898
Figs. 47–60, Table 1

Parabuthus calvus Purcell 1898: 28–30, pl. IV, fig. 7; Purcell 1901: 148, 149; Kraepelin 1908: 250; Hewitt 1918: 104; Lawrence 1955: 226; Lamoral & Reynders 1975: 515; Kovařík 1998: 116; Fet & Lowe 2000: 201; Prendini 2001a: 17; Prendini 2001b: 137; Prendini 2003: 20.

Type material.—Holotype ♂ (SAMC 1201), SOUTH AFRICA: Onder Bokkeveld, Bokkeveld Mountains [31°20′S 19°04′E], Calvinia [*Northern Cape Province*: Calvinia District], M. Schlechter, 1897. At the time of publication of my first contribution on the phylogeny of *Parabuthus* (Prendini 2001a), a thorough search for the holotype of *P. calvus* had failed to locate it in the SAMC or any other South African museum. The holotype was subsequently discovered by Dr. G.J. Müller at the Department of Pharmacology, University of Stellenbosch, among material loaned from the SAMC many years earlier.

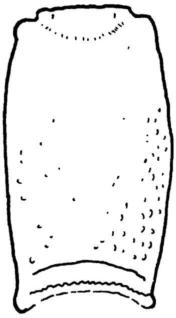
Diagnosis.—*Parabuthus calvus* is similar to *P. planicauda*, with which it shares the following combination of characters: pedipalp chela manus of adult male, slender as in adult female; proximal median lamella of pectines in male, lobate; metasomal segments broad (length IV/width IV: 1.2–1.5); basitarsi of legs I and II, macrosetal combs weakly developed; metasomal segments I and II, stridulatory surface extended anteriorly beyond anterodorsal edge of segment, giving a step-like appearance in lateral aspect; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules more pronounced than preceding granules; metasomal segment IV, dorsosubmedian carinae medially discontinuous; metasomal segment V, dorsosubmedian carinae poorly developed with blunt, rounded granules, dorsolateral carinae distally obsolete.

Parabuthus calvus may be separated from *P. planicauda*, and all other species of *Parabuthus*, on the basis of the following combination of characters: surface of median ocular tubercle (male, female), surrounding surfaces of carapace (female), and lateral intercarinal surfaces of metasomal segments IV and V, smooth and shiny; pedipalp chela manus, metasomal segments I–V and telson virtually asetose; proximal median lamella of pectines in male, strongly lobate; basitarsi of legs III and IV, prolateral surfaces with dense tufts of macrosetae; metasomal segment IV, median lateral, ventrosubmedian and ventrolateral carinae absent; metasomal segment V, ventromedian carina absent.

Redescription.—The following description supplements Purcell's (1898) original description of the male and subsequent description of the female (Purcell 1901), and is based on the holotype male (SAMC 1201), and three female specimens (AMNH; SAMC 2228, C4615).

Color (based on a recently collected female specimen in the AMNH): Carapace, tergites and sternites: Clay Color No. 123B. Metasoma and telson: Yellow Ocher No. 123C. Chelicerae, pedipalps and legs: Buff-Yellow No. 53. Pectines: Pale Horn Color No. 92. Pedipalps, legs, chelicerae, metasoma and telson are slightly lighter than carapace and tergites (Figs. 51, 52). Metasomal segments and telson are uniformly shaded.

Carapace: Carapace sparsely covered by uniform, coarse granulation on interocular and posterolateral surfaces (male) or entirely smooth (female). Anterior and posterior margins of carapace straight or slightly procurved (Figs. 47, 49, 51). Five pairs of lateral ocelli. Median ocelli considerably larger than lateral ocelli, situated anteromedially. Ocular tubercle with pair of smooth superciliary carinae, protruding slightly above median ocelli. An-



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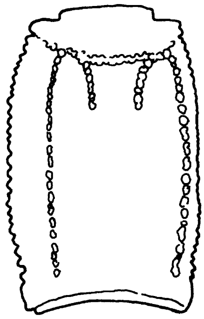

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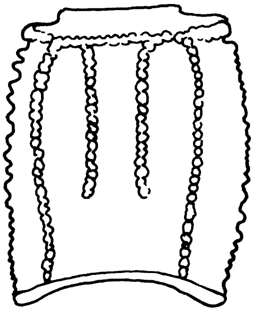

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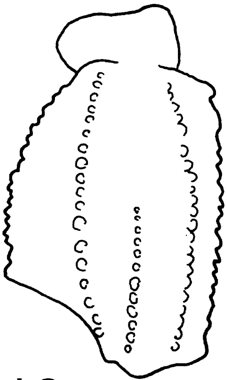

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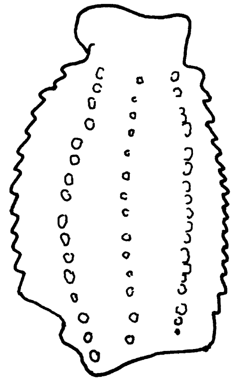

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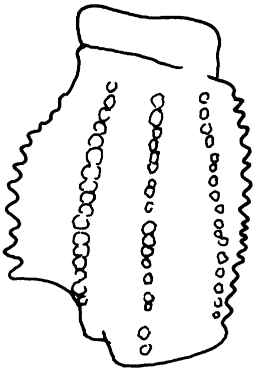

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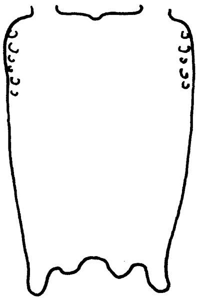

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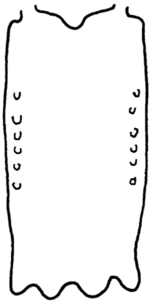

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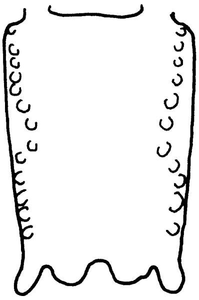

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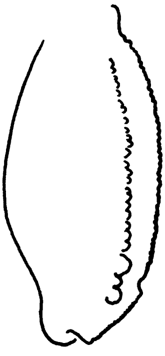

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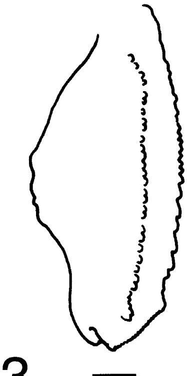

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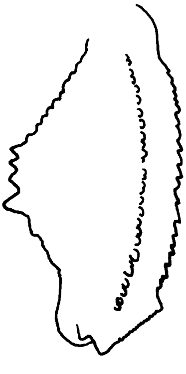

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teromedian furrow shallow; posteromedian furrow shallow anteriorly, becoming deeper posteriorly; posterolateral furrows shallow, wide and curved; posteromarginal furrow narrow, deep.

Chelicerae: Movable finger with distal external and distal internal teeth equal, opposable. Ventral aspect of fingers and manus with long, dense macrosetae. Fixed finger with a pair of denticles on ventral surface.

Sternum: Type I, subtriangular (Figs. 48, 50, 52). Median longitudinal furrow Y-shaped, shallow anteriorly, deep, narrow posteriorly.

Pedipalps: Pedipalps virtually asetose (Figs. 47–52). Femur dorsal surface finely and uniformly granular (male) or smooth (female), all other surfaces smooth (Fig. 59); pentacarinate, all carinae distinct, granular, except for internomedian carina, comprising spiniform granules, and costate externomedian carina. Patella smooth (Figs. 57, 58); carinae absent or obsolete; dorsointernal and ventrointernal carinae each comprising few granules proximally; internomedian carina comprising large spiniform granule, proximally (male, female), and few smaller granules, distally (male only). Chela smooth (Figs. 55, 56); carinae absent. Chela long, slender (male, female), length along ventroexternal carina 38% (male) or 24–31% (female) greater than chela width and 37% (male) or 24–28% (female) greater than chela height (Table 1); length of movable finger 66% (male) to 69–70% (female) greater than length along ventroexternal carina. Chela fixed and movable fingers straight, such that proximal dentate margin linear when fingers closed (Figs. 55, 56). Dentate margins of chela fingers with 11–12 oblique granular rows, each comprising 4–6 small granules and large proximal granule, flanked by inner and outer accessory granules; chela fingers each with terminal denticle.

Trichobothria: Orthobothriotaxic, type A, α configuration (Figs. 55–59), with following segment totals: femur, 11 (5 dorsal, 4 internal, 2 external), patella, 13 (5 dorsal, 1 internal, 7 external) and chela, 15 (8 manus, 7 fixed finger). Total number of trichobothria per pedipalp, 39. Chela with *eb* situated proximal to basal dentate margin of fixed finger, and *esb* situated distal to it; *dt* distinctly distal to *et*; *db* closer to *est* than to *esb*. Patella with esb_2 level with esb_1. Femur with d_2 on proximo-internal side of dorsointernal carina; d_3 distal to d_2; d_4 closer to d_3 than to d_5.

Mesosoma: Pre-tergites smooth, shiny (male, female), granular along posterior margins (male only). Post-tergites entirely covered with very fine, even granulation, imparting matt appearance (male) or smooth, shiny (female); I–VII each with weakly developed, costate median carina (male) or without median carina (female); VII additionally with distinct pairs of costate granular dorsosubmedian and dorsolateral carinae, and well-developed stridulatory surface between dorsosubmedian carinae, consisting of round to slightly crescent-shaped granules reaching posterior margin. Sternites entirely smooth; lateral and distal margins each with few macrosetae; sternite VII with pairs of costate ventrosubmedian and ventrolateral carinae obsolete to absent (Figs. 48, 50, 52).

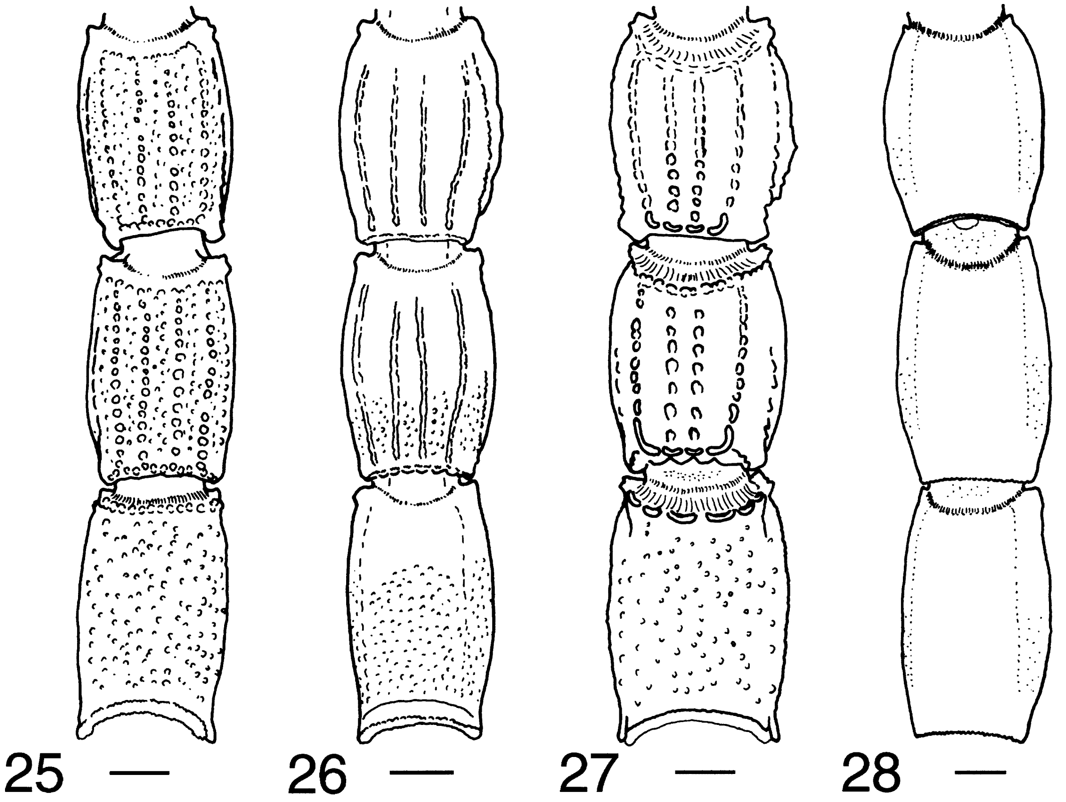
Pectines: First proximal median lamella of each pecten suboval, mesally enlarged, lobate in female and, to lesser extent, in male (Figs. 48, 50, 52). Pectinal teeth: 25/26 (male), 23–24/23–24 (female).

Genital operculum: Completely divided longitudinally. Genital papillae present (male), absent (female).

Legs: Tibiae III and IV with spurs; retrolateral margins with scattered macrosetae. Basitarsi I and II not dorsoventrally com-

←

Figures 13–24.—Diagnostic characters of *Parabuthus* species. 13–15. Metasomal segment IV, ventral aspect, illustrating carinal development. 13. *Parabuthus nanus* Lamoral 1979. 14. *Parabuthus kalaharicus* Lamoral 1977. 15. *Parabuthus villosus* (Peters 1862). 16–18. Metasomal segment IV, lateral aspect, illustrating carinal development. 16. *Parabuthus granulatus* (Ehrenberg 1831). 17. *Parabuthus laevifrons* (Simon 1888). 18. *Parabuthus villosus*. 19–21. Metasomal segment V, dorsal aspect, illustrating carinal development. 19. *Parabuthus stridulus* Hewitt 1913. 20. *Parabuthus namibensis* Lamoral 1979. 21. *Parabuthus transvaalicus* Purcell 1899. 22–24. Metasomal segment V, lateral aspect, illustrating carinal development. 22. *Parabuthus laevifrons*. 23. *Parabuthus namibensis*. 24. *Parabuthus schlechteri* Purcell 1899. Scale bars = 1 mm.



Figures 25–28.—Diagnostic characters of *Parabuthus* species [25–27 modified from Lamoral (1979)]. Metasomal segments II–IV, ventral aspect, illustrating carinal development. 25. *Parabuthus kuanyamarum* Monard 1937. 26. *Parabuthus gracilis* Lamoral 1979. 27. *Parabuthus brevimanus* (Thorell 1876). 28. *Parabuthus distridor* Lamoral 1980. Scale bars = 1 mm.

pressed, retrolateral margins each with sparse row of long, fine macrosetae; III and IV, prolateral surfaces with dense tufts of macrosetae. Telotarsi each with paired ventrosubmedian rows of fine macrosetae. Telotarsal laterodistal lobes truncated; median dorsal lobes extending to ungues. Telotarsal ungues short, distinctly curved, equal in length.

Metasoma and telson: Metasomal segments I–V width/length ratio progressively decreasing (Table 1), width percentage of length 114% (male) or 93–101% (female) for I, 107% (male) or 89–94% (female) for II, 107% (male) or 85–94% (female) for III, 88% (male) or 72–78% (female) for IV, and 73% (male) or 60–67% (female) for V. Telson oval, globose, height 65% (male) or 57–70% (female) of length, with flattened dorsal surface, rounded ventral surface; vesicle not distinctly narrower than metasomal segment V, width 81% (male) or 77–80% (female) of metasomal segment V. Metasoma entirely smooth, except for stridulatory surfaces on dorsal surfaces of segments I and II, each consisting of fine round to slightly crescent-shaped granules extending to posterior margin (Fig. 51); segment III with stridulatory surface absent (female) or obsolete (male), comprising few granules in proximal third of segment; segments II and III with posterodorsal edge straight (Fig. 51). Metasoma almost asetose, with few short macrosetae on ventral surface of telson (Figs. 47–52). Metasomal segments I–III each with ten distinct carinae; segments IV and V each with four obsolete carinae, IV with paired dorsosubmedian and dorsolateral carinae, all other carinae absent, V with paired dorsosubmedian carinae, comprising few rounded granules medially, and paired ventrolateral carinae, reduced to few granules and lobate processes subdistally, all other carinae absent. Metasomal segments I–V with dorsosubmedian carinae converging distally in segment I, subparallel in segments II–V; ventrolateral carinae converging distally in segments I–III, diverging in segment V. Dorsosubmedian and dorsolateral carinae weakly granular, ventrosubmedian and ventrolateral carinae of segment I costate, of segments II and III costate granular, of segment V granular. Metasomal segments I–IV with distal granules of dorsosubmedian carinae very slightly enlarged; segments II and III with distal granules of ventrosubmedian carinae and, to lesser extent, ventrolateral carinae, distinctly enlarged, obtuse, elevated; segment V with subdistal granules of ventrolateral carinae enlarged into laterally compressed, lobate processes. Aculeus short, sharply curved, 51% (43–59%) of vesicle length.

Hemispermatophore: Flagelliform.

Geographic variation: The female from Betjesfontein (SAMC 2228, Figs. 49, 50) is more granular than those from Vanrhynsdorp (SAMC C4615), Paulshoek (AMNH, Figs. 51, 52), Komaggas (ZMHB 11365) further to the north. In SAMC 2228, the interocular and posterolateral surfaces of the carapace are sparsely, but coarsely granular, the median surfaces of the tergites are finely granular, the posterior margins of the tergites are coarsely granular (these surfaces are smooth in the other specimens), and the metasomal carinae are more strongly developed. The metasoma and telson of SAMC 2228 are also more setose than the other specimens.

Ontogenetic variation: All known specimens are adult.

Sexual dimorphism: Unlike most species of *Parabuthus* (except *P. muelleri*, *P. nanus*, *P. pallidus* Pocock 1895 and *P. planicauda*), *P. calvus* is not sexually dimorphic with respect to the shape of the chela manus. The manus of the adult male is slender and similar in shape to that of the adult female (Pocock 1890, 1902; Purcell 1898, 1901; Kraepelin 1908; Hewitt 1918; Prendini 2001a; Figs. 55, 56). However, the adult male is proportionally more slender than the adult female, and differs in the other characters mentioned above (Figs. 47, 48).

Remarks.—*Parabuthus calvus* has not been revised since the original description of the male (Purcell 1898), and subsequent description of the female (Purcell 1901). However, it can be readily distinguished from all other species of the genus on the basis of the diagnostic characters provided above.

This species is extremely rare in collections. It is presently known from only five specimens (1 ♂and 4 ♀, all examined for this study), each from a different locality.

Distribution.—All known localities fall within the Namaqualand region of the Northern and Western Cape provinces of South Africa, to which this species is endemic (Fig. 60). No records are known from north of the Orange River.

Ecology.—The only specimen for which collection data are available (AMNH) was collected at night by means of UV light detection. This specimen was found resting on the surface of coarse, granitic loam soil, in a rocky habitat. As with the related species, *P. planicauda*, elongation of the pedipalps and legs are indicative of a semi-lithophilous ecomorphotype, whereas reduction in the macrosetal combs of basitarsi I and II in *P. calvus* may be associated with its occurrence in regions of hard, compacted soil (Eastwood 1977; Prendini 2001a). Metasomal segments IV and V are mostly lacking carinae.

Although the distribution of *P. calvus* overlaps entirely with that of *P. capensis*, it is not known whether these species occur in sympatry.

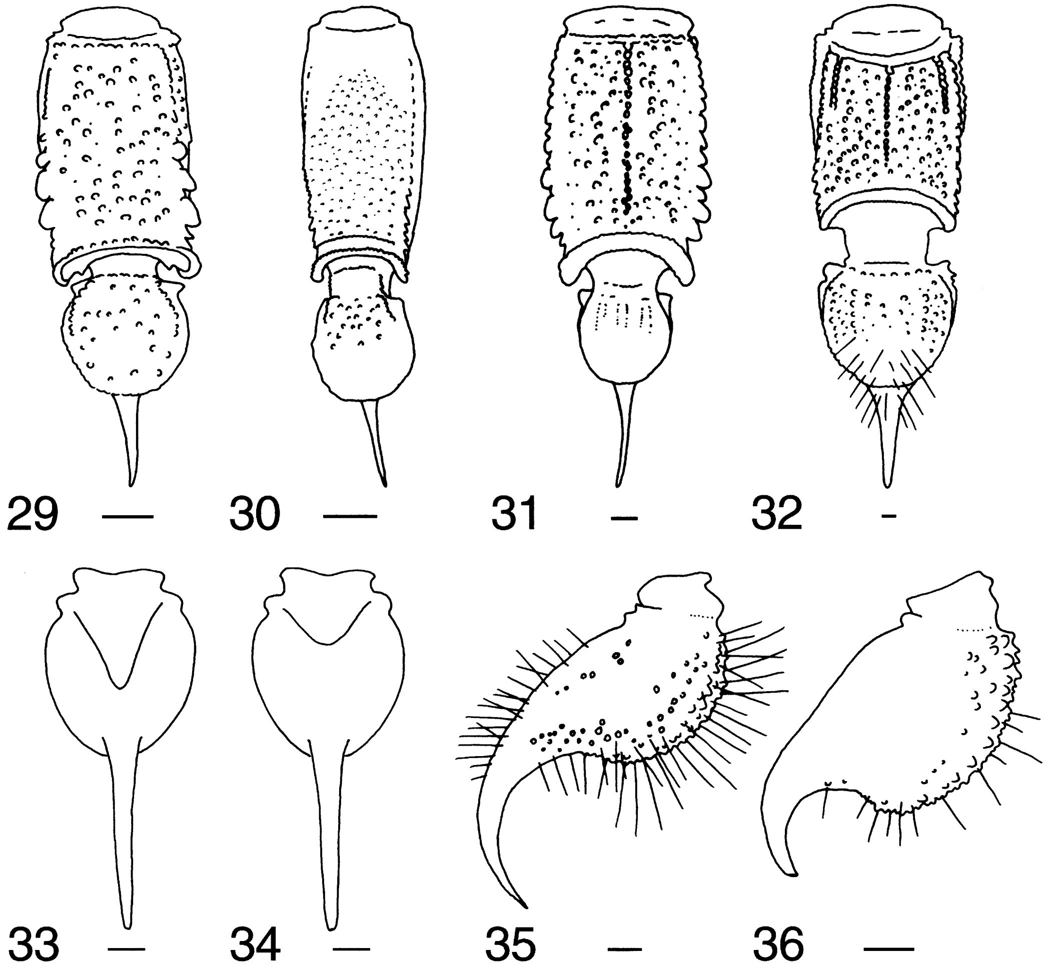
Material examined.—SOUTH AFRICA: *Northern Cape Province*: Namaqualand District: Kamaggas [Komaggas, 32°07′S 19°07′E], v. 1904, L. Schultze, 1 ♀(ZMHB 11365); Paulshoek, E of Garies, 30°22′S 18°16′E, i.1997, S. Todd, 1 ♀ (AMNH). *Western Cape Province*: Clanwilliam District: Betjesfontein [Biesjesfontein, ca. 32°07′S 19°07′E], 1898, M. Bergh, 1 ♀ (SAMC 2228). Vanrhynsdorp District: Knersvlakte, N of Vanrhynsdorp, 31°37′S 18°44′E, 1999, M. de Jager, 1 ♀ (SAMC C4615).

Parabuthus capensis (Ehrenberg 1831)
Figs. 3, 35, 61–74, Table 1

Androctonus (*Prionurus*) *capensis* Ehrenberg in Hemprich & Ehrenberg 1831 [pages unnumbered]; Moritz & Fischer 1980: 311.

Androctonus iros C.L. Koch 1839: 93, 94, pl. CLXIX, fig. 401 (synonymized by Kraepelin 1899: 31; Kraepelin 1908: 254); C.L. Koch 1850: 89.

Scorpio (*Androctonus*) *kochii* Gervais 1844: 45



Figures 29–36.—Diagnostic characters of *Parabuthus* species [29, 30 modified from Lamoral (1979), 35 modified from Eastwood (1977), 36 modified from Prendini (2000)]. 29–32. Metasomal segment V and telson, ventral aspect. 29. *Parabuthus brevimanus* (Thorell 1876). 30. *Parabuthus kuanyamarum* Monard 1937. 31. *Parabuthus granulatus* (Ehrenberg 1831). 32. *Parabuthus villosus* (Peters 1862). 33, 34. Telson, dorsal aspect. 33. *Parabuthus stridulus* Hewitt 1913. 34. *Parabuthus laevifrons* (Simon 1888). 35, 36. Telson, lateral aspect. 35. *Parabuthus capensis* (Ehrenberg 1831). 36. *Parabuthus muelleri* Prendini 2000. Scale bars = 1 mm.

(synonymized by Kraepelin 1899: 31; Kraepelin 1908: 254).

Parabuthus planicauda: Pocock 1889: 344–346 (misidentification: males only).

Parabuthus capensis: Kraepelin 1895: 83; Pocock 1895: 309; Kraepelin 1899: 31; Penther 1900: 154; Kraepelin 1901: 267; Purcell 1901: 143–147; Werner 1902: 598; Kraepelin 1908: 254; Hewitt 1912: 302; Kraepelin 1914: 110, 111; Lampe 1917: 193; Hewitt 1918: 107, 178, pl. XXI, fig. 29; Werner 1936: 178; Roewer 1943: 207; Lawrence 1946: 399; Lawrence 1955: 226; Belfield 1956: 45; Lamoral & Reynders 1975: 515; Eastwood 1977: 200–203, figs. 1, 3a, 4, 6a, 7; Eastwood 1978a: 244; Kovařík 1992: 184; Braunwalder & Fet 1998: 29–35; Kovařík 1998: 116; Fet & Lowe 2000: 201, 202; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 20.

Parabuthus neglectus Purcell 1899b: 433–434 (synonymized by Kraepelin 1908: 254); Purcell 1901: 155–158; Pocock 1902: 366; Eastwood 1977: 203–207, figs. 2, 3b, 5, 6b, 7; Kovařík 1998: 117; Fet & Lowe 2000: 208.

Type material.—*Androctonus* (*Prionurus*) *capensis:* Holotype ♀ (ZMHB 133), SOUTH AFRICA: Cape of Good Hope [*Western Cape*

Province: Simon's Town District: 34°00′S 18°25′E], Lichtenstein.

Androctonus iros: Holotype, ''southern Africa'' [lost].

Parabuthus neglectus: Lectotype: 1 subad. ♂ (SAMC 1197/1) [designated by Eastwood (1977)], SOUTH AFRICA: between Pakhuisberg [32°10′S 19°00′E] and Oorlogskloof [31°30′S 19°27′E], Clanwilliam and Calvinia Divs. [*Western Cape Province*: Clanwilliam District/*Northern Cape Province*: Calvinia District], 1897, M. Schlechter. Paralectotypes: 2 ♂, 9 ♀, 1 subad. ♂, 1 subad. ♀, 1 juv. ♀ (SAMC 1197/2), same data as lectotype.

Diagnosis.—*Parabuthus capensis* forms part of a group of species that also includes *P. calvus*, *P. capensis*, *P. pallidus* and *P. planicauda* (Fig. 1). It is morphologically most similar to *P. muelleri*, with which it shares the following combination of characters: metasomal segments I and II, stridulatory surface extended anteriorly beyond anterodorsal edge of segment, giving a step-like appearance in lateral aspect; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules more pronounced than preceding granules; metasomal segment IV, dorsosubmedian carinae medially discontinuous, median lateral carinae continuous and distinct; metasomal segment V, dorsosubmedian carinae distinct, comprising sharp spiniform or subspiniform granules, dorsolateral carinae distally obsolete.

Parabuthus capensis and *P. muelleri* may be separated from all other *Parabuthus* on the basis of the following character: metasomal segment II, and to a lesser extent III, with posterodorsal edge elevated and slightly curved forward medially, forming a subtriangular V-shape. *Parabuthus capensis* may be separated from *P. muelleri* by the following characters: pedipalp chela, fixed and movable fingers straight, such that proximal dentate margin linear when fingers are closed (i.e., no proximal ''gap'' is evident); metasomal segment I narrower than segment IV; telson without distal ''bulge''; aculeus long, gently curved; pedipalp chela manus of adult male, incrassate (bulbous or swollen), compared with adult female, in which it is slender; proximal median lamella of pectines in male, not lobate.

Redescription.—The following redescription supplements Eastwood's (1977) redescriptions of *P. capensis* and *P. neglectus*. It is based on several typical specimens of *P. capensis* (SAMC C98, C4567), several specimens of the ''dark form'' of *P. capensis* (SAMC C36, C74, C4564), the syntypes of *P. neglectus* (SAMC 1197), and several additional specimens that would key to the latter (SAMC C3830, C4513, C4565).

Color (based on SAMC C3830): Carapace, pedipalps and metasomal segments I–III: Yellow Ocher No. 123C. Tergites and sternites: Cinnamon No. 39. Metasomal segments IV and V: Clay Color No. 123B. Telson: Tawny No. 38. Chelicerae and legs: Buff-Yellow No. 53. Pectines: Cream Color No. 54. Metasomal segments IV, V and telson are slightly to considerably darker than segments I–III (Figs. 53–64), except in the dark form (Figs. 65–68).

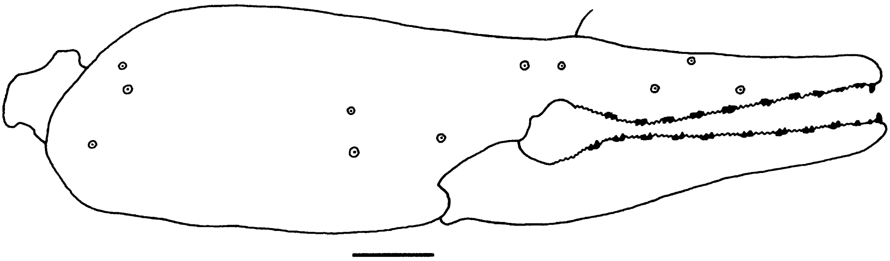
Carapace: As for *P. calvus*, except as follows. Carapace covered entirely by uniform, coarse granulation, becoming coarser on interocular and posterolateral surfaces. Anterior margin of carapace procurved; posterior margin straight (Figs. 53, 61, 63).

Chelicerae: As for *P. calvus*.

Sternum: As for *P. calvus* (Figs. 54, 62, 64).

Pedipalps: As for *P. calvus*, except as follows. Pedipalps covered in short macrosetae (Figs. 53, 54, 61–68). Femur finely and uniformly granular (Fig. 73); pentacarinate, all carinae distinct, granular, except for internomedian carina, comprising spiniform granules. Patella finely and uniformly granular (Figs. 71, 72); carinae absent or obsolete; dorsointernal and ventrointernal carinae each comprising row of granules proximally; internomedian carina comprising large spiniform granule, proximally, and few smaller granules, distally. Chela smooth (Figs. 69, 70); carinae absent. Chela long, slender (female) or incrassate (male), length along ventroexternal carina 29–31% (male) or 26–37% (female) greater than chela width and 35–40% (male) or 34–41% (female) greater than chela height (Table 1); length of movable finger 30–33% (male) to 41–49% (female) greater than length along ventroexternal carina. Chela fixed finger straight or slightly curved dorsally and movable finger straight, such that proximal dentate margin linear when fingers closed (Figs. 69, 70).

Trichobothria: As for *P. calvus*, except as follows (Figs. 69–73). Chela with *dt* situated almost level with or slightly distal to *et*; *db*



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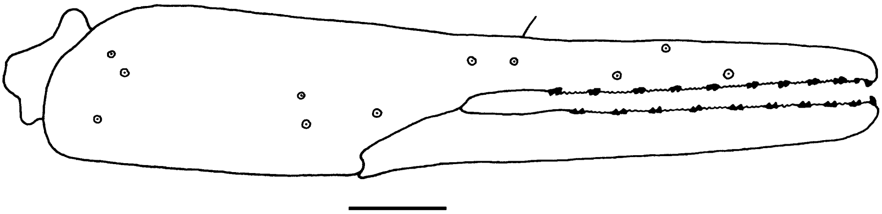

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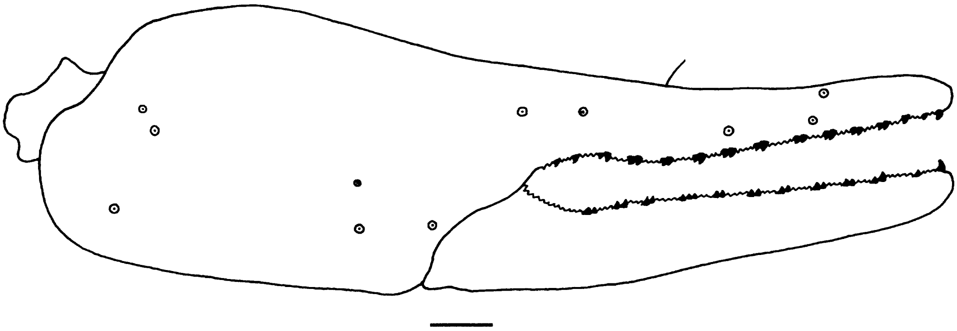

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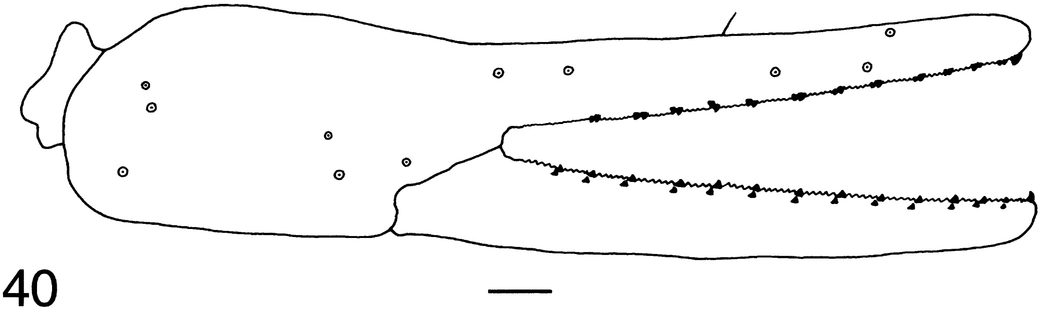

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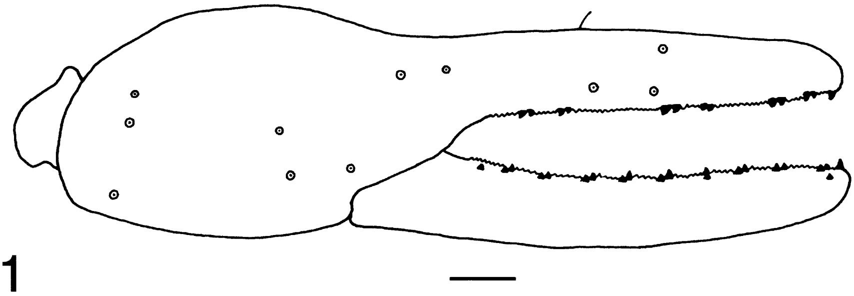

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equidistant between *est* and *esb*. Patella with esb_2 level with or slightly distal to esb_1.

Mesosoma: As for *P. calvus*, except as follows. Pre-tergites smooth, shiny, granular along posterior margins. Post-tergites entirely coarsely granular, granulation becoming coarser distally; I–VII each with weakly developed, granular median carina. Sternites entirely smooth, except for posterolateral surfaces of sternite VII, which are sparsely granular; lateral and distal margins each with sparse row of macrosetae; sternite VII with weakly developed pairs of costate ventrosubmedian and ventrolateral carinae (Figs. 54, 62, 64).

Pectines: First proximal median lamella of each pecten suboval, mesally enlarged, lobate in female but not male (Figs. 54, 62, 64). Pectinal teeth: 37–41/35–41 (male), 32–37/32–38 (female).

Genital operculum: As for *P. calvus*.

Legs: As for *P. calvus*, except as follows. Basitarsi I and II dorsoventrally compressed, retrolateral margins each with dense row of long, fine macrosetae; III and IV, prolateral surfaces without dense tufts of macrosetae. Telotarsal ungues long, distinctly curved, equal in length.

Metasoma and telson: Metasomal segments width/length ratio decreasing from I–II, increasing from II–III and decreasing from III–V (Table 1), width percentage of length 77–83% (male) to 82–95% (female) for I, 78–81% (male) to 81–88% (female) for II, 79–105% (male) to 86–89% (female) for III, 67–79% (male) to 74–77% (female) for IV, and 53–63% (male) to 59–60% (female) for V. Telson oval, globose, height 61–64% (male) or 59–72% (female) of length, with flattened dorsal surface, rounded ventral surface; vesicle not distinctly narrower than metasomal segment V, width 75–80% (male) to 83–86% (female) of metasomal segment V. Metasoma entirely granular, except for ventromedian surfaces of segments I or I and II, and dorsomedian surfaces of IV, V and telson, or V and telson. Metasomal segments I–III each with well-developed dorsal stridulatory surface, consisting of fine round to slightly crescent-shaped granules extending to posterior margin (Figs. 53, 67); stridulatory surface of segment III narrower and less developed than on preceding segments; segment II, and to lesser extent III, posterodorsal edge elevated and slightly curved forward medially, forming subtriangular V-shape (Fig. 3). Metasoma sparsely to densely covered with long macrosetae, especially on ventral surface of telson (Figs. 53, 54, 61–68). Metasomal segments I–IV each with ten carinae; segment IV with ventrosubmedian and median lateral carinae becoming obsolete distally; segment V with seven carinae, including single, obsolete granular ventromedian carina, pair of distinct ventrolateral carinae, pair of dorsolateral carinae, distinct only in proximal half of segment, and pair of dorsosubmedian carinae reduced to few prominent rounded or spiniform granules medially. Metasomal segments I–V with dorsosubmedian carinae converging distally in segment I, subparallel in segments II–V; ventrolateral carinae converging distally in segments I–III, subparallel in segment IV, subparallel to diverging in segment V. All metasomal carinae costate granular to granular, except for ventrosubmedian and ventrolateral carinae of segment I, which are costate to costate granular. Metasomal segments I–IV with distal granules of dorsosubmedian carinae slightly to considerably enlarged, spiniform; segments II and III with distal granules of ventrosubmedian carinae and, to lesser extent, ventrolateral carinae, distinctly enlarged, obtuse, elevated; segment V with subdistal granules of ventrolateral carinae enlarged into laterally compressed, lobate processes. Aculeus long, shallowly curved, 65% (57–73%) of vesicle length.

Hemispermatophore: Flagelliform, with *pars recta* parallel to axis of distal lamina.

Geographic variation: Parabuthus capensis exhibits considerable geographic variation in size, color, granulation, setation, and pectinal tooth count across its distributional range (Figs. 53, 54, 61–68; Table 1). Typical spec-

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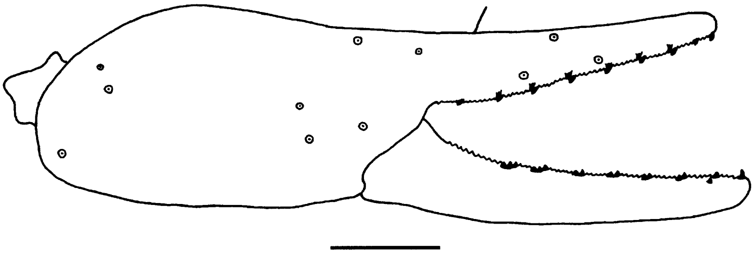
Figures 37–41.—Diagnostic characters of *Parabuthus* species [37–40 modified from Lamoral (1979), 41 modified from Prendini (2000)]. Dextral pedipalp chela. 37. *Parabuthus kalaharicus* Lamoral 1977, ♂. 38. *Parabuthus kalaharicus*, ♀. 39. *Parabuthus granulatus* (Ehrenberg 1831), ♂. 40. *Parabuthus granulatus*, ♀. 41. *Parabuthus muelleri* Prendini 2000, ♀. Scale bars = 1 mm.



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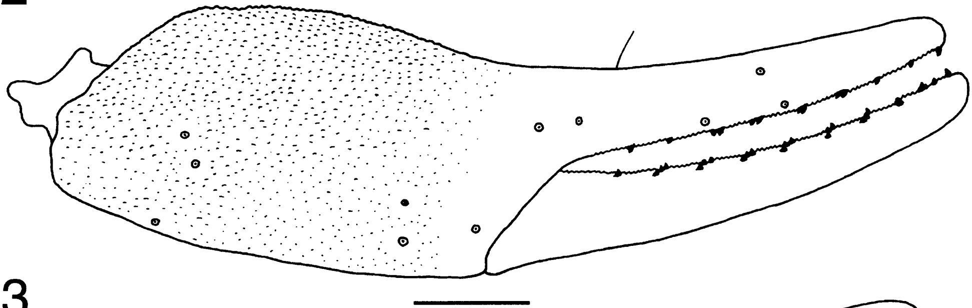

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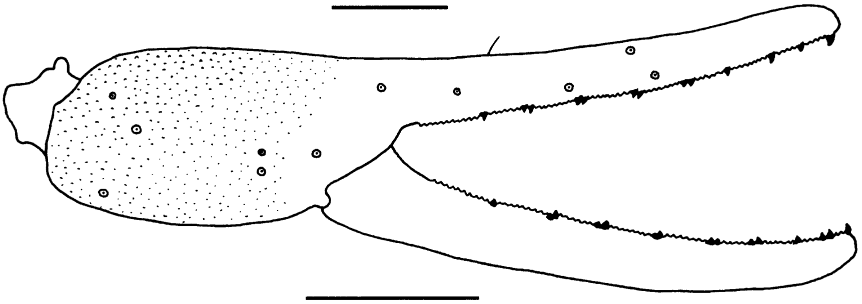

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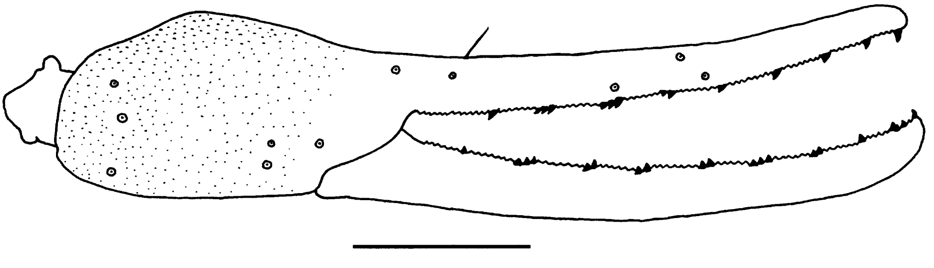

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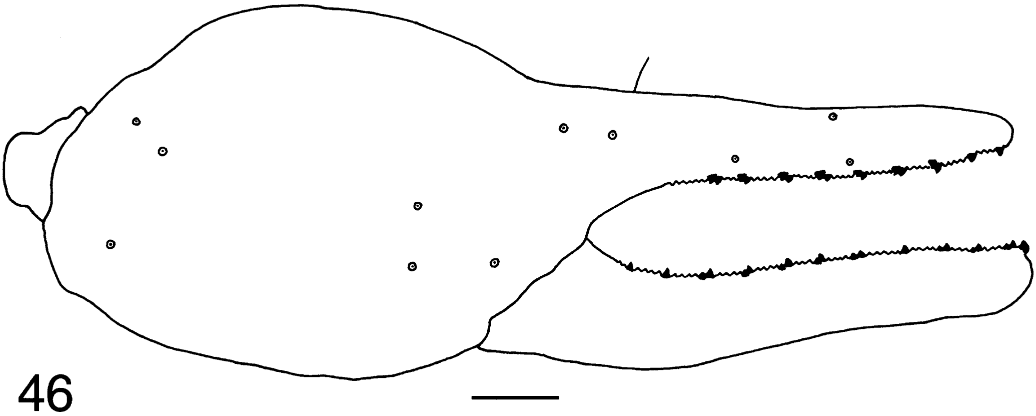

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imens from mesic fynbos and renosterveld habitats in the southwestern part of the distribution are smaller, uniformly pale in color, more sparsely setose (especially on the metasoma and telson), less coarsely granular, with weaker development of the metasomal carinae, with the posterodorsal edge of metasomal segments II and III less strongly curved anteriorly, and with a lower pectinal tooth count (Figs. 63–64). A dark brown to black form, differing from typical *P. capensis* only in color (Figs. 65–68), occurs in the coastal part of this region (Eastwood 1977).

Specimens from xeric karroid habitats further north and east in the range are larger, often display a characteristic darkening of metasomal segments IV, V and telson, are more densely setose (especially on the metasoma and telson), more coarsely granular, with stronger development of the metasomal carinae, with the posterodorsal edge of metasomal segments II and III more strongly curved anteriorly, and with a higher pectinal tooth count (Figs. 53, 54, 61, 62). Eastwood (1977) regarded these differences as sufficient justification for resurrecting *P. neglectus* as a species, distinct from *P. capensis*. As argued below, these differences merely reflect intraspecific variation, perhaps associated with differences in habitat and possibly with a clinal basis. In contrast, distinct differences in venom composition between pale specimens of *P. capensis* (referable to *P. neglectus* or to the typical form) and specimens of the dark form (Dyason et al. 2002), suggest that the dark form may represent a sibling species (Paterson 1985), a question that is currently under investigation with DNA sequence data.

Ontogenetic variation: As in other species of *Parabuthus*, male resembles female very closely until the final instar. Juveniles and subadults may be readily sexed by examination of the pectines and genital aperture.

Sexual dimorphism: Besides the abovementioned characters, *P. capensis* is sexually dimorphic with respect to the shape of the chela manus, as in most species of *Parabuthus*. The manus of the adult male is noticeably incrassate, compared with that of the adult female, which is more slender (Pocock 1889, 1890, 1902; Kraepelin 1899, 1908; Purcell 1898, 1899b, 1901; Werner 1916; Hewitt 1913, 1915, 1918; Eastwood 1977; Lamoral 1977, 1979, 1980; Newlands & Martindale 1980; Figs. 69, 70). In addition, adult males are proportionally more slender than adult females (Figs. 61, 62, 65, 66).

Remarks.—*Androctonus capensis* was described by Ehrenberg (in Hemprich & Ehrenberg 1831), not by Hemprich & Ehrenberg (1831), as recorded in most literature (e.g., Eastwood 1977). Since this description, seven taxa have been listed in synonymy by various authors: *Scorpio teter*, *Androctonus iros*, *Scorpio kochii*, *Prionurus mossambicensis*, *Buthus brevimanus* var. β *segnis*, *Buthus planicauda*, and *Parabuthus neglectus*. Kraepelin (1891) erroneously listed the first six taxa, and *P. capensis*, in synonymy with *P. leiosoma* (as *Heterobuthus liosoma*) but subsequently (Kraepelin 1899) retracted this synonymy, perhaps on the advice of Pocock (1895), who suggested that he had confused several valid species, including *P. planicauda*, under *P. leiosoma*. Pocock (1895) further suggested that *Androctonus iros* (as *P. iros*), *Buthus brevimanus* var. β *segnis* (as *P. segnis*) and *P. planicauda* might be synonymous with *P. capensis*.

Kraepelin (1899) listed *Androctonus iros*, *Scorpio teter* (as *Androctonus teter*), *Scorpio kochii* (as *Androctonus kochii*), *Prionurus mossambicensis* (as *Buthus mosambicensis*), *Buthus brevimanus* var. β *segnis* (as *Buthus segnis*), and *Buthus planicauda* in synonymy with *P. capensis*. *Androctonus iros* and *S. kochii* were also listed as synonyms of *P. capensis* by subsequent authors (Purcell 1899b, 1901; Lamoral & Reynders 1975; Fet & Lowe 2000). *Scorpio kochii* was a replacement name, created by Gervais (1844) when he transferred *A. capensis* to the genus *Scorpio*, in order to avoid homonymy with *Scorpio capensis* Herbst 1800, now *Opistophthalmus ca-*

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Figures 42–46.—Diagnostic characters of *Parabuthus* species [42 modified from Lamoral (1980), 43–46 modified from Lamoral (1979)]. Dextral pedipalp chela. 42. *Parabuthus distridor* Lamoral 1980, ♂. 43. *Parabuthus gracilis* Lamoral 1979, ♂. 44. *Parabuthus nanus* Lamoral 1979, ♂. 45. *Parabuthus nanus*, ♀. 46. *Parabuthus laevifrons* (Simon 1888), ♂. Scale bars = 1 mm.


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pensis (Herbst 1800), family Scorpionidae (Fet & Lowe 2000). *Scorpio teter*, ignored since Kraepelin (1899), was recently discussed by Fet & Lowe (2000), who listed it as a synonym of *P. capensis*. In the present study, it is instead synonymized with *P. transvaalicus* (discussed below). Similarly, *B. brevimanus* var. β *segnis*, listed as a synonym of *P. capensis* by some authors (e.g., Lamoral & Reynders 1975; Fet & Lowe 2000), is synonymized with *P. granulatus* (discussed below). *Parabuthus mossambicensis* has not been regarded as a synonym of *P. capensis* since Kraepelin (1899).

The superficial morphological similarity between *P. planicauda* and *P. capensis*, which are sympatric in the southwestern part of their distributional ranges (Eastern, Northern and Western Cape provinces of South Africa), has caused widespread confusion in the literature about the status of these species, and resulted in the description of *P. neglectus*.

According to Pocock's (1889) original description of *P. planicauda*, the pedipalp chela manus of the adult male is round and considerably thicker than the patella. Pocock (1895) was the first to suggest that *P. planicauda* might be synonymous with *P. capensis*. In response to Pocock's suggestion, Kraepelin (1899) listed *P. planicauda* as a synonym in his redescription of *P. capensis*. Meanwhile, Purcell (1899b) also listed *P. planicauda* as a synonym of *P. capensis* and described a new species, *P. neglectus*. According to Purcell (1899b) the metasoma of *P. neglectus* is similar that of *P. capensis*, but the posterodorsal edge of segment II is strongly elevated and curved forwards in the middle, forming a characteristic tongue-like elevation that is also present, but less strongly developed, in segment III. In addition, the pedipalp chela manus and patella of females and juveniles is unusually wide, the chela manus being almost as wide as that of the adult male.

Purcell (1901) redescribed *P. capensis*, again listing *P. planicauda* in synonymy, and stated that its principal feature is the narrow chela manus of the adult male. According to Purcell (1901), the manus of the adult male is incrassate in almost all other species of *Parabuthus*, including *P. neglectus*, and statements by previous authors that this is also the case in *P. capensis* represented the confusion of several species. Purcell (1901) referred not only to Pocock (1889) but also to Kraepelin (1899), who had stated that the chela manus of the male *P. capensis* is much thicker than that of the female. In his key to the *Parabuthus* species, Purcell (1901) reiterated the difference between *P. neglectus*, in which the posterodorsal edge of metasomal segment II is strongly elevated and curved forwards in the middle, and the remaining species of *Parabuthus*, in which it is straight. Purcell (1901) further commented on the large stridulatory surface of metasomal segments II and III, and the stout pedipalp patella in *P. neglectus*.

Pocock (1902) realized that the two male specimens in his original description of *P. planicauda* were conspecific with *P. neglectus*, whereas the female specimens were conspecific with the form that Purcell (1899b, 1901) had referred to as *P. capensis*. Contradicting his earlier opinion (Pocock 1895), Pocock (1902) presented three lines of evidence to support his view that *P. capensis* and *P. planicauda* were distinct species and that Purcell (1899b) had redescribed *P. capensis* as *P. neglectus*. (1) The types of *P. capensis* in the Berlin Museum probably came from German rather than from British territory in South Africa. *Parabuthus neglectus* inhabits German South-West Africa [now Namibia], but *P. planicauda* does not. [This was only recently confirmed (Prendini 2000)]. (2) When Ehrenberg described *P. capensis*, he also described *P. granulatus*, which is known to occur in German South-West Africa, where it coexists with *P. neglectus*. It is possible that the types of both species were collected together. [This is incorrect because the type locality for both *P. capensis* and *P. granulatus* is the Cape of Good Hope, formerly British territory]. (3) Several specimens from Keyserling's collection in the British Museum, identified as ‘‘*Prionurus capensis*'', are labelled ‘‘Cap b. espér.''. According to Pocock, these specimens were identified by F. Karsch, who had

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Figures 47–50.—*Parabuthus calvus* Purcell 1896, habitus (dorsal and ventral aspects). 47, 48. Holotype ♂ (SAMC 1201). 49, 50. ♀ (SAMC 2228). Scale bars = 5 mm.

Table 1.—Meristic data for *Parabuthus calvus* Purcell 1898, *P. capensis* (Ehrenberg 1831) and *P. planicauda* (Pocock 1896), including syntypes of *P. neglectus* Purcell 1899 (SAMC 1197) and *P. capensis frenchi* Purcell 1901 (SAMC 5207), and specimens of the ‘‘dark form’’ of *P. capensis* (SAMC C4564). Measurements follow Stahnke (1970), Lamoral (1979), and Prendini (2000). [1]Sum of carapace, tergites I–VII, metasomal segments I–V, and telson; [2]sum of tergites I–VII; [3]sum of metasomal segments I–V and telson; [4]measured from base of condyle to tip of fixed finger; [5]sinistral pecten missing, dextral damaged.

		Parabuthus calvus Purcell				*Parabuthus capensis* (Ehrenberg)	
Specimen	sex	♀	♀	♀	♂	♀	♀
	collection	SAMC	SAMC	AMNH	SAMC	SAMC	SAMC
	number	2228	C4615		1201	C98	C4513
	type				holotype		
Total length[1]		62.05	70.63	66.40	62.95	92.77	90.08
Carapace	length	6.78	7.69	6.89	6.98	9.95	9.72
	anterior width	4.16	4.38	4.05	3.60	5.82	5.68
	posterior width	7.73	8.63	7.52	7.66	10.74	10.19
Mesosoma	total length[2]	16.86	21.51	19.28	19.16	26.37	25.01
Sternite VII	length	4.85	5.09	4.80	4.70	6.70	5.87
	width	7.25	8.11	7.24	7.67	9.85	9.81
Metasoma	total length[3]	38.41	41.43	40.23	36.81	56.45	55.35
Metasoma I	length	5.55	5.98	5.80	5.04	8.29	7.81
	width	5.16	6.03	5.40	5.74	6.79	6.95
Metasoma II	length	5.89	6.40	6.04	5.47	8.47	8.26
	width	5.38	6.04	5.35	5.88	6.88	7.25
Metasoma III	length	6.01	6.47	6.17	5.54	8.22	8.20
	width	5.40	6.05	5.27	5.94	7.13	7.28
Metasoma IV	length	6.40	7.39	6.94	6.40	9.10	9.24
	width	5.02	5.70	4.99	5.66	7.03	7.11
Metasoma V	length	7.58	8.04	7.91	6.96	10.85	10.36
	width	4.53	5.35	4.83	5.07	6.36	6.08
Telson	total length	6.98	7.15	7.37	7.40	11.52	11.48
	aculeus length	2.10	2.49	2.74	2.69	4.19	4.50
	vesicle length	4.88	4.66	4.63	4.71	7.33	6.98
	vesicle width	3.60	4.14	3.85	4.09	5.44	5.25
	vesicle height	2.78	3.25	3.05	3.07	4.32	4.38
Pedipalp	total length	23.03	24.60	23.47	24.22	30.14	31.24
Femur	length	4.94	5.41	5.10	5.30	6.64	7.22
	width	1.61	1.82	1.68	1.79	2.59	2.45
Patella	length	5.68	6.50	6.05	5.90	6.89	7.42
	width	2.16	2.56	2.39	2.32	3.57	3.64
Chela	length[4]	9.69	10.18	9.85	10.34	12.73	13.58
	width	1.50	1.70	1.71	1.59	2.94	3.24
	height	1.56	1.73	1.71	1.60	3.03	3.05
	length of ventroext. carina	2.17	2.34	2.26	2.55	4.57	5.18
	length movable finger	7.12	7.73	7.31	7.43	8.28	8.83
Pectines	total length	5.20	6.03	5.54	5.58	8.95	10.60
	length dentate margin	4.11	4.86	5.01	5.49	8.50	9.14
	tooth count (left/right)	–/13[5]	24/23	23/24	25/26	32/32	37/38

access to Ehrenberg’s types for comparison, and are conspecific with *P. neglectus*, not *P. planicauda*. (4) Kraepelin described the male of *P. capensis* as having a wide pedipalp chela manus. This is true of *P. neglectus*, not *P. planicauda*. Kraepelin also had access to Ehrenberg’s type.

Pocock’s (1902) suspicions were correct. Purcell (1899b, 1901) had not examined the holotype of *P. capensis* [Eastwood (1977) lat-

Table 1.—Extended.

Parabuthus capensis (Ehrenberg)				*Parabuthus planicauda* (Pocock)			
♀	♂	♂	♂	♀	♀	♂	♂
SAMC	SAMC	SAMC	SAMC	BMNH	SAMC	SAMC	SAMC
C4564	1197	C4565	C4564	1870.26	5207	5207	C4580
	syntype			lectotype	syntype	syntype	
99.12	79.07	75.28	56.46	85.30	75.80	67.93	63.27
10.68	7.73	8.66	6.53	8.82	7.77	6.86	6.17
6.16	4.21	5.20	3.42	5.37	4.55	4.26	3.61
11.90	7.73	8.90	6.56	10.14	7.87	7.27	6.17
27.00	23.09	19.95	12.72	24.13	20.65	18.69	17.66
6.30	5.70	5.73	3.47	5.57	4.92	4.63	4.51
11.69	7.82	8.32	5.61	9.45	8.88	7.13	6.19
61.44	48.25	46.67	37.21	52.35	47.38	42.38	39.44
8.14	6.86	7.62	5.71	7.37	6.44	6.15	5.83
7.72	5.67	6.18	4.37	6.44	5.46	4.70	4.39
9.66	7.18	8.12	5.73	7.75	6.89	6.36	5.85
7.78	5.78	6.46	4.45	6.46	5.33	4.76	4.54
9.28	7.25	7.75	5.73	7.95	7.24	6.49	5.94
8.01	5.88	8.16	4.51	6.52	5.34	4.94	4.35
10.48	8.11	9.02	5.74	8.89	7.95	7.37	6.68
7.72	5.63	6.04	4.51	6.44	5.15	4.76	4.25
11.78	9.58	10.40	6.42	10.36	9.25	7.89	7.65
6.97	5.15	5.51	4.03	5.78	4.71	4.28	3.93
12.10	9.27	11.22	7.88	10.03	9.61	8.12	7.49
5.03	3.64	4.71	3.32	3.83	3.97	2.81	2.84
7.07	5.63	6.51	4.56	6.20	5.64	5.31	4.65
5.76	4.14	4.42	3.04	4.63	4.04	3.38	3.08
5.08	3.58	3.97	2.83	3.88	3.66	3.17	2.53
33.89	27.36	31.60	22.63	30.36	28.27	27.43	23.11
7.55	5.88	6.75	5.04	6.78	6.23	6.36	5.36
2.77	2.00	2.41	1.65	2.14	2.21	1.75	1.66
7.87	6.27	7.77	5.54	7.58	6.95	6.59	5.64
4.15	2.55	3.67	2.39	3.16	2.75	2.12	2.12
14.68	12.08	13.38	9.69	12.25	11.69	10.91	9.28
3.59	3.53	3.86	2.73	2.50	2.23	1.77	1.71
3.19	3.12	3.52	2.39	2.39	2.16	1.69	1.66
4.82	5.00	5.41	3.98	4.04	3.66	3.33	2.96
9.40	7.12	7.97	5.93	8.54	8.23	7.35	6.06
10.54	9.33	10.36	8.14	9.32	8.85	8.68	7.61
9.44	9.14	9.98	8.01	8.13	8.11	9.17	8.13
34/34	37/35	41/41	38/38	31/31	34/35	40/40	34/34

er examined it and noted that the posterodorsal edge of segment II is elevated and slightly curved forward medially, forming a subtriangular ''lip'']. Purcell (1899b, 1901), probably misled by Pocock's (1889) erroneous statement that the male of *P. planicauda* had round and thick hands, and Pocock's (1895) suggestion that *P. planicauda* was synonymous with

P. capensis, had redescribed *P. planicauda* as *P. capensis* and *P. capensis* as *P. neglectus*.

Kraepelin (1908) subsequently synonymized *P. neglectus* with *P. capensis*, and recognized the diagnostic differences (notably the shape of the posterodorsal edge of metasomal segment II) between *P. capensis* and *P. planicauda*, proposed originally by Purcell (1899b, 1901) for *P. neglectus* and *P. capensis*, respectively. Kraepelin (1914) again commented on the previous confusion between *P. capensis* and *P. planicauda* and on Purcell's (1899b) redescription of *P. capensis* as *P. neglectus*. The status of *P. capensis* and *P. planicauda* as distinct species has not been contested since, and, until Eastwood (1977), all authors similarly accepted the synonymy of *P. neglectus* with *P. capensis* (Hewitt 1912, 1918; Lawrence 1946; Lawrence 1955; Lamoral & Reynders 1975).

Eastwood (1977) redescribed *P. capensis* (including a distinctive dark color form), erroneously credited Hewitt (1918) with the synonymy of *P. neglectus*, and removed *P. neglectus* from synonymy. According to Eastwood (1977), *P. capensis* and *P. neglectus* are separable on the granulation of the dorsosubmedian carinae of metasomal segment V, the granulation of the ventrosubmedian and ventrolateral carinae, the posterodorsal ''lip'' of metasomal segments II and III, the density and length of meso- and metasomal setae, and the pectinal tooth count. The granules of the dorsosubmedian carinae on metasomal segment V are low and rounded in *P. capensis*, but elongated and sharply pointed in *P. capensis*. The ventrosubmedian and ventrolateral carinae of metasomal segments II and III consist of low, almost contiguous granules in *P. capensis* whereas, in *P. neglectus*, these carinae are separate and prominent. The posterodorsal edge of metasomal segments II and III is less strongly curved anteriorly in *P. capensis* than in *P. neglectus*. The meso- and metasomal setae are sparse and short in *P. capensis*, but long and dense in *P. neglectus*. The pectinal tooth count is lower in *P. capensis* (33–35 for males, 31–35 for females) than in *P. neglectus* (36–38 for males, 35–36 for females).

The first three diagnostic differences proposed by Eastwood (1977) are merely a function of increased granulation in *P. neglectus*, compared with *P. capensis*. As intraspecific variation in granulation has been shown to occur in many other species of *Parabuthus* (Lamoral 1979; Harington 1984; FitzPatrick 1994), these differences cannot be used for species delimitation. Similarly, the increased setation cannot be considered diagnostic, for this is also known to vary in other species of *Parabuthus*. For example, a considerable increase in the extent of setation on the meso- and metasoma occurs from north to south in the distributional range of *P. villosus* (Harington 1984). The increased granulation and setation of specimens referred to as *P. neglectus* may be correlated with occurrence on sandy substrata. Eastwood (1977) noted that *P. capensis* was always collected in areas of hard-packed soil whereas *P. neglectus* was always collected in sandy habitats. It thus appears that the increased granulation and setation, considered diagnostic for *P. neglectus*, is merely intraspecific variation in a widespread species, perhaps associated with differences in habitat. The moderate differences in pectinal tooth counts presented by Eastwood cannot be regarded as diagnostic either. Purcell (1899a) has stated that pectinal tooth counts should not be considered of specific importance as they are one of the first characters to change in local varieties. In view of this evidence, I hereby return *P. neglectus* to synonymy with *P. capensis*.

Distribution.—Endemic to the Lüderitz District (Karas Region) of Namibia and to the Eastern, Northern and Western Cape provinces of South Africa (Fig. 74). Lamoral (1979) omitted *P. capensis* from his revision of the scorpions of Namibia and the occurrence of this species north of the Orange River was only recently confirmed (Prendini 2000).

Ecology.—*Parabuthus capensis* is a semi-psammophilous species, inhabiting semi-consolidated to consolidated sandy and gritty sub-

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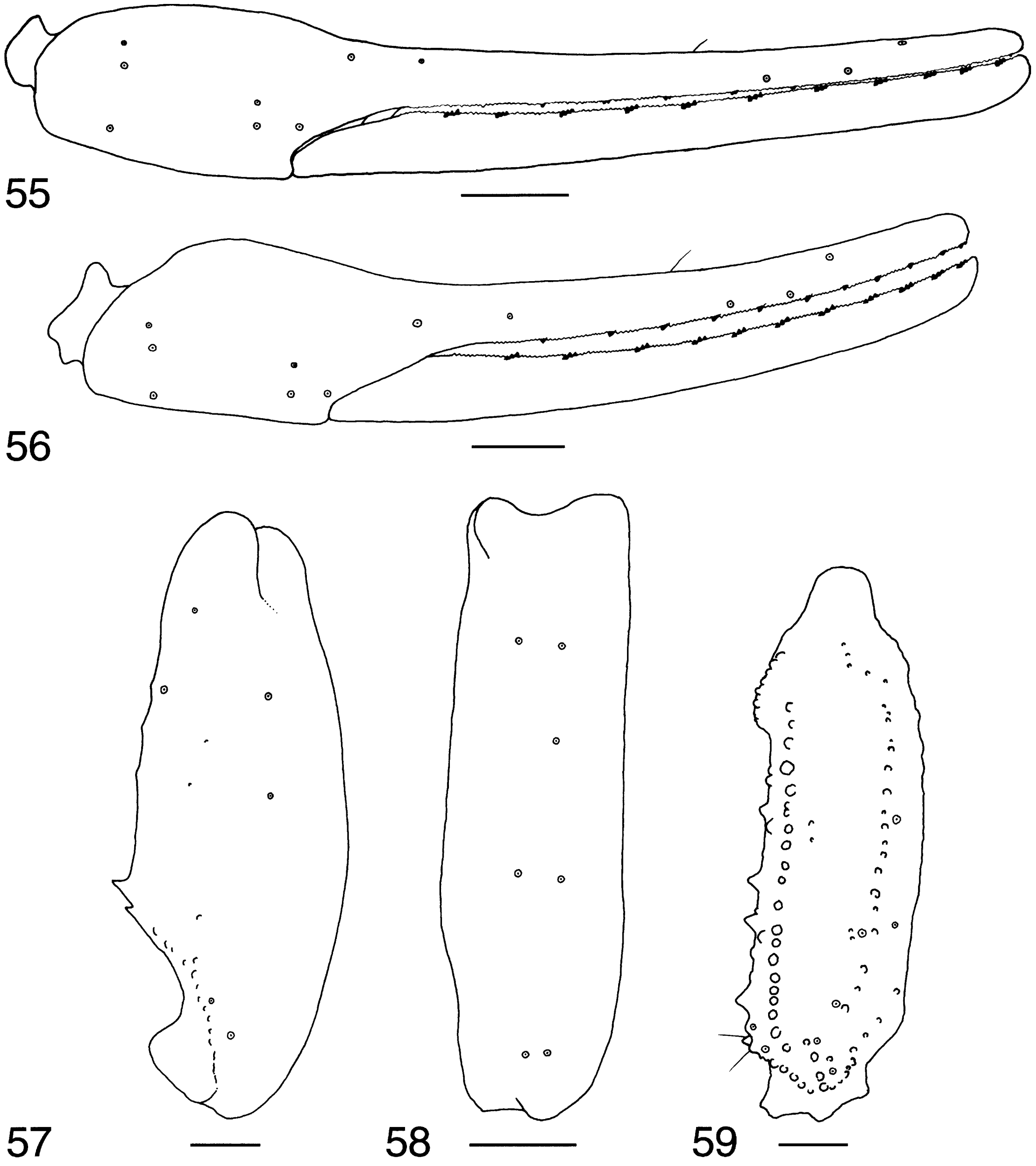
Figures 51–54.—Habitus (dorsal and ventral aspects). 51, 52. *Parabuthus calvus* Purcell 1896, ♀ (AMNH). 53, 54. *P. capensis* (Ehrenberg 1831), ♂ (SAMC C3830). Scale bars = 5 mm.


51


52


53


54



Figures 55–59.—*Parabuthus calvus* Purcell 1896, dextral pedipalp segments, illustrating shape, granulation and trichobothrial distribution. 55. Holotype ♂ (SAMC 1201). 56–59. ♀ (SAMC 2228). 55, 56. Chela, dorsal aspect. 57. Patella, dorsal aspect. 58. Patella, external aspect. 59. Femur, dorsal aspect. Scale bars = 1 mm.

strata, where it excavates burrows in open ground and at the base of shrubs and grass tufts. Comb-like rows of long macrosetae (“sand combs”) on the retrolateral margins of the basitarsi of legs I and II indicate a semi-psammophilous ecomorphotype.

Parabuthus capensis is syntopic with *P. brevimanus*, *P. distridor* and *P. granulatus* in parts of its range. The ranges of *P. capensis* and *P. planicauda* overlap extensively, and these species are occasionally found in syntopy. However, *P. capensis* is more commonly encountered in open sandy habitats, whereas *P. planicauda* frequents rocky habitats.

Material examined.—1 ♂ (SAMC C4533). NAMIBIA: vii.1988, ex M. Filmer, 1 ♀

(SAMC C4568). *Karas Region*: Lüderitz District, Farm Namuskluft 88 [27°53′S 16°50′E], 12–15.ix.1973, E. Mokgoabone, under stones, 1 ♂ (NMNW 480), 21–22.ix.1973, C.G. Coetzee, J. Batista & E. Mokgoabone, in sand, 1 ♀ (NMNW 487); Lüderitz [dubious] [26°40′S 15°10′E], iii.1988, J. Visser, 1 juv. ♂ (SAMC C3882). Fish River Canyon National Park: Boomrivier [28°01′S 17°04′E], 13.i–26.xi.1992, E. Marais, preservative pitfall trap, 1 ♂ (NMNW 1509). Lüderitz District, Diamond Area I: Aurus mountains (Sperrgebiet), Northern end [27°39′S 16°19′E], 19.ix.1978, R.A. Butler, 1 juv. ♀ (AMNH [AH 657]). SOUTH AFRICA: 2 ♂, 4 ♀, 3 subad. ♂, 1 juv. ♂, 6 juv. ♀ (SAMC), 1 ♂ (SAMC C3879), 1 ♀ (SAMC B627), 1 subad. ♂ (SAMC B628), 1895, W.F. Purcell, 1 juv. ♀ (SAMC 507). *Eastern Cape Province*: Graaff-Reinet District, Graaff Reinet [32°15′S 24°33′E] and Kruidfontein, 8 mi from Graaff Reinet [32°22′S 24°36′E], ix.1902, J. Paynter, 5 ♂, 2 ♀, 2 juv. ♀ (SAMC 12010). *Northern Cape Province*: Britstown District, Renostervlei, between Strydenburg and Britstown [30°11′20″S 23°47′51″E], 5.ii.1995, P. Horn, 1088 m, 1 ♀ (AMNH [AH 2506]), 1 subad. ♂ (AMNH [AH 2505]). Calvinia District: Bokkeveld, between Pakhuis Berg and Oorlogskloof [31°40′S 19°02′E], 1897, M. Schlechter, (SAMC 1197); Calvinia [31°25′S 19°45′E], i.1903, G. French, 2 ♀, 1 juv. ♂, 5 juv. ♀ (SAMC 12710), [31°28′S 19°47′E], 11.vi.1997, A. Harington, 2 ♀ (AMNH [AH 4670, 4770]); Farm Botterkloof 973 [31°48′S 19°18′E], 12.vi.1997, A. Harington, 2 subad. ♂ (AMNH [AH 5050, 5051]); Farm Klippe Rivier 630, 1.5 km from Nieuwoudtville on R27 to Vanrhynsdorp, 31°22.226′S 19°05.521′E, 18.ii.2003, L. Prendini & E. Scott, 2469 ft, sandstone outcrops, arid fynbos next to seep, under stone, 1 ♀ (AMNH); Nieuwoudtville, Bokkeveld Mts. [31°23′S 19°06′E], ix.1898, F. Treleaven, 2 ♂, 1 subad. ♂, 1 subad. ♀, 1 juv. ♀ (SAMC 4035); Onder Bokkeveld, Oorlogskloof [31°26′S 19°09′E], 1897, M. Schlechter, 2 ♀ (SAMC 1200); Van Rhyns Pass, Nieuwoudtville [31°23′S 19°01′E], 5.iv.1933, V. Fitzsimons, 1 ♂ (TMSA 6550). Gordonia District: Kakamas, 28°45′S 20°38′E, xii.1996, I. Engelbrecht, 1 ♂ (AMNH); Upington [28°27′S 21°15′E], Boonstra & Thorne, Kalahari Expedition, 1 ♂, 3 ♀, 5 subad. ♂ (SAMC B8943). Hanover District: Hanover [31°04′S 24°27′E], ix.1901, O. Schreiner, 2 ♀ (SAMC 9989). Namaqualand District: T. Wellington, 1 ♀, 1 subad. ♂ (SAMC B9450), viii.1972, 1 ♀, 1 subad. ♀, 1 juv. ♂ (SAMC C1376), 1885, L. Péringuey, 1 ♂, 1 ♀ (SAMC 472), 1897, L. Mally, 1 ♀, 1 juv. ♂ (SAMC C1743); 4 km E Beauvallon, NE of Alexander Bay [28°31′S 16°37′E], 28.i.1995, A. Harington, 1 ♂ (AMNH [AH 2545]); Aggeneys [29°12′S 18°51′E], 2.iii.1880, M. Schlechter, 1 ♂ (SAMC 2948); Base of Anenous Pass, 29°15.180′S 17°35.549′E, 25–27.ii.2003, L. Prendini & E. Scott, 550 m, UV detection on coarse sandy-loam flats at base of pass, succulent karoo, 4 ♂ (AMNH); Anenous Pass, 10 km E [29°14′S 17°42′E], 10.x.1983, J. Visser, 1 ♀ (SAMC C3824); Concordia [29°32′S 17°57′E], 1897, M. Schlechter, 1 ♀ (SAMC 1702); Concordia, 2 km N [29°31′S 17°56′E], 13.i.1995, A. Harington, 1 ♂ (AMNH [AH 2377]), 1 ♀ (AMNH [AH 2376]); Doringpoort, Richtersveld [28°34′S 16°56′E], 7.ix.1976, S. Endrödy-Younga, 1 juv. ♂ (TMSA 12222), 1 juv. ♀ (TMSA 12221); Eksteenfontein, 1–2 km NE [28°49′S 17°14′E], 2.vi.1997, A. Harington, 2 ♀ (AMNH [AH 4964, 4965]), 1 subad. ♂ (AMNH [AH 4966]); Eksteenfontein, 6 km NE [28°47′S 17°16′E], 20.i.1995, A. Harington, 3 ♂ (AMNH [AH 2636–2638]); Farm Gemsbokvlakte [30°23′S 17°23′E], 1.ix.1977, S. Endrödy-Younga, 1 juv. ♀ (TMSA 11660); Farm Perdekraal [30°46′S 17°53′E], 24.viii.1979, S. Endrödy-Younga, 1 ♀ (TMSA 12285), 1 subad. ♂ (TMSA 12286); Farm Quaggafontein [30°08′S 17°38′E], 29.viii.1977, S. Endrödy-Younga, 1 subad. ♂ (TMSA 11654), 1 juv. ♂ (TMSA 11655); Farm Rondabel [30°47′S 17°50′E], 24.viii.1979, S. Endrödy-Younga, 2 subad. ♂ (TMSA 12287, 12289); Farm Rooidam [31°04′S 17°48′E], 26.viii.1979, S. Endrödy-Younga, 1 ♀ (TMSA 12294); Farm Schaaprivier 208, W of Springbok [29°40′S 17°36′E], 27.v.1997, A. Harington, 1 ♂ (AMNH [AH 4812]); Farm Waterval [31°03′S 17°46′E], 25.viii.1979, S. Endrödy-Younga, 2 subad. ♀ (TMSA 12290, 12292), 2 juv. ♀ (TMSA 12291, 12293); Farm Wolfkraal 367 [30°00′S 18°32′E], 9.vi.1997, A. Harington, 1 ♂ (AMNH [AH 5013]); Garies [30°33′S 17°59′E], 1897, M. Schlechter, 1 ♀, 2 subad. ♂ (SAMC 1703), v.1928, B. Peers, 4 ♀, 1 juv. ♀ (SAMC B7295), 18.xi.1975, E.B. Eastwood, 1 juv. ♂ (SAMC C43), 21.v.1997, A.

Harington, 1 ♀ (AMNH [AH 4726]); Groenriviermond [30°51′S 17°35′E], 30.xi.1976, V.B. Whitehead, under stone, 1 juv. ♂ (SAMC C1337); Hartbeesfontein, near Steinkopf [29°14′S 17°48′E], 1897, M. Schlechter, 1 juv. ♂ (SAMC 1713); Helskloof Pass, Richtersveld [28°18′S 16°58′E], 1 subad. ♂ (TMSA 17646); Hoekbaai, 2 km ENE [31°11′S 17°47′E], 27.viii.1979, S. Endrödy-Younga, 1 ♀ (TMSA 12303); Hoits Mine, 10 km E of Springbok [29°54′S 17°57′E], 18.iv.1986, J. Visser, 1 subad. ♂ (SAMC C3867); Holgat, Port Nolloth [29°17′S 16°51′E], 9.iii.1985, J. Visser, 1 ♀ (SAMC C3856); Jakkalsputs, Richtersveld [28°40′S 16°57′E], 21.xi.1975, V.B. Whitehead, on red sand dunes at night, 1 ♀ (SAMC C49); Kamies [30°17′S 18°04′E], vii.1929, B. Peers, 1 ♂, 1 ♀ (SAMC B7314); Kamieskroon [30°12′S 17°56′E], ix.1930, S.A. Museum expedition, 1 ♀, 2 subad. ♂, 1 subad. ♀ (SAMC B7338); Kamieskroon, 20 km E [30°12′S 18°03′E], 19.xi.1975, E.B. Eastwood, under stone, 1 ♀ (SAMC C37); Khubus, Richtersveld [28°27′S 16°59′E], 1.vi.1997, A. Harington, 3 ♀ (AMNH [AH 4896–4898]); Kuboos [Khubus], Richtersveld [28°27′S 17°00′E], R. Smithers, 1 ♂, 2 ♀, 1 subad. ♂ (SAMC B8944), i.1911, C.L.L. Biden, 1 ♂ (SAMC B571); Khubus, ca. 10 km SE (on Farm The Richtersveld 11), 28°25.450′S 17°00.189′E, 1.iii.2003, L. Prendini & E. Scott, 300 m, UV detection in rocky canyon at start of 4x4 trail, succulent karoo, 3 ♂, 1 ♀, 1 juv. ♂, 3 juv. ♀ (AMNH); Kinderlê, 8 km N of Steinkopf [29°11′S 17°48′E], 16.x.1987, J. Visser, 1 ♀ (SAMC C3877); Richtersveld, 8 km N of Kinderlê [29°05′S 17°47′E], v.1987, J. Visser, 1 ♀ (SAMC C3871); Klein Kogelfontein [31°10′S 17°50′E], 27.viii.1979, S. Endrödy-Younga, 1 subad. ♂ (TMSA 12297); Kleinsee [29°40′S 17°05′E], ix.1987, J. Visser, 1 ♂ (SAMC C3878), 1 ♀ (SAMC C3881); Klipdam, SE of Nababeep [29°38′S 17°50′E], 26.v.1997, A. Harington, 1 ♂ (AMNH [AH 4795]); Klipfontein [29°14′S 17°39′E], 1899, R.H. Howard, 1 juv. ♂ (SAMC 5152); Klipfontein mountain, W Steinkopf [29°14′S 17°39′E], 17.i.1995, A. Harington, 1 ♀ (AMNH [AH 2413]); Komaggas [29°48′S 17°30′E], 14.i.1995, A. Harington, 4 ♂ (AMNH [AH 2622–2625]); Kotzesrus [30°57′S 17°50′E], 23.viii.1979, S. Endrödy-Younga, 4 ♀ (TMSA 12273, 12278, 12283, 12284), 4 subad. ♂ (TMSA 12274, 12275, 12277, 12279), 1 juv. ♂ (TMSA 12281); Lekkersing [29°00′S 17°06′E], 30.xi.1962, 1 ♀ (TMSA 14089); Lekkersing, 7 km NW (turnoff 0.85 km from last house on road to Richtersveld National Park), 29°00.723′S 17°02.086′E, 28.ii.2003, L. Prendini & E. Scott, 265 m, UV detection on red sand dune and sandy/alluvial flats in dry riverbed, succulent karoo, syntopic with *P. distridor*, 1 subad. ♂, 1. subad. ♀, 1 juv. ♂, 1. juv. ♀ (AMNH); Lekkersing, 6 km S [29°03′S 17°07′E], 20.i.1995, A. Harington, 3 ♂ (AMNH [AH 2633–2635]), 1 ♀ (AMNH [AH 2632]); Lekkersing, 12 km S [29°06′S 17°07′E], 20.i.1995, A. Harington, 3 ♂ (AMNH [AH 2592, 2594, 2595]), 1 ♀ (AMNH [AH 2593]); Leliefontein [30°19′S 18°05′E], 20.ix.1985, A. V. Evans, 1 ♂ (AMNH [AH 4269]), 1 ♀ (AMNH [AH 4268]); Little Rock, near Springbok [29°38′S 17°52′E], iv–v.1978, S. Salter, 1 ♂ (AMNH [AH 672]), 1 ♀ (AMNH [AH 671]), 1 subad. ♂ (AMNH [AH 673]), xii.1978, S. Salter, 1 ♀ (AMNH [AH 801]); McDougall Bay (near Port Nolloth), 1 km E [29°17′S 16°53′E], 19.i.1995, A. Harington, 1 ♂ (AMNH [AH 2613]), 1 ♀ (AMNH [AH 2614]), 1 subad. ♂ (AMNH [AH 2615]); Middelpos, 1 km N [29°33′S 18°01′E], 13.xii.1984, C.R. Owen, 1 ♂ (AMNH [AH 3600]); Okiep [29°36′S 17°53′E], 1897, M. Schlechter, 1 ♀, 1 subad. ♂ (SAMC 1701); O'okiep [29°36′S 17°53′E], 8.iv.1984, C.R. Owen, 1 ♀ (AMNH [AH 3786]); Port Nolloth [29°15′S 16°52′E], 17.xii.1983, J. Visser, 1 ♂ (SAMC C3825), 9.iii.1985, J. Visser, 1 ♂ (SAMC C3855), v.1986, A.J. Prins, 1 subad. ♀, 1 juv. ♂ (SAMC C4525), ii.1997, L. Prendini & G.J Müller, collected at night with UV light, 2 ♀ (SAMC C4558, C4562); Port Nolloth, 20 km E at turnoff to Lekkersing, 29°15.180′S 17°03.933′E, iii.1997, L. Prendini & E. Scott, 185 m, red sand flats, succulent karoo, collected at night with UV light, 1 subad. ♂ (SAMC C4557), 25.ii.2003, L. Prendini & E. Scott, 1 juv. ♂, 1. juv. ♀ (AMNH); Farm Kannikwa 156, 20 km E Port Nolloth, at turnoff to Lekkersing [29°17′S 17°05′E], 16.i.1999, G.J. Müller, J.J. van der Walt & J. du Plessis, collected at night with UV light, 3 ♂ (AMNH), 1 juv. ♀ (SAMC C4554); Port Nolloth, 36 mi up rail [29°11′S 17°23′E], i.1911, C.L.L. Biden, 1 ♀ (SAMC B568); Rietfontein [28°48′S 16°35′E], 2.ix.1976, S. Endrödy-

Younga, 1 subad. ♀ (TMSA 12218); Rooipoort (E Springbok), 5 km E (near 1090) [29°30′S 18°03′E], 25.v.1997, A. Harington, 1 ♀ (AMNH [AH 4793]); Spektakel Mine, on Farm Spektakel 202, W Springbok [29°39′S 17°34′E], 15.ii.1995, A. Harington, 1 ♂ (AMNH [AH 2692]), 1 juv. ♀ (AMNH [AH 2693]); Springbok [29°40′S 17°53′E], xii.1997, L. Prendini & E. Scott, collected at night with UV light, 1 ♂ (SAMC C4561); S of Springbok [29°54′S 17°52′E], 10.ix.1983, J. Visser, 1 ♀ (SAMC C3822); Springbok, 30 km S [29°55′S 17°53′E], 10.x.1983, J. Visser, 1 ♂ (SAMC C3823); Springbok, 3 km W [29°40′S 17°52′E], 25.xi.1983, J. Visser, 1 ♂ (SAMC C3830); Springbok, 23 km W [29°42′S 17°44′E], 11.xii.1984, C.R. Owen, 1 juv. ♂ (AMNH [AH 3860]); Springbok, 57 km W (Farm Wolfberg 187) [29°34′S 17°28′E], 11.xii.1984, C.R. Owen, 1 ♂ (AMNH [AH 4409]), 1 juv. ♀ (AMNH [AH 2474]), G. Newlands, 1 ♂ (AMNH [AH 3268]); Springbok to Aggeneys [29°30′S 18°10′E], iii.1985, G. Behr, 1 ♂ (SAMC C3852), 1 ♀ (SAMC C3851); Springklipberg, Richtersveld, red sand dunes 2 km E [28°37′S 16°52′E], ii.1997, L. Prendini & G.J. Müller, collected at night with UV light, 1 ♀ (SAMC C4556); Springklipberg, 2 km E S tip [28°38′S 16°54′E], 21.i.1995, A. Harington, 1 ♂ (AMNH [AH 2660]), 1 ♀ (AMNH [AH 2659]); Steinkopf [29°16′S 17°44′E], 1897, M. Schlechter, 1 ♂ (SAMC 1704), W.H. Turle, 1 ♂, 2 ♀ (SAMC 567); Farm Steinkopf 22, 11 km S of Steinkopf, 29°20.367′S 17°47.282′E, 26.ii.2003, L. Prendini & E. Scott, 900 m, UV lighting at night on red sandy flats and loose sand around granite koppies, 1 ♂, 3 ♀, 2 juv. ♂ (AMNH); between Springbokfontein and Steinkopf [29°22′S 17°52′E], 1897, M. Schlechter, 2 ♀ (SAMC 1711); Wildepaardehoek [29°53′S 17°38′E], 28.viii.1977, S. Endrödy-Younga, 1 subad. ♂ (TMSA 11652). Richtersveld National Park: 28°12′S 17°07′E, 14.i.1999, G.J. Müller, J.J. van der Walt, J. Tytgat, J. du Plessis, et al., collected at night with UV light, 1 ♂ (AMNH), 2 juv. ♀ (SAMC C4555); 28°14′S 17°02′E, i.1999, G.J. Müller, J.J. van der Walt, J. Tytgat, J. du Plessis, et al., collected at night with UV light, 1 ♂ (AMNH); 28°18′S 17°05′E, i.1999, G.J. Müller, J.J. van der Walt, J. Tytgat, J. du Plessis, et al., collected at night with UV light, 1 ♂ (AMNH); 28°15′S 17°05′E, x–xii.1994, H. Braack, 2 ♂, 2 ♀ (SAMC C4553); Gannakouriep River bed [28°23′S 17°10′E], ii.1997, L. Prendini, G.J. Müller, et al., collected at night with UV light, 1 ♀ (SAMC C4563); Kokerboomkloof, 28°18.5′S 17°16.0′E, i.1999, G.J. Müller, J.J. van der Walt, J. Tytgat, J. du Plessis, et al., collected at night with UV light, 2 ♂ (AMNH); Potjiespram [28°06′S 16°57′E], 23.i.1995, A. Harington, 1 ♂ (AMNH [AH 2734]), 1 ♀ (AMNH [AH 2733]), [28°10′S 16°53′E], 7.ii.1997, L. Prendini, G.J. Müller, et al., collected at night with UV light, 1 ♂ (SAMC C4560); S of Peilkop [28°11′S 17°02′E], ix.1996, P. Lloyd, collected at night with UV light, 1 ♀ (SAMC C4513); Tatasberg [28°19′S 17°15′E], ii.1997, L. Prendini, G.J. Müller, et al., collected at night with UV light, 1 ♀ (SAMC C4559). Prieska District: Farm Boegoeberg Settlement/Buchuwater Reserve, 5 km S of Water Affairs office, 29°05.368′S 22°11.738′E, 8.iii.2003, L. Prendini & E. Scott, 890 m, UV detection on sandy flats near riverbed, 1 ♀, 1 juv. ♂, 1 juv. ♀ (AMNH), 6 km S of Water Affairs office, 29°05.535′S 22°11.897′E, 914 m, UV detection on rocky flats, 1 subad. ♂, 1 subad. ♀, 1 juv. ♂ (AMNH); Farm Middelwater 18, 3.5 km S of De Duinen homestead towards fountain, 29°25.936′S 22°27.120′E, 9–10.iii.2003, L. Prendini & E. Scott, 935 m, Asbesberge foothills, ironstone, basalt and metamorphic mixture on loamy soil, arid savanna, UV detection, 1 ♀, 5 juv. ♂, 3 juv. ♀ (AMNH), 4.4 km S of De Duinen homestead at fountain, 29°26.282′S 22°27.464′E, 1021 m, 1 ♂, 1 juv. ♂, 1 juv. ♀ (AMNH). Sutherland District: Verlatenkloof, S of Sutherland [32°32′S 20°36′E], J. Visser, 1 ♀ (SAMC C3866). Victoria West District: Victoria West [31°24′S 23°07′E], 7.ix.1983, J. Visser, 1 ♂ (SAMC C3820). Williston District: Zak River [31°37′S 21°37′E], xi.1916, F.M. Wilson, 1 ♀ (SAMC B1753). *Northern Cape and Western Cape Provinces*: Calvinia, Vanrhynsdorp, Clanwilliam and Namaqualand Districts, 1897, L. Mally, 2 ♂, 1 ♀, 2 juv. ♂, 1 juv. ♀ (SAMC 1721). *Western Cape Province*: ‘Great Karoo’, M. Stiller, 1 ♀ (SAMC C1518). Beaufort West District: Beaufort West [32°21′S 22°35′E], 24–30.x.1905, W.F. Purcell, 1 juv. ♂ (SAMC 14361), ii.1958, S.A. Museum expedition, 1 ♂ (SAMC C195), 2.iv.1985, C.R. Owen, 1 juv. ♀ (AMNH [AH

4297]). Karoo National Park [32°23′S 22°38′E], 13.vii.1988, A.J. Prins, 1 ♂ (SAMC C4524), 1.iv.1994, J. Leeming, mid plateau, sympatric with *P. planicauda*, 1 ♂ (SAMC C4545). Bellville District: Belhar [33°57′S 18°38′E], 1998, ex G.J. Müller, brought into Tygerberg hospital, 1 ♀ (SAMC C4547); Japonica Steet, Belhar [33°57′S 18°38′E], 28.iii.1998, ex G.J. Müller, brought into Tygerberg hospital, 1 ♀ (SAMC C4546). Cape District: Devil's Mt., above Woodstock, Park Road [33°55′S 18°26′E], viii.1903, Dreyer, 1 ♀, 2 subad. ♂, 3 subad. ♀, 3 juv. ♂, 1 juv. ♀ (SAMC 12813); Silverstrand, 45 km N of Cape Town [33°34′S 18°22′E], 7.iii.1993, J. Visser, 1 ♂ (SAMC C3885); Table View, Cape Town [33°49′S 18°29′E], 29.iv.1986, Louw, 1 ♀, 1 juv. ♂ (SAMC C1618). Ceres District: Hanglip, ca. 2 km from Farm Bizansgat towards Ceres on R356 from Sutherland (800 m off road)/44 km NE of Karoopoort junction between R355 and R356, 32°53.254′S 19°58.129′E, 12.iii.2003, L. Prendini & E. Scott, 616 m, Tankwa karoo valley floor, Nama karoo-succulent karoo transition on shaley-loam soil, UV detection, 1 ♂ (AMNH). Clanwilliam District: 5 km from Citrusdal on road to Citrusdal Baths [32°36′S 19°01′E], 13.iii.1998, L. Prendini & E. Scott, collected at night with UV light, 2 ♂, 1 ♀ (SAMC C4548); Biedouws Pass [32°02′S 19°24′E], 25.ix.1973, L. Schulze, 1 ♀ (TMSA 12639); Biedouwvallei [32°09′S 19°15′E], ix.1996, J.J. van der Walt, collected at night with UV light, 1 ♂ (AMNH); Blikhuis, 15–20 mi S of Clanwilliam to Modderfontein [32°26′S 18°57′E], viii.1898, R.M. Lightfoot, 1 ♀ (SAMC 3760); Boontjies River, near Pakhuisberg [32°34′S 19°01′E], 1897, M. Schlechter, 1 ♀, 3 juv. ♂ (SAMC 1199); Boshof, western Cedarberg [32°21′S 18°59′E], 14.v.1997, A. Harington, 1 ♀ (AMNH [AH 4699]); Cedar Mountains near Pakhuis [32°07′S 18°52′E], xi.1899, R.M. Lightfoot, 1 ♂ (SAMC 5206); Clanwilliam [32°08′S 18°51′E], 6.ix.1997, J.J. van der Walt, collected at night with UV light, 1 ♀ (SAMC C4550), xii.1997, L. Prendini & E. Scott, collected at night with UV light, 1 ♂ (SAMC C4549); Clanwilliam, 25 km N [32°08′S 18°51′E], 18.xi.1975, E.B. Eastwood, in burrow under stone, 1 ♀ [dark form] (SAMC C36); Keurboschkraal River, Cedar Mts., Clanwilliam [32°40′S 18°45′E], viii.1898, R.M. Lightfoot, 1 ♀ (SAMC 3754); Lambert's Bay [32°06′S 18°19′E], J. Visser, 1 subad. ♂ [dark form] (SAMC C3887), 29.v.1978, sand and bushes, 1 subad. ♂ [dark form] (SAMC C1382), v.1982, J. Visser, 1 subad. ♂ [dark form] (SAMC C3796), 4.vi.1982, J. Visser, 1 ♀ [dark form] (SAMC C3797); Matjiesfontein [32°23′S 19°23′E], 13.vi.1982, J. Visser, 1 subad. ♂ (SAMC C3795), 17.viii.1982, J. Visser, 1 ♂ (SAMC C3800); Olyvenboschkraal, near Bergvlei, north of Piketberg Mts. [32°19′S 18°50′E], 1898, C.L. Leipoldt, 4 ♂ (SAMC 4048); Onderbergvlei Farm, in Zuid Zandvelt Wyk [32°36′S 18°45′E], 24.viii.1898, C.L. Leipoldt, 1 ♂ (SAMC 3755); Rondegat, 5 mi SSE Clanwilliam [32°14′S 18°54′E], 1897, M. Schlechter, 1 juv. ♂ (SAMC 1198). Goodwood District: Goodwood, near Bellville [33°54′S 18°33′E], 3.iii.1996, F. Piser, 1 ♀ (AMNH [AH 2924]). Hermanus District: Hermanuspetrusfontein [dubious] [Hermanus, 34°25′S 19°15′E], on flats near village, ii–iii.1902, R.M. Lightfoot & H. Herman, 2 ♀ (SAMC 11511), near village, 17.ii.1902, R.M. Lightfoot, 2 ♀, 1 subad. ♀, 3 juv. ♂ (SAMC 11506). Hopefield District: Donkergat [33°04′S 18°00′E], ix.1976, G. McLachlin, 2 subad. ♀ (SAMC C80); Hopefield [33°04′S 18°21′E], 16.iii.[?], A.J. Prins, 1 ♂ [dark form] (SAMC C2246), v.1987, H. Schelten, 1 ♀ [dark form] (SAMC C1624); Langebaan [33°06′S 18°02′E], 21.x.1983, J. Visser, 3 subad. ♂ (SAMC C3826–C3828); Saldanha Bay [33°00′S 18°03′E], 1980, A.J. Prins, 1 juv. ♂ (SAMC C4526), viii.1991, N. Larsen, under stone, 1 ♂ (SAMC C2285). Kuils River District: Kuilsrivier [34°02′S 18°42′E], 1997, ex G.J. Müller, brought into Tygerberg Hospital, 1 ♀ (SAMC C4551). Laingsburg District: Matjiesfontein [33°14′S 20°35′E], viii.1903, W.F. Purcell, 1 subad. ♀ (SAMC 12809), 1–3.xi.1905, W.F. Purcell, 1 juv. ♀ (SAMC 14363). Malmesbury District: Klipheuwel, N Durbanville [33°42′S 18°42′E], 5.viii.1982, J. Visser, 2 ♀ (SAMC C3798, C3799), 2 juv. ♂ (SAMC C3778, C3779), ix.1982, J. Visser, 1 subad. ♀ (SAMC C3801); Melkbosstrand [33°44′S 18°26′E], v.1997, M.D. Picker, 1 juv. ♀ (SAMC C4552). Montagu District: Montagu [33°47′S 20°07′E], xi.1919, R.W.E. Tucker, 1 ♀ (SAMC B3979). Piketberg District: Eendekuil [32°41′S 18°53′E], Muller, 2 ♀ (SAMC B8934); Laaiplek [32°46′S

18°10′E], ix.1976, G. McLachlin, in sand dune, 1 ♂, 2 ♀, 1 subad. ♂ [dark form] (SAMC C74); Laaiplek near Veldrift [32°46′S 18°09′E], 10.i.1979, A. Harington, under carton boxes and drums on white coastal dunes, 4 ♂ [dark form] (AMNH [AH 1503–1505, 1176]); Laaiplek, near Velddrif [32°46′S 18°10′E], xii.1998, Zoology Department, University of the Western Cape, under stones, ♂ attempted to mate with ♀ of typical *P. capensis*, 1 ♂, 1 ♀ [dark form] (SAMC C4564); Piekenierskloof Pass [32°37′S 18°57′E], 30.xi.1976, E.B. Eastwood, under stones, 1 ♀, 1 subad. ♀, 3 juv. ♀ (SAMC C98). Prince Albert District: Farm Zwartskraal [33°10′S 22°32′E], 5.ix.1979, S. Endrödy-Younga, 1 ♀ (TMSA 12310), 25.x.1979, S. Endrödy-Younga, 1 juv. ♂ (TMSA 12340), 5.xii.1979, S. Endrödy-Younga, 1 juv. ♀ (TMSA 12349), 15.xii.1979, S. Endrödy-Younga, 1 juv. ♀ (TMSA 12352), 1.ii.1980, S. Endrödy-Younga, 1 subad. ♂ (TMSA 12256), 1 subad. ♀ (TMSA 12369), 18.iii.1980, S. Endrödy-Younga, 1 subad. ♀ (TMSA 12261), 1 juv. ♂ (TMSA 12266); Swartberg [33°25′S 22°40′E], 17.xii.1978, S. Endrödy-Younga, 1 subad. ♂ (TMSA 12235). Saldanha Bay District: Langebaanweg [32°58′S 18°09′E], vii.1973, B. Kensley, 1 subad. ♂ (SAMC C6). Simon's Town District: Cape Peninsula [34°07′S 18°22′E], 26.v.1907, C.J. French, 1 ♀ (SAMC B545). Tulbagh District: Piquetberg Road Station, Gouda [33°22′S 19°07′E], viii.1898, R.M. Lightfoot, 1 ♀, 1 juv. ♂ (SAMC 3758); Tulbagh Road Station [33°19′S 19°06′E], 1895, J.P. Cregoe, 1 ♀ (SAMC 504). Vanrhynsdorp District: Farm Rietpoort [30°59′S 18°06′E], 22.viii.1979, S. Endrödy-Younga, 1 subad. ♂ (TMSA 12271); Klawer [31°47′S 18°37′E], v.1996, L. Prendini, collected at night with UV light, 1 subad. ♂ (SAMC C4566); Kliprand [30°36′S 18°42′E], 21.xi.1975, A.J. Prins, under stone, 1 juv. ♂ (SAMC C41); Vanrhynsdorp [31°37′S 18°44′E], 5.vi.1968, G.R. McLachlan, 1 juv. ♂ (TMSA 17645), [31°36′S 18°44′E], 12.xii.1984, C.R. Owen, 2 ♂ (AMNH [AH 3489, 4325]), 1 ♀ (AMNH [AH 4324]), G. Newlands, 3 ♂ (AMNH [AH 3179, 3181, 3182]), 1 ♀ (AMNH [AH 3180]); Vanrhynsdorp, 12 km N near Varschrivier [31°33′S 18°32′E], xii.1997, L. Prendini & E. Scott, collected at night with UV light, 1 ♂ (SAMC C4565); Vanrhynsdorp, 60 km N [31°10′S 18°25′E], v.1987, J. Visser, 1 ♂ (SAMC C3874). Vredenburg District: Jacobsbaai, N of Saldanha Bay [32°58′S 17°54′E], 21.viii.1975, V. Branco, under stones, 1 subad. ♂, 1 juv. ♀ (SAMC C27), 14.viii.1977, E.B. Eastwood, 1 juv. ♀ (SAMC C170), xii.1985, A.J. Prins, 1 ♀, 1 juv. ♂ (SAMC C4523); Steenberg's Cove, St Helena Bay [32°46′S 18°02′E], v.1902, J.E.C. Goold, 1 subad. ♀, 1 juv. ♂, 4 juv. ♀ (SAMC 11501); Stompneus, St Helena Bay [32°44′S 17°58′E], ii–iii.1902, J.E.C. Goold, 3 ♀ (SAMC 10007), v.1902, J.E.C. Goold, 2 juv. ♂ (SAMC 10009), vi.1902, J.E.C. Goold, 1 ♀ (SAMC 11500), vii.1903, J.E.C. Goold, 1 ♀, 3 juv. ♂, 2 juv. ♀ (SAMC 12807). Vredendal District: Koekenaap [31°32′S 18°14′E], 30.viii.1979, S. Endrödy-Younga, 3 ♀ (TMSA 12304, 12308, 12309), 2 subad. ♂ (TMSA 12305, 12306). Wellington District: Bartholomeus Klip, Bo-Hermon [33°26′S 18°58′E], iii.1997, L. Prendini & E. Scott, under stones on ridge, sympatric with *P. planicauda*, 2 ♀, 1 subad. ♂, 1 subad. ♀ (SAMC C4567). Worcester District: De Doorns [33°29′S 19°41′E], xii.1906, J. Paynter, 6 ♂, 12 ♀, 1 juv. ♂, 5 juv. ♀ (SAMC B609); Touws River station [33°20′S 20°03′E], xii.1904, J. Paynter, 1 ♀ (SAMC 14263); Touws River [33°20′S 20°03′E], 5.xi.1905, W.F. Purcell, 1 ♀ (SAMC 14365), xii.1905, J. Paynter, 1 ♀ (SAMC 14378).

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Parabuthus distridor Lamoral 1980: 206–210, figs. 12–22; Kovařík 1998: 116; Fet & Lowe 2000: 202; Prendini 2001a: 17; Prendini 2001b: 136; Prendini 2003: 20.

Type material.—Holotype ♀ (NMSA 11435), SOUTH AFRICA: Cape Province, sandy ridge, 8 km south of Springklipberg, Richtersveld [*Northern Cape Province*: Namaqualand District], 28°40′S 16°53′E, 21.ii.1979, B.H. Lamoral. Paratypes: 1 ♂ (AMNH), 1 ♂ (BMNH), 1 ♂ (CASC), 1 ♂ (MNHN), 1 ♂ (NMSA 11436), 11 ♂, ♀, 2 subad. ♂, 2 juv. ♀ (NMSA 11305), same data as holotype.

Diagnosis.—*Parabuthus distridor* is most closely related to *P. kuanyamarum*, the two species forming a sister group to the *P. gracilis*–*P. nanus* group (Fig. 1). Both species may be separated from all other species of *Parabuthus* by means of the following combination

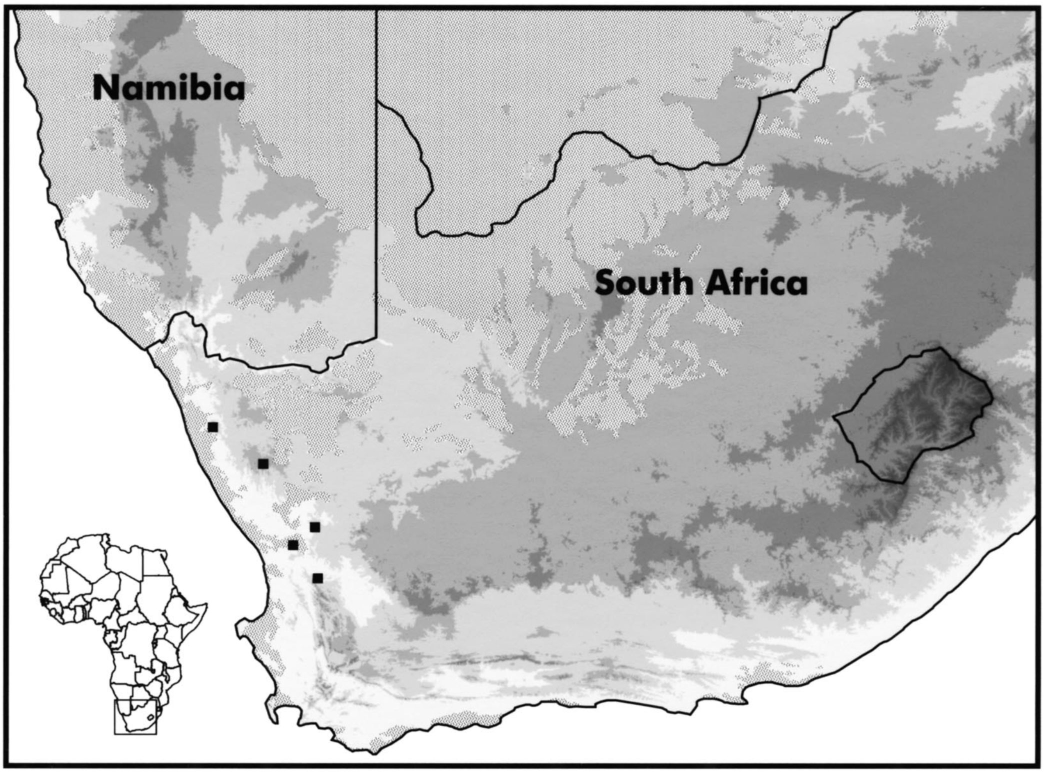


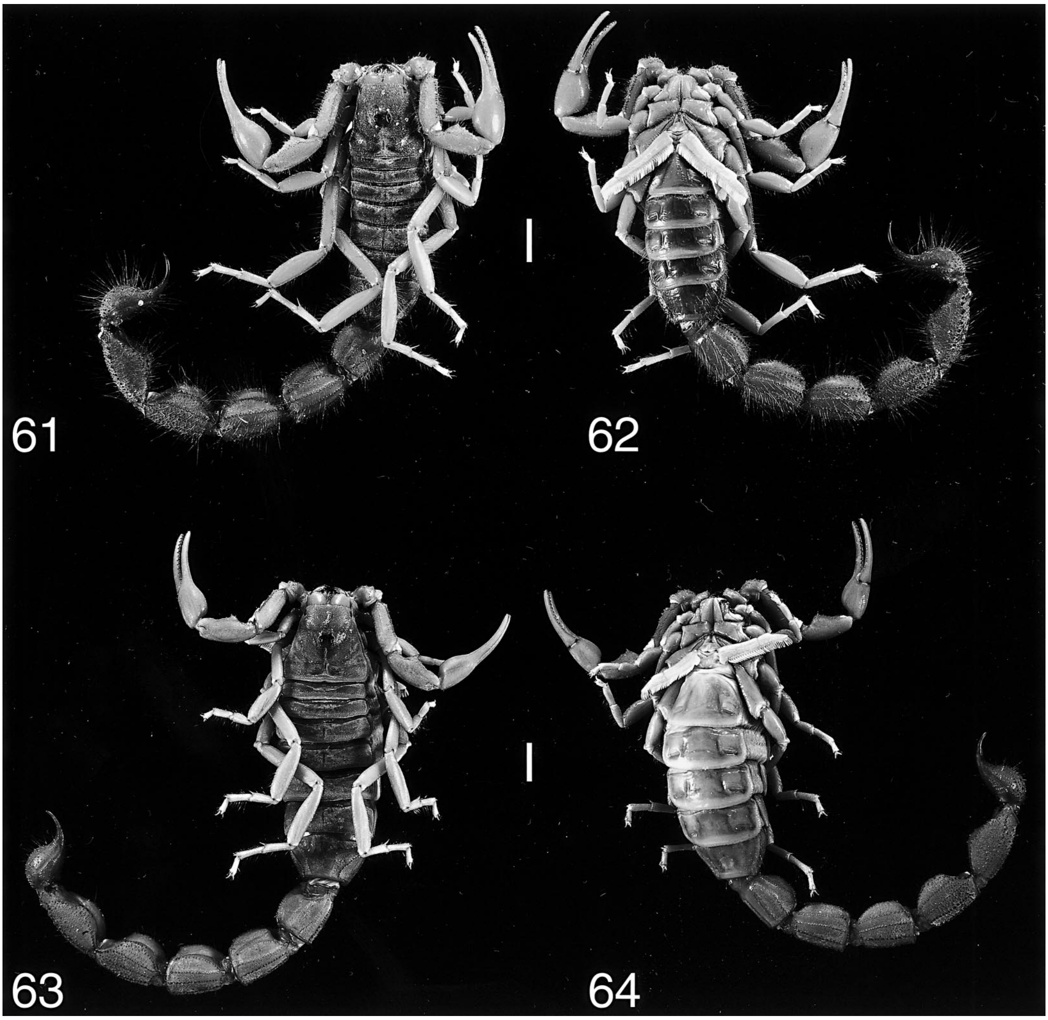
Figure 60.—The known distribution of *Parabuthus calvus* Purcell 1896 (■), which is endemic to South Africa. Contour interval = 500 m. Major sand systems stippled.

of characters: small adult size, carapace length 2.5–5.0 mm; surface of median ocular tubercle (male, female) and surrounding surfaces of carapace (female), smooth and shiny; pedipalp chela manus smooth; pedipalp chela with trichobothrium *dt* situated proximal to *et*; metasomal segments slender (length IV/width IV: 1.7–2.11); metasomal segments I–IV, dorsosubmedian and dorsolateral carinae absent; metasomal segments II and III, posteroventral margins not demarcated by a transverse row of granules or tubercles; metasomal segment IV with median lateral, ventrolateral and ventrosubmedian carinae absent; metasomal segments IV and V, lateral intercarinal surfaces smooth; metasomal segment V with dorsosubmedian, dorsolateral and ventromedian carinae absent, but with ventrolateral carinae present, converging distally, and comprising spinose processes subdistally.

Parabuthus distridor may be separated from *P. kuanyamarum*, and all other species of *Parabuthus*, by means of the following characters: metasomal segments I–III, median lateral, ventrolateral, and ventrosubmedian carinae absent; metasomal segments I and II, dorsal stridulatory surface absent. Additional characters separating *P. distridor* from *P. kuanyamarum* are as follows: chela (adult male), fixed and movable fingers straight, such that proximal dentate margin linear when fingers are closed (i.e., no proximal ‘‘gap’’ is evident); metasomal segments I–V and telson, moderately setose.

Distribution.—Endemic to sandy areas in the Richtersveld located in the northwestern corner of the Northern Cape Province (Namaqualand District), South Africa. This species has not been recorded north of the Orange River.

Ecology.—*Parabuthus distridor* is a psammophilous species, which displays several ecomorphological adaptations to its sandy habitat: elongated, unequal telotarsal ungues; dorsoventral compression of the basitarsi of legs I and II, with comb-like rows of long



Figures 61–64.—*Parabuthus capensis* (Ehrenberg 1831), habitus (dorsal and ventral aspects). 61, 62. ♂ (SAMC C4565). 63, 64. ♀ (SAMC C98). Scale bars = 5 mm.

macrosetae (‘‘sand combs’’) on the retrolateral margins; metasoma and telson lacking carinae on segments I−V. All specimens thus far collected were located at night with the aid of UV light detection, resting on the surface of unconsolidated red sand dunes. *Parabuthus distridor* is syntopic with *P. capensis* throughout its distributional range. The species is allopatric with its sister species, *P. kuanyamarum*.

Material examined.—SOUTH AFRICA: *Northern Cape Province*: Namaqualand District, 25 km E of Port Nolloth at turn-off to Wolfberg, iii.1997, L. Prendini & E. Scott, 2 ♂, 1 ♀ (SAMC C4604).

Parabuthus gracilis Lamoral 1979
Figs. 11, 26, 43

Parabuthus gracilis Lamoral 1979: 566–571, figs. 96, 103, 104, 107–116; Kovařík 1998: 116; Fet & Lowe 2000: 202; Prendini 2001a: 17; Prendini 2001b: 136; Prendini 2003: 20.

Type material.—Holotype ♀ (NMSA 10925), NAMIBIA: Messum Crater [*Erongo Region*: Omaruru District], 21°16′S 14°13′E, 26.iii.1976, B.H. Lamoral. Paratypes: NAMIBIA: 8 ♂, 1 ♀, 4 juv. (NMSA 10848), 1 ♂ (NMSA 10926), same data as holotype; 2 ♂ (NMSA 10854), Cape Cross [*Erongo Region*: Swakopmund District], 21°43′S

13°58′E, 25.iii.1976, B.H. Lamoral; 1 subad. ♀, 1 juv. ♀ (NMSA 10857), Möwebaai [*Kunene Region*: Opuwo District: Skeleton Coast National Park], 16°20′S 12°43′E, 28.iii.1976, B.H. Lamoral; 3 ♂, 1 ♀, 4 juv. (NMSA 10859), same data, except 29.iii.1976; 1 ♂, 1 juv. ♂ (NMSA 10860), Torra Bay [*Kunene Region*: Khorixas District: Skeleton Coast National Park], 20°12′S 13°11′E, 30.iii.1976, B.H. Lamoral.

Diagnosis.—*Parabuthus gracilis* is most closely related to *P. nanus*, the two species forming a sister group to the *P. distridor*–*P. kuanyamarum* group (Fig. 1). *Parabuthus gracilis* is most easily confused with *P. brevimanus*, but may be separated from that species, and from all other species of *Parabuthus*, except *P. nanus*, by means of the following combination of characters: small adult size, carapace length 2.5–5.0 mm; carapace, including median ocular tubercle (male, female), entirely granular; pedipalp chela manus granular; pedipalp chela with trichobothrium *dt* situated proximal to *et*; metasomal segments slender (length IV/width IV: 1.7–2.11); metasomal segments I–IV, dorsosubmedian and dorsolateral carinae absent; metasomal segments II and III, posteroventral margins demarcated by a transverse row of isolated, round granules; metasomal segment IV with median lateral, ventrolateral and ventrosubmedian carinae absent; metasomal segments IV and V, lateral intercarinal surfaces granular; metasomal segment V with dorsosubmedian, dorsolateral and ventromedian carinae absent, but with ventrolateral carinae present, converging distally, and comprising spinose processes subdistally.

Parabuthus gracilis may be separated from *P. nanus* by both of the following characters: pedipalp chela movable finger of female, short, compared with manus (measured along ventroexternal carina), length finger/length carina: ± 1.50; manus of adult male, noticeably incrassate, compared with that of adult female, which is slender.

Distribution.—Endemic to sandy areas in the central and northern Namib (Khorixas, Omaruru, and Swakopmund districts of northwestern Namibia), north of the Kuiseb River.

Ecology.—*Parabuthus gracilis* is a psammophilous species, which displays several ecomorphological adaptations to its sandy habitat: elongated telotarsal ungues; basitarsi of legs I and II dorsoventrally compressed, with comb-like rows of long macrosetae (“sand combs”) on the retrolateral margins; metasoma and telson lacking carinae on segments III−V. Specimens of *P. gracilis* have been found at night with UV light detection, resting on the surface of unconsolidated white sand dunes, and have been excavated from burrows in shrub-coppice dunes.

Parabuthus gracilis is syntopic with *P. stridulus* in the coastal part of its distributional range, and with *P. brevimanus* and *P. granulatus* inland, e.g., at the Brandberg (pers. obs.) and the Messum Crater (Lamoral 1979). *Parabuthus gracilis* generally inhabits softer substrata than *P. brevimanus*. The species is allopatric with its sister species, *P. nanus*.

Material examined.—NAMIBIA: *Erongo Region*: Omaruru District: Messum Crater area, 21°25′S 14°13′E, 21.i.1981, A. Harington, 1 ♂ (AMNH [AH 2164]). *Erongo Region*: Swakopmund District: Cape Cross, 5 km N [21°43′S 13°56′E], 13.i.1981, A. Harington, 1 ♀ (AMNH [AH 3608]).

Parabuthus granulatus (Ehrenberg 1831)
Figs. 16, 31, 39, 40

Androctonus (*Prionurus*) *granulatus* Ehrenberg in Hemprich & Ehrenberg 1831 [pages unnumbered]; Moritz & Fischer 1980: 315.

Scorpio (*Androctonus*) *granulatus*: Gervais 1844: 45.

Buthus brevimanus var. β *segnis* Thorell 1876b: 110, 112 (NEW SYNONYMY)

Buthus fulvipes Simon 1888: 378, 379 (synonymized by Purcell 1899b: 434; Lamoral 1979: 571).

Parabuthus fulvipes: Pocock 1895: 309; Kraepelin 1899: 30.

Parabuthus granulatus: Kraepelin 1899: 30; Purcell 1901: 168–173; Pocock 1902: 367; Kraepelin 1908: 251, 252; Hewitt 1912: 302; Hewitt 1913: 146; Kraepelin 1914: 110; Lampe 1917: 192; Hewitt 1918: 108; Lawrence 1928: 270; Monard 1937: 257; Roewer 1943: 207; Lawrence 1946: 399; Lawrence 1955: 226; Lawrence 1959: 383; Lawrence 1961: 153; Lawrence 1962: 220; Probst 1973: 330; Lamoral & Reynders 1975: 516, 517; Lamoral 1977: 105; Lamoral 1979: 571–576, figs. 117–124; FitzPatrick 1994: 7, 8; Braunwalder & Fet 1998: 33, 34; Jäger 1998: 87, 88; Kovařík 1998: 116; Fet & Lowe 2000: 203; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 20.

Parabuthus granulatus fuscus Pocock 1901: 285 (synonymized by Kraepelin 1908: 251, 252; Lamoral 1979: 571); Pocock 1902: 367; Hewitt

1918: 108; Hewitt 1935: 467, 468; Lamoral & Reynders 1975: 517.

Parabuthus granulatus bergeri Werner 1916: 83, 84 (synonymized by Lamoral 1979: 571); Lampe 1917: 192; Lawrence 1955: 226; Lamoral & Reynders 1975: 517.

Parabuthus granulatus fulvipes: Lampe 1917: 192; Hewitt 1918: 108; Werner 1936: 177, 178; Lamoral & Reynders 1975: 517.

Parabuthus granulatus strenuus Hewitt 1918: 176 (NEW SYNONYMY); Lawrence 1955: 226; Lamoral & Reynders 1975: 517; Kovařík 1998: 116; Fet & Lowe 2000: 203.

Parabuthus bergeri: Werner 1936: 178.

Parabuthus granulatus granulatus: Fet & Lowe 2000: 203.

Type material.—*Androctonus* (*Prionurus*) *granulatus:* Holotype 1 subad. ♂ (ZMHB 132), SOUTH AFRICA: Promont bonae spei [Cape of Good Hope, *Western Cape Province:* Simon's Town District: 34°00′S 18°25′E], Lichtenstein.

Buthus brevimanus var. β *segnis:* Holotype ♂ [not ♀] (GNME), ''S. Afrika'', 28.xi.1864 [not 23.xi.1864], C.J. Andersson.

Buthus fulvipes: Holotype ♀ (MNHN RS 0311), NAMIBIA: ''sud-ouest Afrique'', 1884–1886, Dr H. Schinz.

Parabuthus granulatus fuscus: Holotype ♀ (BMNH 1894.5.3.4), ''Kalahari Desert'', R.J. Cunningham.

Parabuthus granulatus bergeri: Syntypes: NAMIBIA: 3 ♂, 4 ♀ (NHMW 1046), Berseba, Deutsch-Südwest-Afrika [*Karas Region*: Keetmanshoop District: 25°59′S 17°47′E]; 1 ♂, 3 juv. (NHMW 1047), Haruchas, near Gochas, Deutsch-Südwest-Afrika [*Hardap Region*: Mariental District: 24°50′S 18°55′E].

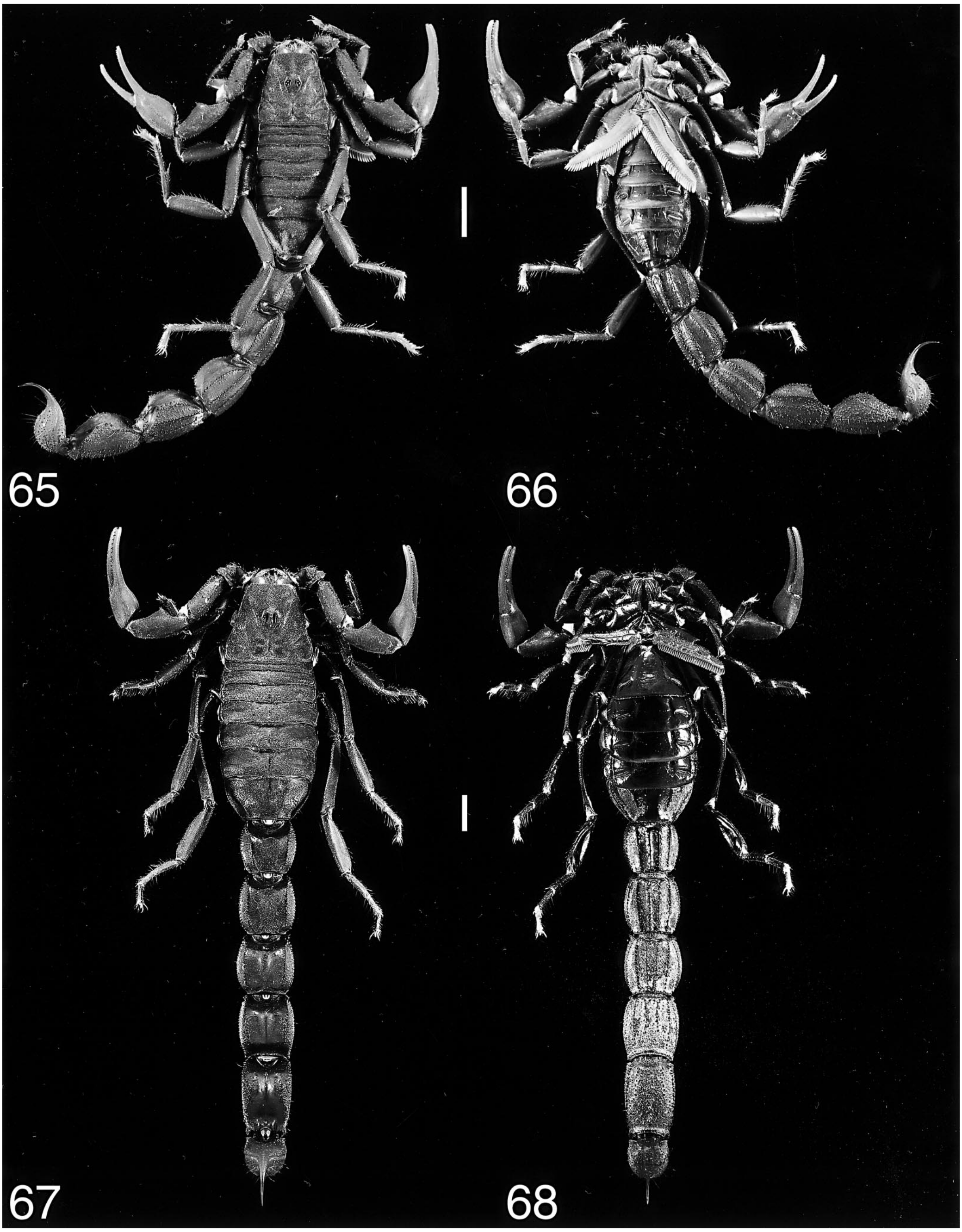
Parabuthus granulatus strenuus: Holotype ♂ (MMKZ), SOUTH AFRICA: Worcester, Cape Province [*Western Cape Province*: Worcester District: 33°39′S 19°25′E], G.B. Townsend.

Diagnosis.—*Parabuthus granulatus* is most closely related to *P. kalaharicus* (Fig. 1). The two species may be separated from all other species of *Parabuthus* by means of the following combination of characters: pedipalp chela, asetose; chela (adult male), fixed and movable fingers strongly curved, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ''gap'' is evident); chela manus, smooth and shiny; first proximal median lamella of pectines (female) suboval, with mesal margin arcuate (i.e., not enlarged and lobate) and free of teeth; metasomal segments broad (length IV/width IV: 1.2–1.5); metasomal segments I–V and telson, virtually asetose; metasomal segment II, stridulatory surface not reaching posterodorsal margin of segment; metasomal segment IV, median lateral carinae proximally obsolete; metasomal segment V, dorsosubmedian carinae absent, dorsolateral carinae distally obsolete; telson vesicle, width considerably narrower (65–72%) than width of metasomal segment V.

Parabuthus granulatus may be separated from *P. kalaharicus* by means of the following characters: pedipalp chela fixed finger, trichobothrium *dt* situated in line with or distal to *et*; chela movable finger of female, long, compared with manus (measured along ventroexternal carina), length finger/length carina: 1.70–2.00; metasomal segment IV, ventrosubmedian carinae becoming obsolete in distal third of segment; metasomal segment V, ventromedian carina present, ventrolateral carinae comprising enlarged, lobate processes subdistally.

Remarks.—Pocock (1895) suspected that *Buthus brevimanus* var. β *segnis* (as *P. segnis*) was a junior synonym of *P. capensis*. Kraepelin (1899) subsequently listed *Buthus segnis* in synonymy with *P. capensis*, but placed a questionmark next to the synonymy. Purcell (1901) noted that *P. segnis* was doubtfully described as a variety of *P. brevimanus* and doubtfully referred to *P. capensis* by later authors. Purcell further suggested that *P. segnis* and *P. capensis* are unlikely to conspecific, because the type of *P. segnis* was collected by C.J. Andersson, who travelled in Damaraland and Ovamboland (northern Namibia). Kraepelin (1908) again suggested that *P. segnis* does not belong to *P. brevimanus*, but probably to *P. capensis* or *P. granulatus*. Lamoral & Reynders (1975) listed *Buthus segnis* as a synonym of *P. capensis*.

During the present investigation, the holotype of *B. brevimanus* var. β *segnis*, which had not been examined since its description by Thorell, was obtained from the Göteborg Museum for study. The adult male holotype was found to be conspecific with *P. granulatus*, not with *P. capensis*, thus supporting the suspicions of Purcell (1901) and Kraepelin (1908). *Buthus brevimanus* var. β *segnis* is therefore synonymized with *P. granulatus*.



Figures 65–68.—*Parabuthus capensis* (Ehrenberg 1831), habitus (dorsal and ventral aspects). 65, 66. ♂ (AMNH [AH 1176]). 67, 68. ♀ (SAMC C4564). Scale bars = 5 mm.

Purcell (1899b, 1901) first listed *Buthus fulvipes* in synonymy with *P. granulatus* and noted (1901) that the holotype, from German South-West Africa (Namibia), agrees closely in coloration with specimens of *P. granulatus* from Bushmanland (Northern Cape Province, South Africa), as does *P. granulatus fuscus*. Kraepelin (1908) subsequently listed *P. granulatus fuscus* in synonymy with *P. granulatus*.

Subsequent authors appear to have overlooked these synonyms. Werner (1916) described *P. granulatus bergeri*, without citing Purcell (1901) or Kraepelin (1908), and subsequently (Werner 1936) raised *P. bergeri* to species level, while recognizing *P. granulatus fulvipes*. Hewitt (1918) regarded *P. fulvipes* and *P. granulatus fuscus* as local races of *P. granulatus* and described a new variety, *P. granulatus strenuus*. Lawrence (1955) may have been aware of these synonyms, for he listed *P. granulatus bergeri* and *P. granulatus strenuus* in his checklist, but omitted *P. granulatus fulvipes* and *P. granulatus fuscus*. However, Lawrence (1955) did not list these taxa as synonyms of *P. granulatus*.

Lamoral & Reynders (1975) again ignored these synonyms when they listed the following subspecies: *P. granulatus bergeri*, *P. granulatus fulvipes*, *P. granulatus fuscus*, and *P. granulatus strenuus*. Lamoral (1979) later revised *P. granulatus*, synonymizing *P. granulatus bergeri* and erroneously claiming that *Buthus fulvipes* and *P. granulatus fuscus* were new synonyms. Lamoral (1979) neglected to address the status of *P. granulatus strenuus*, presumably because it was extralimital. FitzPatrick (1994) recently provided additional diagnostic differences between *P. granulatus* and other members of the genus, but again omitted to address *P. granulatus strenuus*, perhaps for the same reason.

Hewitt (1918) distinguished *P. granulatus strenuus* solely on the extent of the stridulatory surface on metasomal segments I and II. According to Hewitt (1918), these segments are less deeply grooved dorsomedially in *P. granulatus strenuus* than in the typical form, and the stridulatory surface of segment II occupies a fairly deep independent excavation rather than a portion of one continuous groove. In both segments of *P. granulatus strenuus*, the anterior edge of the stridulatory surface descends obliquely, but more abruptly than in the typical form. In segment I, the stridulatory surface is very wide anteriorly, and laterally includes several enlarged granules that also occur in the typical form, but in which they are closer to the dorsosubmedian carinae than to the stridulatory surface. The stridulatory surface of *P. granulatus strenuus* extends posteriorly almost to the hind margin of the segment and broadens out near to the margin. The stridulatory surface of segment II is about twice as long as wide.

Lamoral (1979) provided evidence of extensive morphological variation in *P. granulatus*, which is the most widely distributed scorpion species in southern Africa (Prendini 1995). Harington (1984) has shown that the extent of the stridulatory surface is highly variable and cannot be used to separate *P. brachystylus* from *P. villosus* (discussed below). Newlands & Martindale (1980) also noted that this character is prone to considerable individual variation among species of *Parabuthus*. Even Hewitt (1918) admitted that the stridulatory surface is variable within *P. granulatus*. *Parabuthus granulatus strenuus* clearly represents nothing more than intraspecific polymorphism within a widespread species and is hereby synonymized with the typical form.

Distribution.—Recorded from Angola, Botswana, Namibia, South Africa, and Zimbabwe. Newlands & Martindale (1980) omitted this species in their review of the Zimbabwean scorpion fauna, but FitzPatrick (1994) and Bergman (1995, 1997b) provided records from Zimbabwe. *Parabuthus granulatus* is the most widespread species of *Parabuthus* in southern Africa. Its distribution crosses all major drainage systems in the region (e.g., Kunene, Orange, Limpopo), extending from the Western Cape Province of South Africa, throughout Namibia, to Angola, and across Botswana to Zimbabwe and the Limpopo Province of South Africa (Prendini 1995). The species probably also occurs in southern Zambia. It has not been recorded from Mozambique.

Ecology.—*Parabuthus granulatus* is a semi-psammophilous species, inhabiting semi-consolidated to consolidated sandy and gritty substrata, where it excavates burrows in open ground, at the base of shrubs and grass tufts and, less commonly, under logs and stones. Comb-like rows of long macrosetae (‘‘sand combs’’) on the retrolateral margins of the basitarsi of legs I and II indicate a semi-psammophilous ecomorphotype.

The widespread distribution of *P. granulatus* may be related to its ecology. Available data suggest that *P. granulatus* is more abundant in disturbed areas, such as dry riverbeds, where other large, potentially competitive species of *Parabuthus* (e.g., *P. raudus*, *P. schlechteri* and *P. transvaalicus*) are uncommon, suggesting that *P. granulatus* may be competitively superior in disturbed areas. As disturbed areas are often associated with human habitation, *P. granulatus* comes into contact more regularly with humans than most other species of *Parabuthus*, with consequent implications for envenomation by this species. The widespread distribution of *P. granulatus*, not to mention the prevalence of envenomation by this species, which is more often implicated in serious envenomations than other species in the genus (Müller 1993), may thus be directly related to the spread of human-induced environmental disturbance in southern Africa.

The widespread distribution of *P. granulatus* may also be related to the fact that this is one of the only large *Parabuthus* species (other than *P. kalaharicus* and *P. villosus*) that consistently adopts an ‘‘errant’’ mode of foraging (Polis 1990). Unlike many other large species of the genus (e.g., *P. raudus* and *P. schlechteri*), *P. granulatus* usually hunts actively, rather than lying in wait for prey (the ‘‘sit-and-wait’’ strategy). The errant foraging strategy may allow *P. granulatus* to disperse further on average than other species in ecological time, resulting in a broader distribution in evolutionary time. The errant strategy may also contribute to the prevalence of envenomation by this species, compared with species characterized by the sit-and-wait strategy, because *P. granulatus* may come into more frequent contact with humans as a consequence of its greater surface activity (e.g., by wandering indoors at night).

Due to its widespread distribution and generalist habitat requirements, *P. granulatus* has been recorded in sympatry with most other southern African species of *Parabuthus*: *P. brevimanus*, *P. capensis*, *P. gracilis*, *P. kalaharicus*, *P. kraepelini*, *P. kuanyamarum*, *P. laevifrons*, *P. mossambicensis*, *P. muelleri*, *P. nanus*, *P. planicauda*, *P. raudus*, *P. schlechteri*, *P. transvaalicus*, *P. villosus*.

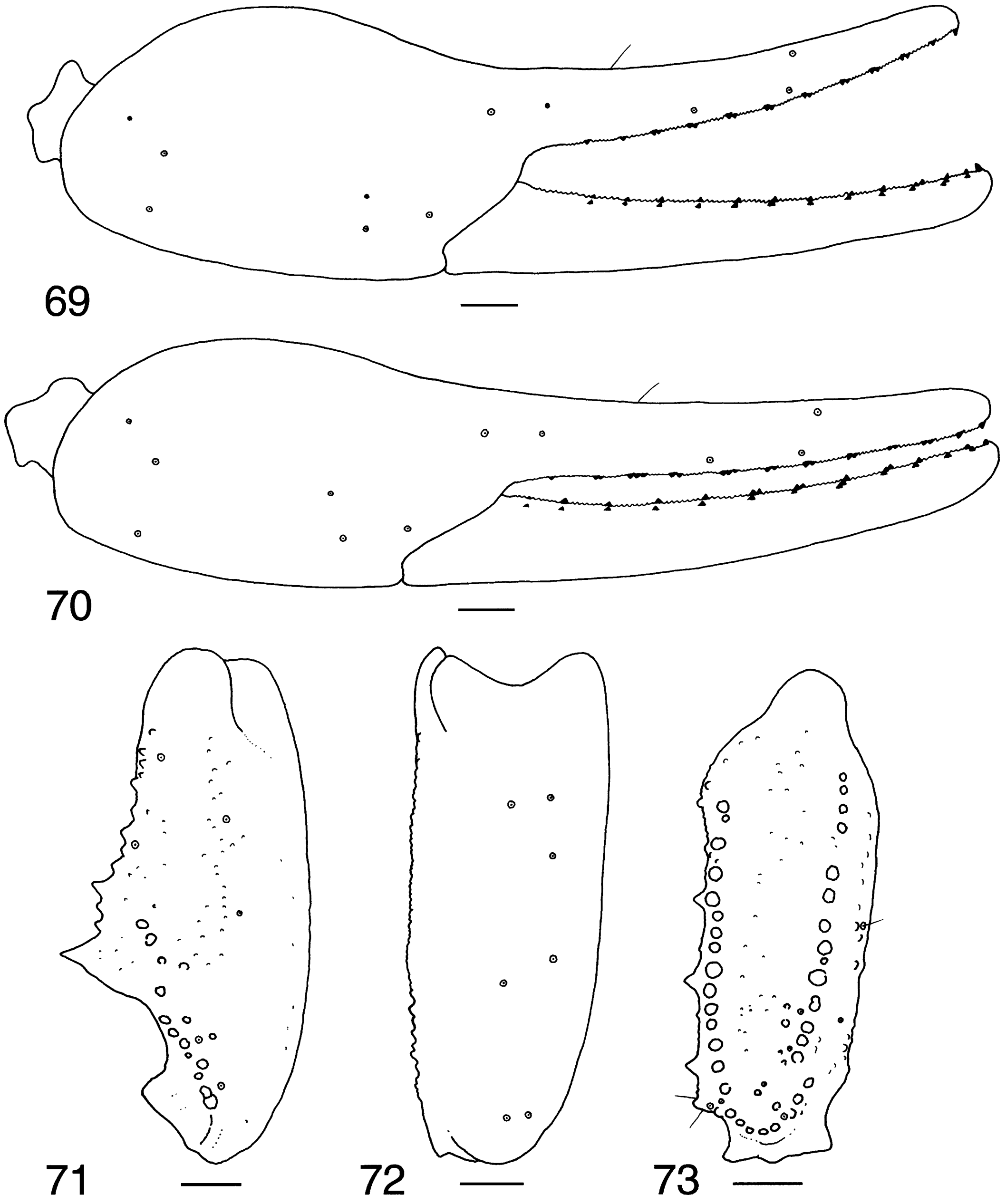
Material examined.—NAMIBIA: *Karas Region*: Keetmanshoop District: Berseba, 10 km S, 26°07′S 17°46′E, 27.ii.1976, B. Lamoral 9 ♂, 2 ♀, 1 juv. ♂, 1 juv. ♀ (NMSA 10731). *Khomas Region*: Windhoek District: Farm Frischgewaagd 289, 22°32′S 17°50′E, 20.iii.1976, B.H. Lamoral, 1 ♂ (NMSA 10900) [homotype designated by Lamoral (1979)]. *Kunene Region*: Khorixas District: Farm Vrede 719, 20°23′S 14°14′E, 31.iii.1976, B. Lamoral & L. Ferguson, 4 ♂, 2 ♀, 3 subad. ♀, 9 juv. (NMSA 10836).

Parabuthus kalaharicus Lamoral 1977
Figs. 14, 37, 38

Parabuthus kalaharicus Lamoral 1977: 101–107, figs. 1–5; Lamoral 1979: 576–579, figs. 125–132; Kovařík 1998: 116; Fet & Lowe 2000: 204; Prendini 2001a: 17; Prendini 2001b: 136; Dyason et al. 2002: 769; Prendini 2003: 20, 21.

Type material.—Holotype ♂ (NMSA 10945), SOUTH AFRICA: Twee Rivieren, Kalahari Gemsbok National Park [*Northern Cape Province*: Gordonia District], 26°30′S 20°35′E, iii.1970, B.H. Lamoral, caught at night. Paratypes: SOUTH AFRICA: 80 ♂ (NMSA 10439; AMNH; BMNH; CASC; MCZ; MNHN; TMSA 17984–17985), 4 ♂ (NMSA 10452), 2 ♀ (NMSA 10946), same data as holotype; 70 ♂ (NMSA 10455; BMNH; CASC; MCZ; MNHN; SAMC C213; TMSA 12453–12455), Twee Rivieren, 1960–1970, le Riche family and staff; 29 ♂ (NMSA 10948), Mata Mata [*Northern Cape Province*: Gordonia District: Kalahari Gemsbok National Park], 25°53′S 20°01′E, 24.iv.1970, B.H. Lamoral; juv. ♂ (NMSA 10453), same data except 27.iv.1970; NAMIBIA: 9 ♂ (NMSA 10947), Farm Sterkstroom 320 [*Karas Region*: Keetmanshoop District], 25°43′S 19°19′E, 19.iii.1969, B.H. Lamoral.

Diagnosis.—*Parabuthus kalaharicus* is most closely related to *P. granulatus* (Fig. 1). The two species may be separated from all other species of *Parabuthus* by means of the following combination of characters: pedipalp chela, asetose; chela (adult male), fixed and movable fingers strongly curved, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); chela manus, smooth and shiny; first proximal median lamella of pectines (female) suboval, with mesal margin arcuate (i.e., not enlarged and lobate) and free of teeth; metasomal segments broad (length IV/width IV: 1.2–1.5); metasomal segments I–V and telson, virtually asetose; metasomal segment II, stridulatory surface not reaching posterodorsal margin of segment; metasomal segment IV, median lateral carinae proximally obsolete; metasomal segment V, dorsosubmedian carinae absent, dorsolateral carinae distally obsolete; telson vesicle, width consider-



Figures 69–73.—*Parabuthus capensis* (Ehrenberg 1831), dextral pedipalp segments, illustrating shape, granulation and trichobothrial distribution. 69. ♂ (SAMC C4565). 70–73. ♀ (SAMC C4513), 69, 70. Chela, dorsal aspect. 71. Patella, dorsal aspect. 72. Patella, external aspect. 73. Femur, dorsal aspect. Scale bars = 1 mm.

ably narrower (65–72%) than width of metasomal segment V.

Parabuthus kalaharicus may be separated from *P. granulatus* by means of the following characters: pedipalp chela fixed finger, trichobothrium *dt* situated proximal to *et*; chela movable finger of female, short, compared with manus (measured along ventroexternal carina), length finger/length carina: ± 1.50; metasomal segment IV, ventrosubmedian carinae reduced to the proximal third of segment (posterior three quarters obsolete); metasomal segment V, ventromedian carina absent, ventrolateral carinae comprising spinose processes subdistally.

Remarks.—Lamoral (1979) added further comparative morphological data to his original description of *P. kalaharicus* (Lamoral 1977).

Distribution.—Endemic to the southwestern part of the Kalahari sand system, with records from Namibia (Keetmanshoop District, Karas Region) and South Africa (Gordonia District, Northern Cape Province). No specimens of *P. kalaharicus* have yet been recorded from Botswana. However, the association of this species with the Kalahari sand system in Namibia and South Africa suggests that it must also occur in the Kgalagadi District of southwestern Botswana, adjacent to the Kalahari Gemsbok National Park of South Africa, where most of the specimens have been collected. This species has not been recorded south of the Orange River.

Ecology.—*Parabuthus kalaharicus* is a psammophilous species, which displays several ecomorphological adaptations to its sand dune habitat: elongated, unequal telotarsal ungues; basitarsi of legs I and II dorsoventrally compressed, with comb-like rows of long macrosetae (‘‘sand combs’’) on the retrolateral margins; metasoma lacking some carinae on segments IV and V. Specimens of *P. kalaharicus* have been found at night with UV light detection, walking on the surface of unconsolidated red sand dunes, and have also been excavated from burrows at the base of shrubs growing on the sand dunes. As with *P. granulatus*, *P. kalaharicus* is an errant forager, which moves about actively in search of prey, rather than adopting a sit-and-wait strategy.

Parabuthus kalaharicus is syntopic with *P. granulatus*, *P. kuanyamarum* and *P. raudus* throughout its distributional range, and has been recorded in syntopy with *P. laevifrons* at Twee Rivieren (pers. obs.). *Parabuthus kalaharicus* and *P. kuanyamarum* inhabit softer sand on the dune crests, whereas *P. granulatus*, *P. laevifrons*, and *P. raudus* are more common in the interdune valleys, where the sand is more compacted.

Material examined.—SOUTH AFRICA: *Northern Cape Province*: Gordonia District: Askham [26°59′S 20°47′E], i.2000, G.J. Müller et al., collected at night with UV light, 1 ♂ (AMNH); Farm Alpha, 40 km S of Twee Rivieren on road to Andriesvale [26°47′S 20°10′E], iii.2000, J. du Plessis et al., collected at night with UV light, 4 ♂ (AMNH).

Parabuthus kraepelini Werner 1902
Fig. 4

Parabuthus kraepelini Werner 1902: 599; Kraepelin 1914: 111; Werner 1916: 82, 83; Lampe 1917: 193; Hewitt 1918: 108–111; Lawrence 1928: 270; Roewer 1943: 207; Lawrence 1955: 227; Lamoral & Reynders 1975: 518; Lamoral 1979: 579–583, figs. 133–139; Kovařík 1998: 116; Fet & Lowe 2000: 205; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 21.

Parabuthus flavidus: Kraepelin 1908: 254, 255.

Type material.—Holotype: 1 juv. ♀ (NHMW 2080), NAMIBIA: Windhoek, South West Africa [*Khomas Region*: Windhoek District, 22°34′S 17°06′E].

Diagnosis.—*Parabuthus kraepelini* is basal to the clade comprising *P. raudus*, *P. schlechteri*, *P. transvaalicus* and *P. villosus* (Fig. 1). The five species may be separated from all other species of *Parabuthus* by means of the following combination of characters: pedipalp chela (adult male), fixed finger strongly curved dorsally, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); metasomal segments broad (length IV/width IV: 1.2–1.5); metasomal segment I, stridulatory surface (dorsal aspect) extended forwards in V-shape onto anterior surface; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules noticeably more pronounced than preceding granules; metasomal segment IV, median lateral carinae continuous and distinct; metasomal segment V, dorsosubmedian carinae distinct, comprising sharp spiniform granules, dorsolateral carinae continuous to distal edge of segment.

Parabuthus kraepelini may be separated from the other four species in this clade by means of the following combination of characters: metasomal segment IV, dorsosubmedian carinae continuous; metasomal segment V, ventrolateral carinae comprising lobate processes subdistally.

Remarks.—Kraepelin (1908) erroneously listed *P. kraepelini* as a junior synonym of *P. flavidus*, which he, in turn, suggested might be a junior synonym of *P. mossambicensis*, and later (Kraepelin 1914) listed as such (discussed below). Kraepelin (1914), apparently prompted by Hewitt's (1912) remarks, retracted his synonymy of *P. kraepelini* with *P. mossambicensis*, and instead considered them distinct species. The status of *P. kraepelini* remained uncontested by subsequent authors (e.g., Hewitt 1918; Lawrence 1928, 1955; Roewer 1943; Lamoral & Reynders 1975) and the species was revised by Lamoral (1979).

Distribution.—Endemic to consolidated sandy areas in central and northern Namibia, north of 23°S latitude, east of the Namib sand system, and west of the Kalahari sand system. This species has not been recorded north of the Kunene River (Prendini 1995). However, its occurrence throughout the northern half of Namibia suggests that it may also occur in regions of similar soil and vegetation in southern Angola. Furthermore, in the northern part of its range, *P. kraepelini* is sympatric with a scorpionid, *Opistophthalmus gibbericauda* Lamoral 1979, which has similar substratal requirements, and has been recorded from southern Angola (Lamoral 1979).

Ecology.—*Parabuthus kraepelini* is a semi-psammophilous species, inhabiting consolidated sandy and gritty substrata, where it excavates burrows in open ground and at the base of shrubs and grass tufts. Comb-like rows of long macrosetae (''sand combs'') on the retrolateral margins of the basitarsi of legs I and II indicate a semi-psammophilous ecomorphotype.

Parabuthus kraepelini is syntopic with *P. brevimanus*, *P. granulatus* and *P. villosus* in part of its range. Where they occur in sympatry (e.g., at Hobatere in the Kunene Region of Namibia), *P. kraepelini* is generally found in open sandy habitats, whereas *P. villosus* frequents rocky habitats.

Material examined.—NAMIBIA: *Hardap Region*: Rehoboth District: Farm Kangas 371, 23°36′S 17°03′E, 14.iii.1976, B. Lamoral, 1 subad. ♂ (NMSA 10850). *Kunene Region*: Outjo District: Etosha National Park: Aus [19°15′S 16°15′E], 2–6.iii.1969, B. Lamoral & R. Day, 1 ♀ (NMSA 10022); Gemsbokvlakte, 4.iii.1969, B. Lamoral & R. Day, 2 ♀ (NMSA 10019). *Otjozondjupa Region*: Okahandja District: Okahandja [21°59′S 16°55′E], 24.ix.1994, I. Engelbrecht, 2 ♂, 2 ♀ (SAMC C4605).

Parabuthus kuanyamarum Monard 1937
Figs. 25, 30

Parabuthus kuanyamarum Monard 1937: 258, 259; Forcart 1961: 48; Lamoral & Reynders 1975: 518; Lamoral 1979: 583–586, figs. 95, 140–147; FitzPatrick 1994: 8; Kovařík 1998: 116; Fet & Lowe 2000: 205; Prendini 2001a: 17; Prendini 2001b: 136; Dyason et al. 2002: 769; Prendini 2003: 21.

Type material.—Lectotype ♀ (MNHN) [designated by Lamoral (1979)], ANGOLA: Mupanda [*Cunene Province*: Omupanda, 17°08′S 15°46′E], vii.1933, A. Monard. Paralectotypes: (NHMB 96a), same data as lectotype. Monard's (1937) original description was based on 4 male and 3 female syntypes. Lamoral (1979) discovered one of these in the MNHN collection, which he designated as the lectotype, but noted that the remaining syntypes, formerly in the MHNC, were lost. Lamoral was apparently unaware of the existence of two syntypes in the NHMB (Forcart 1961).

Diagnosis.—*Parabuthus kuanyamarum* is the sister species of *P. distridor*, the two species forming a sister group to the *P. gracilis*–*P. nanus* group (Fig. 1). Both species may be separated from all other species of *Parabuthus* by means of the following combination of characters: small adult size, carapace length 2.5–5.0 mm; surface of median ocular tubercle (male, female) and surrounding surfaces of carapace (female), smooth and shiny; pedipalp chela manus smooth; pedipalp chela with trichobothrium *dt* situated proximal to *et*; metasomal segments slender (length IV/width IV: 1.7–2.11); metasomal segments I–IV, dorsosubmedian and dorsolateral carinae absent; metasomal segments II and III, posteroventral margins not demarcated by a transverse row of granules or tubercles; metasomal segment IV with median lateral, ventrolateral and ventrosubmedian carinae absent; metasomal segments IV and V, lateral intercarinal surfaces smooth; metasomal segment V with dorsosubmedian, dorsolateral and ventromedian carinae absent, but with ventrolateral carinae present, converging distally, and comprising spinose processes subdistally.

Parabuthus kuanyamarum may be separated from *P. distridor* by means of the following characters: pedipalp chela (adult male), fixed and movable fingers strongly curved, such that proximal dentate margin distinctly

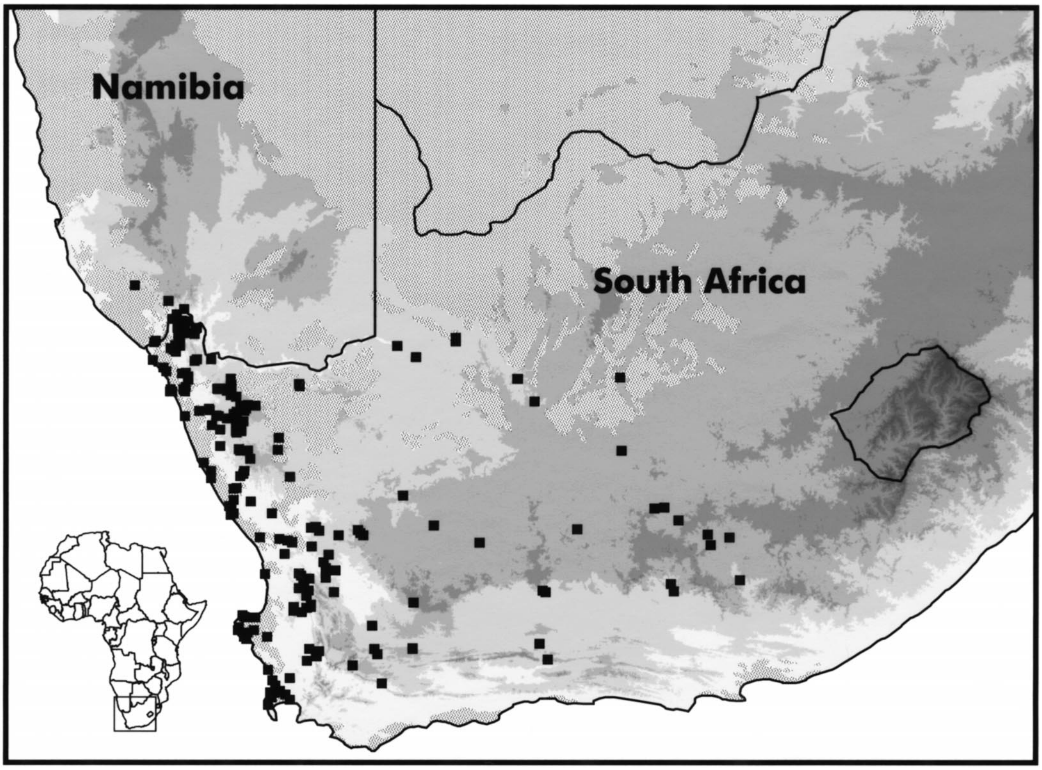


Figure 74.—The known distribution of *Parabuthus capensis* (Ehrenberg 1831) (■), which is endemic to Namibia and South Africa. Contour interval = 500 m. Major sand systems stippled.

emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); metasomal segments I–V and telson, virtually asetose; metasomal segments I–III, median lateral, ventrolateral, and ventrosubmedian carinae present; metasomal segments I and II, dorsal stridulatory surface present.

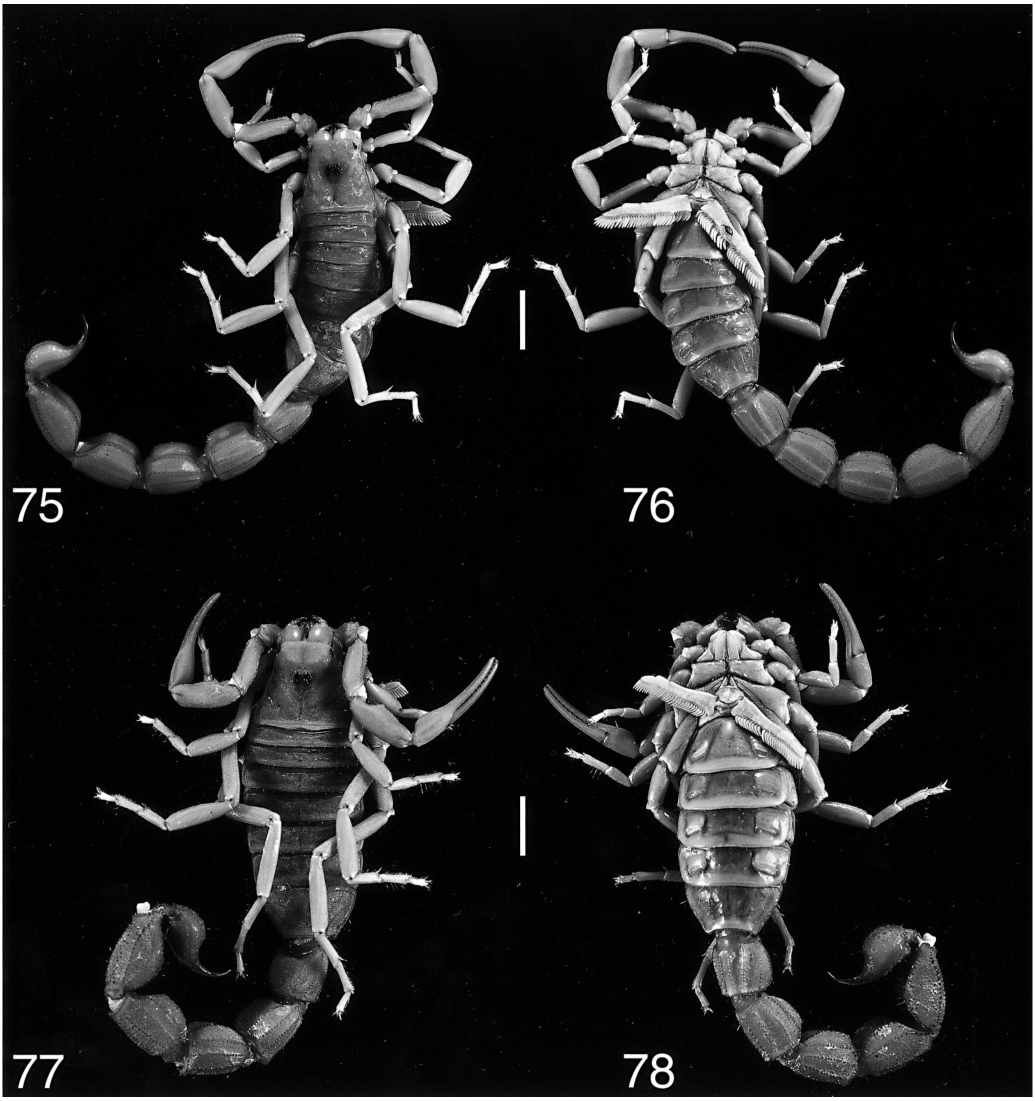
Remarks.—*Parabuthus kuanyamarum* was revised by Lamoral (1979). FitzPatrick (1994) provided additional diagnostic differences between this species and other members of the genus.

Distribution.—Endemic to the Kalahari sand system, with records from Angola, Botswana, Namibia, South Africa, Zambia, and Zimbabwe. Lawrence (1955) omitted *P. kuanyamarum* from his checklist to the scorpions of South Africa and Newlands & Martindale (1980) omitted it from their review of the Zimbabwean buthid fauna. This species has not been recorded south of the Orange River.

Ecology.—*Parabuthus kuanyamarum* is a psammophilous species, which displays several ecomorphological adaptations to its sandy habitat: elongated, unequal telotarsal ungues; basitarsi of legs I and II dorsoventrally compressed, with comb-like rows of long macrosetae (‘‘sand combs’’) on the retrolateral margins; metasoma and telson lacking carinae on segments III−V. Specimens of *P. kuanyamarum* have been found at night with UV light detection, resting on the surface of unconsolidated red sand dunes, and have also been excavated from burrows in the side of sand dunes.

Parabuthus kuanyamarum is syntopic with *P. granulatus* and *P. raudus* throughout its distributional range, and with *P. kalaharicus* and *P. laevifrons* in the southwestern part of its range. Like *P. kalaharicus*, *P. kuanyamarum* inhabits softer sand on the dune crests, whereas *P. granulatus*, *P. laevifrons*, and *P. raudus* are more common in the interdune valleys, where the sand is more compacted.

Parabuthus kuanyamarum is sympatric with *P. brevimanus* on the western periphery of its range (Lamoral 1979), and with *P. mossambicensis* and *P. transvaalicus* on the east-



Figures 75–78.—*Parabuthus planicauda* (Pocock 1889), habitus (dorsal and ventral aspects). 75, 76. ♂ (SAMC C4580). 77, 78. ♀ (SAMC C128). Scale bars = 5 mm.

ern periphery (pers. obs.). However, *P. kuanyamarum* inhabits softer substrata than these species and is rarely syntopic. The species is allopatric with its sister species, *P. distridor*.

Material examined.—BOTSWANA: Ngamiland District: N Khwaai and Lechwee camps, 18°40′S–19°00′S 23°00′E–23°45′E, 16–20.xi.1979, B. Lamoral, 3 ♀ (NMSA 13972). NAMIBIA: *Hardap Region*: Rehoboth District: Farm Ghobab 381, 23°26′S 17°21′E, 12.iii.1976, B. Lamoral, 13 ♂, 1 ♀, 7 juv. (NMSA 10813). SOUTH AFRICA: *Northern Cape Province*: Gordonia District: Kalahari Gemsbok National Park: Mata Mata, 25°53′S 20°01′E, 24.iv.1970, B.H. Lamoral, 1 ♀ (NMSA 10430) [homotype designated by Lamoral (1979)].

Parabuthus laevifrons (Simon 1888)
Figs. 17, 22, 34, 46

Buthus laevifrons Simon 1888: 379, 380.

Parabuthus laevifrons: Kraepelin 1899: 30, 31; Purcell 1901: 151–155; Kraepelin 1908: 251; Hewitt 1912: 301; Kraepelin 1914: 109; Hewitt 1918: 104, 105; Werner 1936: 177; Roewer 1943: 207; Lamoral & Reynders 1975: 518; Lamoral 1979: 586–591, figs. 148–154; Kovařík 1998: 117; Fet

& Lowe 2000: 205; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 21.

Parabuthus ibelli Werner 1916: 84–86 (synonymized by Lamoral 1979: 586); Lampe 1917: 193.

Parabuthus laevifrons australis Hewitt 1918: 105, 177 (synonymized by Lamoral 1979: 586); Lawrence 1955: 227; Lamoral & Reynders 1975: 518.

Parabuthus laevifrons ibelli: Lawrence 1955: 227; Lamoral & Reynders 1975: 519.

Type material.—*Buthus laevifrons:* Holotype ♀ (not ♂) (formerly in the MNHN, now lost). NAMIBIA: ‘‘sud-ouest Afrique’’, 1884–1886, Dr H. Schinz. Neotype ♀ (NMSA 10436) [designated by Lamoral (1979)]. NAMIBIA: Hardap Dam, Mariental [*Hardap Region*: Mariental District: 24°30′S 17°52′E], x.1968, R.F. Lawrence.

Parabuthus ibelli: Syntypes: 1 ♂, 1 ♀ (NHMW 1056–1057). NAMIBIA: Berseba, South West Africa [*Karas Region*: Keetmanshoop District: 25°59′S 17°47′E].

Parabuthus laevifrons australis: Syntypes: SOUTH AFRICA: 1 ♂, 1 ♀ (MMKZ), south of the Orange River [*Northern Cape Province*]; 1 ♂ (MMKZ), Upington [*Northern Cape Province*: Gordonia District: 28°26′S 21°14′E], Miss H. Lennox.

Diagnosis.—*Parabuthus laevifrons* is most closely related to *P. stridulus* (Fig. 1). The two species may be separated from all other species of *Parabuthus* by means of the following combination of characters: surface of median ocular tubercle (male, female) and surrounding surfaces of carapace (female), smooth and shiny; pedipalp chela, asetose; chela manus, smooth and shiny; chela (adult male), fixed and movable fingers strongly curved, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); chela movable finger of female, short, compared with manus (measured along ventroexternal carina), length finger/length carina: ± 1.50; metasomal segments slender (length IV/width IV: 1.7–2.11), virtually asetose; metasomal segments I and II, stridulatory surface extended anteriorly beyond anterodorsal edge of segment, giving a step-like appearance in lateral aspect; metasomal segments IV and V, lateral intercarinal surfaces smooth; metasomal segment IV, median lateral carinae poorly developed; metasomal segment V, dorsosubmedian carinae and dorsolateral carinae absent, but ventrolateral carinae distinct.

Parabuthus laevifrons may be separated from *P. stridulus* by means of the following characters: pedipalp chela fixed finger with trichobothrium *dt* situated proximal to *et*; metasomal segment II dorsal stridulatory surface composed of fine granules; metasomal segments III–V and telson strongly infuscated, contrasting markedly with segments I and II, which are pale in coloration; metasomal segment V, ventrolateral carinae comprising lobate processes subdistally; telson vesicle shallowly excavated along longitudinal half of dorsoproximal surface.

Remarks.—Lawrence (1955) suggested that *P. laevifrons militum* is a junior synonym of *P. ibelli*. Lamoral (1979) revised *P. laevifrons,* and demonstrated that *P. ibelli* and *P. laevifrons australis* are junior synonyms, whereas *P. laevifrons militum* is synonymous with *P. stridulus*.

Distribution.—Endemic to consolidated sandy areas in the Hardap and Karas regions of southern Namibia and the Northern Cape Province (Gordonia, Kenhardt and Namaqualand districts) of South Africa. The distribution of this species extends across the Orange River.

Although no specimens of *P. laevifrons* have yet been recorded from Botswana, the occurrence of a few records from the Kalahari Gemsbok National Park of South Africa (Gordonia District, Northern Cape Province) suggests that this species may also occur in the Kgalagadi District of southwestern Botswana, adjacent to the park. *Parabuthus laevifrons* is largely absent from the Kalahari sand system, only appearing in association with major dry watercourses, e.g., the Auob and Nossob riverbeds.

Ecology.—*Parabuthus laevifrons* is a psammophilous species, which excavates burrows in open ground, at the base of shrubs, grass tufts and shrub coppice dunes. The species displays several ecomorphological adaptations to its sandy habitat: unequal telotarsal ungues; basitarsi of legs I and II dorsoventrally compressed, with comb-like rows of long macrosetae (‘‘sand combs’’) on the retrolateral margins.

Parabuthus laevifrons is syntopic with *P. granulatus*, *P. nanus* and *P. schlechteri* throughout its distributional range and with *P.*

brevimanus, *P. kalaharicus*, *P. kuanyamarum* and *P. raudus* in part of its range. The species is sympatric (but not syntopic) with *P. villosus* in some areas. It is allopatric with its sister species, *P. stridulus*.

Material examined.—NAMIBIA: *Karas Region*: Karasburg District: Farm Ortmansbaum 120, 28°19′S 18°43′E, 26–28.i.1973, B. Lamoral & L. Ferguson, 2 ♂, 1 ♀, 1 juv. ♀ (NMSA 10509). Keetmanshoop District: Tses, dune strip SE, 25°53′S 18°10′E, 23–24.ii.1973, B. Lamoral & K. Porter, 1 ♂, 4 ♀, 2 subad. ♀, 3 juv. ♂, 3 juv. ♀ (NMSA 10521).

Parabuthus mossambicensis (Peters 1861)
Fig. 2

Prionurus mossambicensis Peters 1861: 516.
Parabuthus capensis: Kraepelin 1899: 31.
Parabuthus flavidus Pocock 1899: 419, 420 (synonymized by Kraepelin 1914: 111; Newlands & Martindale 1980: 54, 55); Pocock 1902: 367; Kraepelin 1908: 254, 255, fig. 1b; Hewitt 1912: 300, 301; Hewitt 1918: 108, 178. pl. XXVII, fig. 69; Hewitt 1935: 467; Lawrence 1942: 235; Lawrence 1955: 226; Lamoral & Reynders 1975: 516.
Parabuthus mosambicensis: Kraepelin 1908: 255, 256, fig. 1a; Newlands & Martindale 1980: 54, 55; Kovařík 1998: 117.
Parabuthus truculentus Hirst 1911: 2 (synonymized by FitzPatrick 1994: 8); Loveridge 1925: 306; Bacelar 1950: 5; Lamoral & Reynders 1975: 523; Newlands & Martindale 1980: 58–60, fig. 17.
Parabuthus triradulatus Hewitt 1914: 1, fig. 1 (synonymized by FitzPatrick 1994: 8); Lawrence 1942: 235; Lawrence 1955: 228; Lawrence 1964: 34; Lawrence 1967: 85; Lamoral & Reynders 1975: 523; Aguiar 1978: 108, fig. 1.
Parabuthus mossambicensis: Werner 1916: 83; Lamoral & Reynders 1975: 520; Moritz & Fischer 1980: 319; FitzPatrick 1994: 8–10, fig. 2; Fet & Lowe 2000: 207, 208; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 21.
Parabuthus mossambicus: Bacelar 1950: 5.
Parabuthus scobinifer: Newlands & Martindale 1980: 54, 55.
Parabuthus mossambicensis flavidus: FitzPatrick 1994: 10, 11; Fet & Lowe 2000: 208.
Parabuthus mosambicensis flavidus: Kovařík 1998: 117.
Parabuthus mossambicensis mossambicensis: FitzPatrick 1994: 8–10; Fet & Lowe 2000: 208.

Type material.—*Prionurus mossambicensis:* Holotype 1 subad, ♂ (ZMHB 2305), MOZAMBIQUE: Tette [*Tete Province*: Tete, 16°10′S 33°35′E], W. Peters.

Parabuthus flavidus: Holotype ♀ (BMNH 1897.12.4.2). SOUTH AFRICA: Taungs [Taung, 27°32′S 24°48′E], Bechuanaland [*Northern Cape Province*: Taung District], H.A. Spencer.

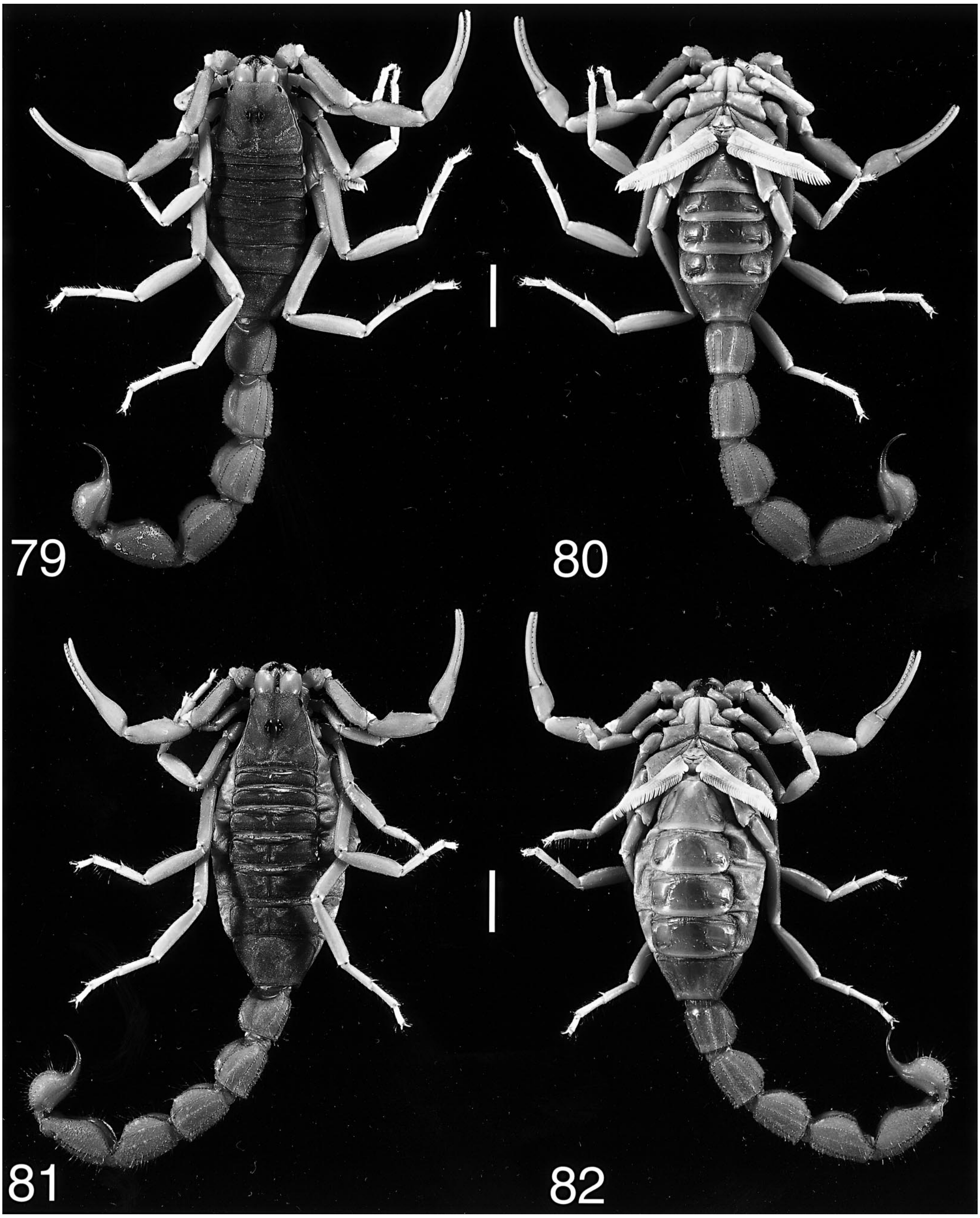
Parabuthus truculentus: Holotype ♀ (BMNH 1911.8.2.1). MOZAMBIQUE: East bank of Loangwa, Portuguese East Africa, 15.vii–1.x.1904.

Parabuthus triradulatus: Syntypes: 1 subad. ♂ [not ♀] (TMSA 1867), 1 ♀ (AMGS), SOUTH AFRICA: Transvaal, N of Soutpansberg, between Sand and Nwanedzi Rivers [*Limpopo Province*: Soutpansberg District], 28.ix.1913, Messrs. Noomé and Roberts. As noted by FitzPatrick (1994), the syntypes of *P. triradulatus* in the TMSA collection have dried out and been rehydrated. They are therefore very brittle.

Diagnosis.—*Parabuthus mossambicensis* is basal to the clade comprising *P. kraepelini*, *P. raudus*, *P. schlechteri*, *P. transvaalicus* and *P. villosus* (Fig. 1). The six species differ from all other species of *Parabuthus* by means of the following combination of characters: metasomal segments broad (length IV/width IV: 1.2–1.5); metasomal segment I, stridulatory surface (dorsal aspect) extended forwards in V-shape onto anterior surface; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules noticeably more pronounced than preceding granules; metasomal segment IV, median lateral carinae continuous and distinct; metasomal segment V, dorsosubmedian carinae distinct, comprising sharp spiniform granules, dorsolateral carinae continuous to distal edge of segment.

Parabuthus mossambicensis may be separated from all species of *Parabuthus* by means of the following combination of characters: pedipalp chela (adult male), fixed and movable fingers straight, such that proximal dentate margin linear when fingers are closed (i.e., no proximal ‘‘gap’’ is evident); metasomal segments I and II, stridulatory surface extended anteriorly beyond anterodorsal edge of segment, giving a step-like appearance in lateral aspect, and composed of transverse ridges, some of which extend right across the surface.

Remarks.—Confusion has surrounded the identity of *P. mossambicensis* since its description more than a century ago. Kraepelin



Figures 79–82.—*Parabuthus planicauda* (Pocock 1889), habitus (dorsal and ventral aspects). 79, 80. ♂ (SAMC C4575). 81, 82. ♀ (SAMC C4575). Scale bars = 5 mm.

(1891) first listed the species in synonymy with *P. leiosoma* (as *Heterobuthus liosoma*) but subsequently (Kraepelin 1899) listed it (as *Buthus mosambicensis*) in synonymy with *P. capensis*. Kraepelin (1908) later regarded *P. mossambicensis* as a distinctive species, and mentioned an apparent similarity to *P. planicauda*. However, Purcell (1901), who regarded *P. planicauda* as a junior synonym of *P. capensis* (discussed above), doubted that *P. mossambicensis,* collected at Tete (Mozambique), could be synonymous with *P. capen-*

sis, an opinion later supported by Lamoral & Reynders (1975).

Pocock (1899) described *P. flavidus*, from Taung (Northern Cape Province, South Africa), which he believed to be allied to *P. capensis*. However, Purcell (1901) considered *P. flavidus* more closely related to *P. raudus* and *P. schlechteri*. One year later, Werner (1902) described *P. kraepelini*, from Windhoek (Namibia). Kraepelin (1908) then erroneously listed *P. kraepelini* in synonymy with *P. flavidus* (discussed above), an error compounded by his fig. 1, demonstrating the dorsal stridulatory surfaces of metasomal segments I and II in *P. mossambicensis* and *P. flavidus*, which he treated as distinct species. Kraepelin's (1908) fig. 1 was a source of great confusion in the literature because, whereas his diagram of *P. mossambicensis* (fig. 1a) was based on Peters' holotype, his diagram of *P. flavidus* (fig. 1b) was based on a nontype specimen of *P. kraepelini*. Hewitt (1912) commented on the discrepancy, noting that Kraepelin had recorded *P. flavidus* from Windhoek, but that his figure appeared to refer to another species (viz. *P. kraepelini*), whereas his figure of *P. mossambicensis* was barely distinguishable from the true *P. flavidus* suggesting, as also suggested by Hirst (1911), that *P. flavidus* and *P. mossambicensis* are synonymous. Hewitt (1918) provided a diagram (Text-Fig. 1) of the stridulatory surfaces on metasomal segments I and II in a specimen of *P. kraepelini* from Heichamchab (Namibia), demonstrating the similarity to Kraepelin's (1908) fig. 1b.

Kraepelin (1908) had evidently suspected that *P. flavidus* was a junior synonym of *P. mossambicensis* as he commented on the close similarity between them and, to a lesser extent, *P. planicauda*. However, although Newlands & Martindale (1980) credited Kraepelin (1908) for the synonymy of *P. flavidus* with *P. mossambicensis*, it was not until later that Kraepelin (1914) officially listed *P. flavidus* in synonymy. It does not appear that Kraepelin ever actually examined the type specimen of *P. flavidus* from the BMNH.

Kraepelin's (1908, 1914) synonymy of *P. flavidus* with *P. mossambicensis* was accepted by some authors (e.g., Hirst 1911; Werner 1916), but not others (e.g., Hewitt 1913, 1914, 1915, 1918, 1935; Lawrence 1942). For example, Kraepelin's (1908) erroneous synonymy of *P. kraepelini* discouraged Hewitt (1918) from accepting the synonymy of *P. flavidus* until more material from Tete was available.

During this period, two more species, *P. truculentus* and *P. triradulatus*, distinguished from each other, and from *P. mossambicensis* and *P. flavidus*, only by the stridulatory surface (Hirst 1911; Hewitt 1914), were described from the region between the type localities of the latter species. According to Hewitt (1914), *P. triradulatus* belongs to the group including *P. flavidus*, *P. truculentus* and perhaps *P. mossambicensis*, but differs from these based on the ridged stridulatory surface of the last mesosomal tergite. Hewitt (1918) maintained that *P. triradulatus* is closely related to, or conspecific with, *P. truculentus*, and further suggested that both might be synonymous with *P. mossambicensis*. Hewitt (1918) examined the type of *P. truculentus* and noted that the median portion of the last tergite is coarsely granular, and that the medial granules in the posterior third of the tergite are transversely elongated into short stout ridges, although none stretch across even half the breadth of the surface, as in *P. triradulatus*. Hewitt (1918) also noted that the four carinae of the last sternite are more strongly developed than in *P. triradulatus*, but suggested that this may be because the type of *P. triradulatus* is subadult.

Thirty years later, when Lawrence's (1955) key and checklist to the South African scorpions was published, *P. flavidus* and *P. triradulatus* were included, whereas *P. mossambicensis* and *P. truculentus* were omitted, perhaps because they were extralimital. Furthermore, Lawrence (1955) made no mention of the discussion raised by Kraepelin (1908, 1914), Hirst (1911), or Hewitt (1914, 1918). More recently, Lamoral & Reynders (1975) listed all four species as valid, noting the arguments of Kraepelin (1908) and Hewitt (1918), but omitting to mention Kraepelin's (1914) synonymy of *P. flavidus* with *P. mossambicensis*.

Newlands & Martindale (1980) subsequently revised the Zimbabwean buthid scorpions, returning *P. flavidus* to synonymy with *P. mossambicensis*, and listing yet another species, *P. scobinifer*, as a new synonym of the latter. Newlands & Martindale (1980) did not examine the type of *P. mossambicensis*, but accepted Kraepelin's opinion based on an examination of nontype material from Mozambique. The types of *P. scobinifer* and *P. flavidus* were compared in the BMNH and deemed conspecific by Newlands & Martindale (1980). Apparently, the only difference between them was the relative area covered by the stridulatory surface of metasomal segment II, which did not quite reach the posterior margin in *P. scobinifer* but did so in *P. flavidus*. The type of *P. flavidus* came from Taung (Northern Cape Province, South Africa) whereas the type of *P. scobinifer* was collected in ''N.W. Rhodesia'' [N.W. Zimbabwe, not Zambia as stated by Newlands & Martindale (1980)]. According to Newlands & Martindale (1980), the stridulatory surface of several *Parabuthus* species varies with geographical location and this single character cannot be considered sufficient grounds for specific status.

Newlands & Martindale (1980) also synonymized *P. triradulatus* with *P. truculentus*, after a comparison of the types revealed no meaningful morphological differences which could justify the validity of *P. triradulatus*. However, the failure of Newlands & Martindale (1980) to synonymize *P. truculentus* and *P. triradulatus* with *P. mossambicensis* contradicts their justification for synonymizing *P. flavidus* and *P. scobinifer* with the latter. According to these authors, the only consistent character distinguishing *P. truculentus* is the stridulatory surface of metasomal segment I, which is composed of distinct transverse ridges compared with the broadened granules seen in *P. mossambicensis*. However, FitzPatrick (1994) recently examined some of the specimens examined by Newlands & Martindale (1980) and found none with broadened granules but only ridges.

FitzPatrick (1994) set out to clarify the status of *P. flavidus*, *P. mossambicensis*, *P. scobinifer*, *P. triradulatus* and *P. truculentus* anew by means of a comparison of the types and a large number of additional specimens, the localities of which were mapped to determine whether there was any geographic pattern to the variation. FitzPatrick (1994) demonstrated that *P. scobinifer* is actually a junior synonym of *P. raudus* (discussed below), and that *P. truculentus* and *P. triradulatus* are junior synonyms of *P. mossambicensis*. FitzPatrick (1994) observed an increase in metasomal length and granulation from northeast to southwest in the distributional range she mapped from the locality records, but noted that intraspecific variation in scorpion tail length and granulation are known to occur (Lamoral 1979; Harington 1984). According to FitzPatrick (1994), the holotypes of *P. mossambicensis*, *P. truculentus*, and *P. triradulatus*, all of which originate from northeast in the distributional range, are identical morphologically, demonstrating short ridges on tergite VII, and metasomal segments IV and V that are slightly longer and less granular than in specimens from southwest in the distributional range. FitzPatrick (1994) concluded that they are conspecific and should therefore be synonymized.

Rather than following Newlands & Martindale (1980) in retaining *P. flavidus* as a junior synonym of *P. mossambicensis*, FitzPatrick (1994) provided subspecific status for *P. flavidus*. FitzPatrick (1994) offered no substantial reasons for this decision, which was supported by the following arguments: (1) The holotype of *P. flavidus* is juvenile, (2) The type locality of *P. flavidus* is located southwest in the distributional range, (3) Trichobothrial patterns are the same in all four holotypes (*P. flavidus*, *P. mossambicensis*, *P. triradulatus* and *P. truculentus*) and in nontype specimens from both regions, (4) Haemolymph electrophoresis could be used to confirm the specific status of specimens from the southwestern region, (5) *Parabuthus flavidus* should be regarded as a subspecies of *P. mossambicensis* until this is performed.

It is unclear as to why, in the absence of consistent morphological differences, FitzPatrick (1994) rejected Kraepelin's (1914) synonymy of *P. flavidus*, later adopted by Newlands & Martindale (1980). FitzPatrick (1994) erroneously stated that this was the first time the type of *P. mossambicensis* had been re-examined since Peters (1861) described it. According to FitzPatrick (1994), Kraepelin (1908) claimed to have examined the type but erroneously stated that the dorsal carina of metasomal segment V is present throughout its length, published diagrams to show this, and synonymized *P. flavidus* with *P. mossambicensis* on this basis. But it is evident, from the above discussion, that Kraepelin (1908) did indeed examine the type of *P. mossambicensis*, and thus came to the correct conclusion, although his formal synonymy of *P. flavidus* with *P. mossambicensis* only appeared later (Kraepelin 1914). Contrary to FitzPatrick's (1994) assertion, Kraepelin's (1908) fig. 1 shows metasomal segments I and II, not V.

Given the evidence presented here, it is clear that no morphological character or combination thereof can be used to separate *P. flavidus*, *P. mossambicensis*, *P. triradulatus* and *P. truculentus*. Neither an appeal for unavailable electrophoretic evidence, nor the arbitrary partitioning of continuous variation across the distributional range of a widespread, polymorphic species, can justify retaining FitzPatrick's (1994) putative subspecies distinction between *P. mossambicensis mossambicensis* and *P. mossambicensis flavidus*. Moreover, providing subspecific status for *P. flavidus*, while placing *P. truculentus* and *P. triradulatus* in synonymy, is logically inconsistent. Accordingly, *P. flavidus* is returned to synonymy with *P. mossambicensis*.

Distribution.—Recorded from east of the Kalahari sand system in Botswana, Mozambique, South Africa, Zambia, and Zimbabwe. This species has not been recorded south of the Orange River.

Ecology.—*Parabuthus mossambicensis* is a semi-psammophilous species, inhabiting semi-consolidated to consolidated sandy and gritty substrata, where it excavates burrows in open ground and at the base of shrubs. Comb-like rows of long macrosetae (''sand combs'') on the retrolateral margins of the basitarsi of legs I and II indicate a semi-psammophilous ecomorphotype.

Parabuthus mossambicensis is syntopic with *P. transvaalicus* throughout its range and with *P. granulatus* and *P. kuanyamarum* in part of its range. Where they occur in sympatry (e.g., at Rochdale in the Limpopo Province of South Africa), *P. mossambicensis* is generally found in open sandy habitats, whereas *P. transvaalicus* frequents rocky habitats.

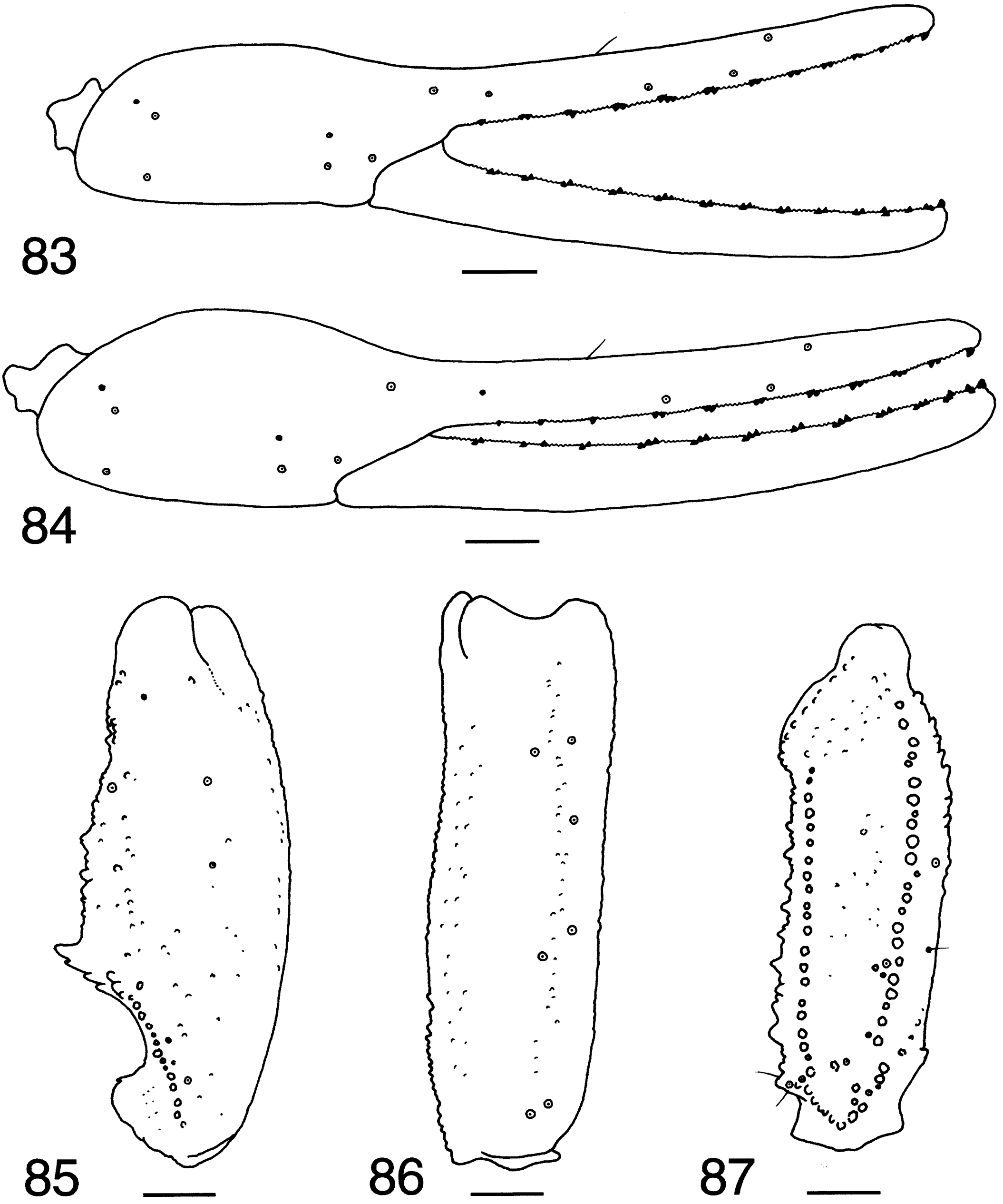
Conservation.—The international trade in exotic pets poses a small, but ever-increasing threat to the future survival of *Parabuthus* species, which have recently become extremely popular among amateur enthusiasts. Two southern African species, *P. mossambicensis* (the ''Mozambique fat-tailed'' scorpion) and *P. transvaalicus* (the ''S.A. giant fat-tailed'' scorpion), allegedly imported from Mozambique, are commonly available in Europe, the U.S.A. and Japan. The increasing appearance of such species in international collections is a matter of concern, given the frequency with which invertebrates are being smuggled illegally, along with insects and reptiles, out of southern African countries (A.L. de Villers, K. de Wet, M. Forsyth, P. Geldenhuys, A. Leroy, R. Stals, pers. comm.). The presence in the international pet trade of scorpions that originated from South Africa has always been difficult to verify given the fact that the distributional ranges of most species traded extend beyond South African borders, and dealers usually cite neighboring states with relaxed collecting and export regulations (e.g., Mozambique) as the source of specimens. As with most other scorpions imported into the pet trade, species of *Parabuthus* are not CITES-listed and there is little or no regulation on their harvesting from the wild, a situation that is clearly inadequate for safe-guarding their future survival.

Material examined.—''Kalahari Desert'', R.J. Cunningham, 1 ♂ [not type as stated on label] (BMNH 1894.5.3.3). MOZAMBIQUE: *Sofala Province*: Gorongoza [18°41′S 34°19′E], 22.ii.1971, G. Vasse, 1 ♂ (NMSA 10088). SOUTH AFRICA: *Limpopo Province*: Messina District: Messina Nature Reserve [22°22′S 30°03′E], xii.1993, L. Prendini & K.M.A. Prendini, 1 ♂ (SAMC C4606). Soutpansberg District: Farm Rochdale 700 [22°54′S 29°42′E], i.1996, L. Prendini & J. Laing, 3 ♂ (SAMC C4607); Waterpoort [22°54′S 29°37′E], i.1996, L. Prendini & J. Laing, 3 ♀ (SAMC C4608).

Parabuthus muelleri Prendini 2000
Figs. 36, 41

Parabuthus muelleri Prendini 2000: 32–38, figs. 1–9, table 2; Prendini 2001a: 17; Prendini 2001b: 137; Prendini 2003: 5, 7, 9–16, 21, figs. 2–14, table 4.

Type material.—Holotype ♀ (NMNW 1854), NAMIBIA: *Hardap Region*: Maltahöhe District, Farm Onis 8, 82 km from Sesriem to Naukluft, 24°22.46′S 16°13.17′E, 1260 m, 7.i.1998, L. Prendini & E. Scott. Paratype ♀ (SAMC C4514), NAMIBIA: Karas Region: *Lüderitz District*: Farm Plateau 38, near Aus, 26°40.62′S 16°31.85′E, 1550 m, 30.xii.1997, L. Prendini & E. Scott.



Figures 83–87.—*Parabuthus planicauda* (Pocock 1889), dextral pedipalp segments, illustrating shape, granulation and trichobothrial distribution. 83. ♂ (SAMC C4573). 84–87. ♀ (SAMC C4573), 83, 84. Chela, dorsal aspect. 85. Patella, dorsal aspect. 86. Patella, external aspect. 87. Femur, dorsal aspect. Scale bars = 1 mm.

Diagnosis.—*Parabuthus muelleri* is part of a group of species that also includes *P. calvus*, *P. capensis*, *P. pallidus* and *P. planicauda* (Fig. 1), but is morphologically most similar to *P. capensis*, with which it shares the following combination of characters: metasomal segments I and II, stridulatory surface extended anteriorly beyond anterodorsal edge of segment, giving a step-like appearance in lateral aspect; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules more pronounced than preceding granules; metasomal segment IV, dorsosubmedian carinae medially discontinuous, median lateral carinae continuous and distinct; metasomal segment V, dorsosubmedian carinae distinct, comprising sharp spiniform or subspiniform granules, dorsolateral carinae distally obsolete.

Parabuthus muelleri and *P. capensis* may be separated from all other *Parabuthus* on the basis of the following character: metasomal segment II, and to a lesser extent III, with posterodorsal edge elevated and slightly curved forward medially, forming a subtriangular V-shape. *Parabuthus muelleri* may be separated from *P. capensis* by the following characters: pedipalp chela, movable finger curved ventrally, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); metasomal segment I wider than segment IV; telson with distal ‘‘bulge’’ and a very short, sharply curved aculeus; pedipalp chela manus of adult male, slender as in adult female; proximal median lamella of pectines in male, lobate.

Distribution.—Endemic to Namibia (Lüderitz and Maltahöhe districts). This species has not been recorded south of the Orange River. It is known from only three specimens.

Ecology.—The only specimens of *P. muelleri* for which ecological data are available were collected in a region of compacted, chalky soil, calcrete nodes and dolomite rocks. The holotype was excavated from the burrow of a scorpionid, *Opistophthalmus opinatus* (Simon 1888), under a stone, whereas the paratype was found sitting on a stone at night. The paratype was syntopic with *P. granulatus* and *P. villosus* at Plateau.

Material examined.—NAMIBIA: *Karas Region*: Lüderitz District: Locality uncertain, probably Aus [26°41′S 16°15′E], A. Harington, 1 ♂ (AMNH [AH 3991]).

Parabuthus namibensis Lamoral 1979
Figs. 20, 23

Parabuthus namibensis Lamoral 1979: 591–594, figs. 155–163; Kovařík 1998: 117; Fet & Lowe 2000: 208; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 21.

Type material.—Holotype ♀ (NMSA 10822), NAMIBIA: 5 km N of Cape Cross, Skeleton Coast [*Erongo Region*: Swakopmund District], 21°43′S 13°56′E, 25.iii.1976, B.H. Lamoral. Paratypes: NAMIBIA: 1 ♂ (NMSA 10822), same data as holotype; 1 ♂ (TMSA 9787), Gobabeb [*Erongo Region*: Swakopmund District: Namib-Naukluft Park], 23°34′S 15°03′E; 1 subad. ♂ (TMSA 11086), 32 km from Gobabeb on way to Mirabib [*Erongo Region*: Swakopmund District: Namib-Naukluft Park], 23°02′S 15°02′E, S. Endrödy-Younga.

Diagnosis.—*Parabuthus namibensis* is most closely related to the *P. laevifrons*–*P. stridulus* group (Fig. 1). The three species may be separated from all other species of *Parabuthus* by means of the following combination of characters: surface of median ocular tubercle (male, female) and surrounding surfaces of carapace (female), smooth and shiny; chela (adult male), fixed and movable fingers strongly curved, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); metasomal segments slender (length IV/width IV: 1.7–2.11); metasomal segments I and II, stridulatory surface extended anteriorly beyond anterodorsal edge of segment, giving a step-like appearance in lateral aspect; metasomal segment IV, median lateral carinae poorly developed; metasomal segment V, dorsolateral carinae absent to distally obsolete, ventrolateral carinae distinct.

Parabuthus namibensis may be separated from *P. laevifrons* and *P. stridulus* by means of the following characters: pedipalp chela covered in setae; pedipalp chela fixed finger with trichobothrium *dt* situated distal to *et*; chela movable finger of female, long, compared with manus (measured along ventroexternal carina), length finger/length carina: 1.70–2.00; metasomal segments I–V and telson moderately setose; metasomal segments IV and V, lateral intercarinal surfaces granular; metasomal segment V, dorsosubmedian carinae poorly developed and comprising blunt, rounded granules.

The following additional characters separate *P. namibensis* from *P. stridulus*, the distributional ranges of which overlap in the central and northern Namib: metasomal segment II, stridulatory surface composed of fine granules; metasomal segments III–V and telson strongly infuscated, contrasting markedly with segments I and II, which are pale in coloration; ventrolateral carinae comprising lobate processes subdistally; telson vesicle very shallowly excavated along longitudinal half of dorsoproximal surface.

Distribution.—Endemic to gravel plains in the central and northern Namib, north of the Kuiseb River (Swakopmund and Walvis Bay districts of northwestern Namibia).

Ecology.—*Parabuthus namibensis* is a semi-psammophilous species, inhabiting semi-consolidated to consolidated sandy and gritty substrata (gravel plains of the central Namib), where it presumably excavates burrows in open ground and at the base of shrubs. All specimens collected to date were either captured in pitfall traps or at night by means of UV light detection. Comb-like rows of long macrosetae (‘‘sand combs’’) on the retrolateral margins of the basitarsi of legs I and II indicate a semi-psammophilous ecomorphotype.

Parabuthus namibensis is syntopic with *P. gracilis* and *P. stridulus* in part of its range. It is also sympatric (and possibly syntopic) with *P. brevimanus* in part of its range.

Material examined.—NAMIBIA: *Erongo Region*: Swakopmund District: Rössing, Lower Ostrich Gorge, 22°30′S 14°58′E, 8.v–5.vi.1984, E. Griffin, 1 ♀, 1 juv. ♂ (NMNW 845), 2–3.xi.1985, J. Irish & H. Rust, 1 ♂ (NMNW 896).

Parabuthus nanus Lamoral 1979
Figs. 13, 44, 45

Parabuthus nanus Lamoral 1979: 594–597, figs. 100–102, 105, 106, 164–172; Kovařík 1998: 117; Fet & Lowe 2000: 208; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 21.

Type material.—Holotype ♀ (NMSA 10926), NAMIBIA: Farm Noachabeb 97 [*Karas Region*: Keetmanshoop District], 27°24′S 18°30′E, 6.ii.1973, B.H. Lamoral. Paratypes: NAMIBIA: 1 ♂ (NMSA 10926), 2 ♂ (NMSA 10927), same data as holotype; 1 ♂, 1 subad. ♀, 1 juv. ♂ (NMSA 10698), same data as holotype, except 8.ii.1973; 1 ♂ (NMSA 10701), Farm Belda 361 [*Karas Region*: Karasburg District], 28°27′S 18°01′E, 1.ii.1973, B.H. Lamoral; 1 ♂, 1 ♀, 2 subad. ♂ (NMSA 10702), same data except 28.i.1973; 1 ♀ (NMSA 10699), Farm Louwshoop 330 [*Karas Region*: Karasburg District], 28°07′S 18°07′E, 3.ii.1973, B.H. Lamoral; 1 ♂, 1 ♀ (NMSA 10772), Farm Tsirub 13 [*Karas Region*: Lüderitz District: Diamond Area I], 26°52′S 16°02′E, 3.iii.1976, B.H. Lamoral. SOUTH AFRICA: 1 ♂ (NMSA 10703), Goodhouse (*Northern Cape Province*: Namaqualand District), 29°00′S 18°13′E, 29–31.i.1973, B.H. Lamoral; 1 ♀ (NMSA 10700), same data except 30.i.1973.

Diagnosis.—*Parabuthus nanus* is most closely related to *P. gracilis*, the two species forming a sister group to the *P. distridor*–*P. kuanyamarum* group (Fig. 1). *Parabuthus nanus* may be separated from all other species of *Parabuthus*, except *P. gracilis*, by means of the following combination of characters: small adult size, carapace length 2.5–5.0 mm; carapace, including median ocular tubercle (male, female), entirely granular; pedipalp chela manus granular; pedipalp chela with trichobothrium *dt* situated proximal to *et*; metasomal segments slender (length IV/width IV: 1.7–2.11); metasomal segments I–IV, dorsosubmedian and dorsolateral carinae absent; metasomal segments II and III, posteroventral margins demarcated by a transverse row of isolated, round granules; metasomal segment IV with median lateral, ventrolateral and ventrosubmedian carinae absent; metasomal segments IV and V, lateral intercarinal surfaces granular; metasomal segment V with dorsosubmedian, dorsolateral and ventromedian carinae absent, but with ventrolateral carinae present, converging distally, and comprising spinose processes subdistally.

Parabuthus nanus is the smallest species of *Parabuthus*. In addition to its smaller size, *P. nanus* may be separated from *P. gracilis* by both of the following characters: chela movable finger of female, long, compared with manus (measured along ventroexternal carina), length finger/length carina: 1.70–2.00; manus of adult male, slender as in adult female.

Distribution.—Endemic to sandy areas in the Karas Region of southern Namibia and the Northern Cape Province (Namaqualand District) of South Africa. The distribution of this species extends across the Orange River.

Ecology.—*Parabuthus nanus* is a psammophilous species, which displays several ecomorphological adaptations to its sandy habitat: elongated telotarsal ungues; basitarsi of legs I and II dorsoventrally compressed, with comb-like rows of long macrosetae (‘‘sand combs’’) on the retrolateral margins; metasoma and telson lacking carinae on segments III−V. Specimens of *P. nanus* have been found at night with UV light detection, resting on the surface of unconsolidated sand dunes, and have been excavated from burrows at the base of shrubs.

Parabuthus nanus is syntopic with *P. granulatus*, *P. laevifrons*, and *P. schlechteri* throughout its distributional range. *Parabuthus nanus* is sympatric with *P. brevimanus* in part of its range, e.g., at Aggeneys in the Northern Cape Province of South Africa (pers. obs.) and Noachabeb in the Karas Region of Namibia (Lamoral 1979), but these species are not syntopic: *P. nanus* inhabits softer substrata than *P. brevimanus*. The species is allopatric with its sister species, *P. gracilis*.

Material examined.—NAMIBIA: *Karas Region*: Lüderitz District, Diamond Area II: Awasib [25°23′S 15°39′E, 26.ii.1981, G. Newlands, 1 ♂ (AMNH [AH 4345]).

Parabuthus planicauda (Pocock 1889)
Figs. 75–88, Table 1

Buthus planicauda Pocock 1889: 344–346, pl. XV, fig. 5.

Parabuthus planicauda: Pocock 1895: 309; Pocock 1902: 365, 366; Hewitt 1912: 302; Hewitt 1918: 104, 178, pl. XXI, fig. 31; Pavlovsky 1924: 77; Pavlovsky 1925: 140; Lawrence 1946: 399; Lawrence 1955: 227; Lamoral & Reynders 1975: 521; Eastwood 1978b: 251, 252; Kovařík 1998: 117; Fet & Lowe 2000: 209; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 21.

Parabuthus capensis: Purcell 1901: 143–147.

Parabuthus capensis frenchi Purcell 1901: 148 (NEW SYNONYMY); Pocock 1902: 366.

Parabuthus planicauda frenchi: Hewitt 1918: 104, 178, pl. XXI, fig. 32; Lawrence 1955: 227; Lamoral & Reynders 1975: 521; Kovařík 1998: 117; Fet & Lowe 2000: 209.

Parabuthus planicauda planicauda: Fet & Lowe 2000: 209.

Type material.—*Buthus planicauda:* Lectotype ♀ (BMNH 1870.26), SOUTH AFRICA: Dr Quain. In the original description, Pocock (1889) listed five specimens, but did not state whether these were syntypes, or one was a holotype: 2 ♂ (BMNH), ''West Africa'' [erroneous]; 2 ♀ (BMNH), South Africa, Dr Quain & Dr Smith; 1 ♀ (BMNH), locality unknown, presented by Capt. Belcher, R.N. Subsequently, Pocock (1902) realized that two of these specimens, i.e., the two males labelled ''W. Africa'' that he originally referred to as *P. planicauda*, were conspecific with *P. neglectus* (itself a junior synonym of *P. capensis*). Pocock (1901) then specified a holotype for *P. planicauda*, i.e., the female specimen measured and described in the original description. According to the description, measurements were based on the largest specimen (Pocock 1889), but it is not known whether that specimen was one of the pair collected by Dr Quain & Dr Smith, or the single specimen presented by Capt. Belcher. Of these syntypes, only a single female (BMNH 1870.26), labelled ''South Africa, Dr Quain'', remains (J. Margerison, pers. comm.). This specimen is hereby designated as the lectotype of *P. planicauda*.

Parabuthus capensis frenchi: Syntypes: 1 ♂, 4 ♀ (SAMC 5207). SOUTH AFRICA: Graaff-Reinet, Cape Province (*Eastern Cape Province*: Graaff-Reinet District: 32°16′S 24°33′E), G. French; 1 juv. (SAMC) (lost, M. Cochrane, pers. comm.), Graaff-Reinet, C.L. Leipoldt.

Diagnosis.—*Parabuthus planicauda* is closely related to *P. calvus* (Fig. 1), with which it shares the following combination of characters: pedipalp chela manus of adult male, slender as in adult female; proximal median lamella of pectines in male, lobate; metasomal segments broad (length IV/width IV: 1.2–1.5); basitarsi of legs I and II, macrosetal combs weakly developed; metasomal segments I and II, stridulatory surface extended anteriorly beyond anterodorsal edge of segment, giving a step-like appearance in lateral aspect; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules noticeably more pronounced than preceding granules; metasomal segment IV, dorsosubmedian carinae medially discontinuous; metasomal segment V, dorsosubmedian carinae poorly developed and comprising blunt, rounded granules, dorsolateral carinae distally obsolete.

Parabuthus planicauda may be separated from *P. calvus* on the basis of the following combination of characters: surface of median ocular tubercle (male, female), surrounding surfaces of carapace (female) and lateral intercarinal surfaces of metasomal segments IV and V, granular; pedipalp chela manus, metasomal segments I–V and telson setose; proximal median lamella of pectines in male, weakly lobate; basitarsi of legs III and IV, prolateral surfaces without dense tufts of macrosetae; metasomal segment IV, median lateral, ventrosubmedian and ventrolateral carinae present; metasomal segment V, ventromedian carina present.

Parabuthus planicauda is commonly misidentified as *P. capensis*, a species of similar size and coloration, the distributional range of which overlaps in the Eastern, Northern and Western Cape provinces of South Africa. Both species share the following combination of characters: metasomal segments broad (length IV/width IV: 1.2–1.5); metasomal segments I and II, stridulatory surface extended anteriorly beyond anterodorsal edge of segment, giving a step-like appearance in lateral aspect; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules noticeably more pronounced than preceding granules; metasomal segment IV, dorsosubmedian carinae medially discontinuous, median lateral carinae continuous and distinct; metasomal segment V, dorsolateral carinae distally obsolete. *Parabuthus planicauda* can be readily separated from *P. capensis* on the basis of the following character: metasomal segments II and III, posterodorsal edge straight, not elevated and curved forward medially into a subtriangular V-shape.

Redescription.—The following description is based on the lectotype female (BMNH 1870.26), several specimens of the typical form (SAMC C118, C4580), the syntypes of *P. planicauda frenchi* (SAMC 5207), and several other specimens that could be assigned to the latter subspecies (SAMC C128, C4573, C4575).

Color: (based on SAMC C4575 and C4580): Carapace, metasoma and telson: Buff-Yellow No. 53 to Yellow Ocher No. 123C. Chelicerae, pedipalps, legs and sternites: Cream Color No. 54 to Chamois No. 123D. Tergites: Clay Color No. 123B to Cinnamon No. 39. Pectines: Pale Horn Color No. 92. Pedipalps, legs, chelicerae, metasoma and telson are slightly paler than carapace and tergites, but metasomal segments and telson are uniformly shaded (Figs. 75–82).

Carapace: As for *P. calvus*, except as follows. Carapace covered entirely by uniform, coarse granulation, becoming coarser on interocular and posterolateral surfaces. Anterior margin of carapace straight or slightly procurved; posterior margin straight (Figs. 75, 77, 79, 81).

Chelicerae: As for *P. calvus*.

Sternum: As for *P. calvus* (Figs. 76, 78, 80, 82).

Pedipalps: As for *P. calvus*, except as follows. Pedipalps covered in short macrosetae (Figs. 75–82). Femur dorsal, internal and dorsoexternal surfaces finely and uniformly granular, ventroexternal surface finely granular (male) to smooth (female) (Fig. 87); pentacarinate, all carinae distinct, granular, except for internomedian carina, comprising spiniform granules. Patella finely and uniformly granular; carinae absent or obsolete (Figs. 85, 86); dorsointernal and ventrointernal carinae each comprising row of granules proximally; internomedian carina comprising large spiniform granule, proximally, and few smaller granules, distally. Chela smooth (Figs. 83, 84); carinae absent. Chela long, slender (male, female), length along ventroexternal carina 42–47% (male) or 38–39% (female) greater than chela width and 44–49% (male) or 41–42% (female) greater than chela height (Table 1); length of movable finger 51–55% (male) to 53–56% (female) greater than length along ventroexternal carina. Chela fixed and movable fingers straight, such that proximal dentate margin linear when fingers closed (Figs. 83, 84).

Trichobothria: As for *P. calvus*, except as follows (Figs. 83–87). Patella with esb_2 distal to esb_1.

Mesosoma: As for *P. calvus*, except as follows. Pre-tergites smooth and shiny, granular along posterior margins. Post-tergites entirely coarsely granular, granulation becoming coarser distally; I–VII each with weakly developed, granular median carina. Sternites entirely smooth, except for posterolateral surfaces of sternite VII, which are sparsely granular; lateral and distal margins each with sparse row of macrosetae; sternite VII with weakly developed pairs of costate ventrosubmedian and ventrolateral carinae (Figs. 76, 78, 80, 82).

Pectines: First proximal median lamella of each pecten suboval, mesally enlarged, lobate in female and, very slightly, in male (Figs. 76, 78, 80, 82). Pectinal teeth: 34–40/34–40 (male), 31–34/31–35 (female).

Genital operculum: As for *P. calvus*.

Legs: As for *P. calvus*, except as follows.

Basitarsi III and IV, prolateral surfaces without dense tufts of macrosetae.

Metasoma and telson: Metasomal segments I–V width/length ratio progressively decreasing (Table 1), width percentage of length 75–76% (male) to 85–87% (female) for I, 75–78% (male) to 77–83% (female) for II, 73–76% (male) to 74–82% (female) for III, 64–65% (male) to 65–72% (female) for IV, and 51–54% (male) to 51–56% (female) for V. Telson oval, globose, height 54–60% (male) to 63–65% (female) of length, with flattened dorsal surface, rounded ventral surface; vesicle not distinctly narrower than metasomal segment V, width 78–79% (male) to 80–86% (female) of metasomal segment V. Metasoma entirely granular, except for dorsomedian surfaces of IV, V and telson, or V and telson. Metasomal segments I–III each with well-developed dorsal stridulatory surface, consisting of fine round to slightly crescent-shaped granules, which may or may not extend to posterior margin of segment II (Figs. 75, 79); stridulatory surface of segment III narrower and less developed than on preceding segments; segments II and III with posterodorsal edge straight (Figs. 75, 79). Metasoma sparsely covered with short macrosetae, especially on ventral surface of telson (Figs. 75–82). Metasomal segments I–IV each with ten carinae; segment IV with ventrosubmedian and median lateral carinae becoming obsolete distally; segment V with seven carinae, including single, obsolete granular ventromedian carina, pair of distinct ventrolateral carinae, pair of dorsolateral carinae, distinct only in proximal half of segment, and pair of dorsosubmedian carinae reduced to few prominent rounded granules medially. Metasomal segments I–V with dorsosubmedian carinae converging distally in segment I, subparallel in segments II–V; ventrolateral carinae converging distally in segments I–IV, subparallel in segment V. All metasomal carinae costate granular to granular, except for ventrosubmedian and ventrolateral carinae of segment I, which are costate to costate granular. Metasomal segments I–IV with distal granules of dorsosubmedian carinae slightly enlarged; segments II and III with distal granules of ventrosubmedian carinae and, to lesser extent, ventrolateral carinae, distinctly enlarged, obtuse, elevated; segment V with subdistal granules of ventrolateral carinae enlarged into laterally compressed, lobate processes. Aculeus long, shallowly curved, 61.5% (53–70%) of vesicle length.

Hemispermatophore: Flagelliform, with *pars recta* parallel to axis of distal lamina.

Geographic variation: In specimens from mesic fynbos and renosterveld habitats south and west of the Cape Fold Mountains (typical form; Figs. 75–78), the stridulatory surface on the dorsal surface of metasomal segment II reaches the posterior margin of the segment, whereas in specimens from xeric karroid habitats north and east of the Cape Fold Mountains (previously referred to as *P. planicauda frenchi*), the stridulatory surface does not reach the posterior margin of metasomal segment II. Specimens from the north and east of the Cape Fold Mountains are also slightly darker, with longer legs and pedipalps, and higher pectinal tooth counts, than those from the south and west (Figs. 79–82).

Ontogenetic variation: As in other species of *Parabuthus*, male resembles female very closely until the final instar. However, juveniles and subadults may be readily sexed by examination of the pectines and genital aperture.

Sexual dimorphism: Unlike most species of *Parabuthus* (except *P. calvus*, *P. muelleri*, *P. nanus* and *P. pallidus*), *P. planicauda* is not sexually dimorphic with respect to the shape of the chela manus. The manus of the adult male is slender and similar in shape to that of the adult female (Pocock 1890, 1902; Purcell 1898, 1901; Kraepelin 1908; Hewitt 1918; Prendini 2001a; Figs. 83, 84). However, the adult male is proportionally more slender than the adult female, and differs in the other characters mentioned above (Figs. 75, 76, 79, 80).

Remarks.—Much confusion has surrounded the status of *P. planicauda*, which was viewed as a junior synonym of *P. capensis* by various authors (discussed above). *Parabuthus planicauda* has not been revised since Purcell (1901) redescribed it as *P. capensis*. In addition, the status of the subspecies, *P. planicauda frenchi*, originally described as *P. capensis frenchi*, has not been addressed since its description. Comparison of the type specimens of *P. capensis frenchi* confirmed that this subspecies differs from *P. planicauda* only in the extent of the stridulatory surface of metasomal segment II, which reaches the posterior margin of the segment in *P. planicauda*, but does not in *P. planicauda frenchi* (Purcell

1901). Harington (1984) has shown that the extent of the stridulatory surface is highly variable and cannot be used to separate *P. brachystylus* from *P. villosus* (discussed below). Newlands & Martindale (1980) have also noted that this character is prone to considerable individual variation amongst species of *Parabuthus*. Purcell (1901) even mentioned that a small stridulatory surface occurs at the posterior edge of metasomal segment II in some specimens of *P. planicauda frenchi* and that, in one specimen, it is almost connected medially to the anterior surface by a few isolated granules. This variety clearly represents nothing more than intraspecific polymorphism within a widespread species. I therefore synonymize *P. capensis frenchi* with *P. planicauda*.

Distribution.—Endemic to South Africa (Fig. 88). Recorded from the Eastern Cape Province, Northern Cape Province, Western Cape Province and the Free State. No records are known from north of the Orange River.

Ecology.—*Parabuthus planicauda* is a semi-lithophilous species, inhabiting consolidated sandy, gritty and clayey substrata in rocky habitats. This species excavates burrows under rocks or stones and never in open ground. Elongation of the pedipalps and legs, as well as slight dorsoventral compression are indicative of a semi-lithophilous ecomorphotype, whereas a reduction in the macrosetal combs on the basitarsi of legs I and II in this species may be associated with its occurrence in regions of hard, compacted soil (Eastwood 1977; Prendini 2001a, b).

Parabuthus planicauda is sympatric with *P. granulatus* in parts of its range, but it is not known whether these species are syntopic. The range of *P. planicauda* overlaps extensively with that of *P. capensis*, and these species are occasionally found in syntopy. However, *P. capensis* is more commonly encountered in open sandy habitats.

Material examined.—SOUTH AFRICA: 3 ♂ (NMSA 9056, 9065, 9066), 2 ♂ (SAMC B630, B631), 1 ♀ (SAMC B629), 37 1st instars (SAMC 6315), J. Visser, 1 ♂ (SAMC C3862), 1914, 2 ♀ (SAMC B617, B618), 1 juv. ♀ (SAMC B619), 1895, W.F. Purcell, 1 ♀ (SAMC 506). *Eastern Cape Province*: Adelaide District: Adelaide, 2 km SE [32°43′S 26°19′E], 6.vii.1997, A. Harington, 2 ♀ (AMNH [AH 5090, 5091]). Albany District: Alicedale [33°19′S 26°05′E], 1915, 2 ♀ (NMSA 658), 18.vi.1913, P.A. Methuen, 1 subad. ♂ (TMSA 1825); Alicedale, 1 km behind town [33°19′S 26°05′E], 25.i.1979, A. Harington, 1 ♂ (AMNH [AH 928]), 1 ♀ (AMNH [AH 929]); Brakkloof, Grahamstown [33°14′S 26°23′E], 1897, J. White, 4 ♂, 6 ♀, 2 subad. ♂, 1 juv. ♀ (SAMC 1734); Grahamstown [33°19′S 26°31′E], 8.x.1905, W.F. Purcell, 2 ♀ (SAMC 14357), vii.1910, R.H. Ivy, 2 ♂ (TMSA 1821, 1823), 2 ♀ (TMSA 1820, 1822); Groot Brak Valley [33°19′S 26°31′E], 10–21.iii.1986, MacPherson & Roux, Water Affairs Survey, N face, fynbos and aloe, 1 juv. ♂ (SAMC C4527); Resolution Halt, near Grahamstown [33°10′S 26°37′E], v.1928, A. Walton, 1 ♂, 1 ♀, 2 subad. ♂, 1 juv. ♂ (SAMC B7297), xi.1928, A. Walton, 1 ♂, 1 ♀, 2 juv. ♂, 3 juv. ♀ (SAMC B7303), xii.1929, A. Walton, 1 ♀ (SAMC B7330); Farm Resolution [33°08′S 26°37′E], i.1910, A. Walton, 1 ♀ (TMSA 4862), i.1928, A. Walton, 2 ♂ (TMSA 4873, 4876), 3 ♀ (TMSA 4863, 4874, 4875), 4 juv. ♂ (TMSA 4872), 1 juv. ♂ (TMSA 4867), vi.1928, A. Walton, 2 ♂, 2 subad. ♂ (TMSA 4963), 1 ♂ (TMSA 4958), 5 ♀ (TMSA 4956, 4957, 4959, 4961, 4962), 1 subad. ♂ (TMSA 4960). Albert District: Burgersdorp [30°59′S 26°19′E], 1900, Schönland, 1 ♂, 1 ♀ (SAMC 6400), ix.1909, Kannemeyer, 1 ♂ (SAMC B554), 2 ♀ (SAMC B551, B552), 1 subad. ♂ (SAMC B553), 1 subad. ♀ (SAMC B559). Aliwal North District: Aliwal North [30°42′S 26°42′E], 18.ii.1971, R.H. Jones, 1 subad. ♂ (TMSA 10043); St Stephany, Aliwal North [30°42′S 26°42′E], xii.1916, Albany Museum, 1 ♀ (TMSA 1177). Bathurst District: Port Alfred [33°36′S 26°54′E], 19.i.1911, R.H. Ivy, 1 ♀ (TMSA 1824). Cradock District: Cradock [32°11′S 25°37′E], x.1918, G.P.F. van Dam, 2 ♂ (TMSA 2005, 2006), 2 juv. ♂ (TMSA 2007, 2008), 24.v.1987, A.J. Prins & A. Roux, 1 juv. ♀ (SAMC C4528), 29.iv.1997, M. de Jager, 1 ♂ (SAMC C4572). Mountain Zebra National Park: [32°07′S 25°32′E], iii.1998, M. de Jager, 1 ♂, 2 ♀ (SAMC C4571); Berylfberge [32°16′S 25°28′E], 15.xi.1976, 1 ♂ (AMNH [AH 440]), 1 ♀ (AMNH [AH 441]); Boesmanskloof [32°14′S 25°27′E], 11.xi.1976, J. Clarke, 1 ♂ (AMNH [AH 675]); Langkloof [32°15′S 25°29′E], 8.xi.1976, 1 ♀ (AMNH [AH 454]); Rooiplaats [32°11′S 25°27′E], 1 subad. ♂ (AMNH [AH 462]); Wilgerboomrivier bo Berghof [32°15′S 25°28′E], 7.vi.1976, 1 ♀ (AMNH [AH 436]). Glen Grey District: Bankies, 20 km S Dordrecht [31°32′S 26°57′E], 17.i.1996, A. Harington, 1 ♀ (AMNH [AH 3054]). Graaff-Reinet District: Farm Opreisfontein, 27 km SW Graaff-Reinet [32°15′S 24°44′E], 3.viii.1976, A. Harington, 2 ♂ (AMNH [AH 686, 687]); Graaff-Reinet [32°15′S 24°33′E], ii.1906, Meyer, 3 ♂ (SAMC B592–B594), 3 ♀ (SAMC B589–B591), 12.xii.1976, A. Harington, 1 juv. ♂ (AMNH [AH 517]); Graaff-Reinet and Kruidfontein, 8 mi from Graaff-Reinet [32°22′S 24°36′E], ix.1902, J. Paynter, 15 ♂, 28 ♀ (SAMC 12008); Karoo Nature Reserve, Graaff-Reinet [32°12′S 24°28′E], 8–9.ix.1987, S. van Noort, 1 ♂ (SAMC C3751), 2 ♀ (SAMC C3748, C3749), 1 juv. ♀ (SAMC C3750); near Valley of Desolation, Graaff-Reinet, 1600 ft [32°17′S 24°28′E], 1.vi.1900, M. Robinson & M. Way, 1 juv. ♀ (SAMC 5790). Jansenville District: Waterford [33°05′S 25°01′E], 17.xi.1969, H.C. Snyman, 1 ♀ (TMSA 9452). King William's Town District: King William's Town [32°53′S 27°24′E], 14.v.1941, H.W. Bell-Marley, 1 ♀ (TMSA 8298). Kirkwood District: Addo Elephant National Park [33°30′S 25°45′E], 21.v.1987, A.J. Prins & A. Roux, under elephant dung, 1 ♀ (SAMC C2321), 2 juv. ♂, 1 juv. ♀ (SAMC C4529), 1 juv. ♀ (SAMC C2320); Dunbrody, near Blue Cliff [33°28′S 25°33′E], 1899, 1901, J.A. O'Neil, 4 ♂, 2 ♀, 2 subad. ♀ (SAMC 5184, 5770, 6483). Lady Grey District: Kafferskop [30°30′S 27°04′E] on Paardeverlies, near Lady Grey, viii.1995, A. Thornley, 1 ♂ (AMNH [AH 3249]), 1 ♀ (AMNH [AH 3248]), 2 ♀, 1 subad. ♀ (AMNH [AH 3250]). Middelburg District: Farm Meent Kamp West, 5 km W [31°03′S 25°00′E], 1997, M. de Jager, under stones, 2 ♂, 2 ♀ (SAMC C4573); Klerksdale, Middelburg (31°03′S 25°00′E), 1915, 1 subad. ♀ (NMSA 649); Ludlow [31°16′S 24°40′E], 1917, Albany Museum, 1 ♂ (TMSA 1175), 1 ♀ (TMSA 1176); Middelburg (31°29′S 25°01′E), 1968, C.H. Steenkamp, 2 ♂ (TMSA 18065, 18066), 1 ♀ (TMSA 18064), v.1968, C.H. Steenkamp, 1 ♂ (TMSA 18163), vi.1968, C.H. Steenkamp, 2 ♂ (TMSA 18059, 18060), 9.vi.1968, C.H. Steenkamp, 2 subad. ♂ (TMSA 18062, 18063), 1 subad. ♀ (TMSA 18061), (31°30′S 25°00′E), ii.1997, M. de Jager, 1 ♀ (SAMC C4574), iii.1998, M. de Jager, under stones, 2 ♂ (SAMC C4576, C4577), 1 ♀, 1 subad. ♂, 1 subad. ♀ (AMNH). Oorlogspoort, 10 km NE (31°03′S 25°00′E), 15.viii.1996, M. de Jager, under dolerite stones, 1 ♂, 1 ♀ (SAMC C4575); Sneeuwkuil, Sneeuwbergen, about 40 mi from Richmond (31°38′S 24°32′E), xii.1901–ii.1902, S.C. Schreiner, 1 ♂ (SAMC 11517). Pearston District: Pearston (32°35′S 25°08′E), 1 ♀ (NMSA 8347); Zwagershoek, near Pearston, Somerset East (32°30′S 25°25′E), 1902, R. Broom, 1 ♀ (SAMC 12026). Port Elizabeth District: Coega (33°46′S 25°40′E), xi.1899, J.L. Drège, 1 ♀ (SAMC 5203), vi.1998, Zoology Department, University of the Western Cape, 1 ♂ (SAMC C4578); Port Elizabeth (33°58′S 25°36′E), 1897, xi.1898, J.L. Drège, 3 ♂, 4 ♀, 3 subad. ♀ (SAMC 1740, 4053, 5270); Redhouse, Port Elizabeth (33°50′S 25°34′E), 1891, H.A. Spencer, 1 ♂, 1 ♀ (SAMC 521), 1914, Mrs Paterson, 1 ♀ (SAMC B651), Stephenson, 1 ♂ (SAMC B653), 1 ♀ (SAMC B652), iii.1915, Mrs Paterson, [see SAMC B610] (SAMC B688). Somerset East District: Cookhouse (32°45′S 25°49′E), iii.1998, M. de Jager, 1 ♂ (SAMC C4579). Steynsburg District: Steynsburg (31°18′S 25°49′E), 1910, F. Eleuberger, 1 ♂ (NMSA 10087), (31°18′S 25°50′E), 1903, R. Broom, 1 ♂ (SAMC 12732), [31°22′S 25°52′E], 1904, S.S. Ponder, 2 juv. ♂, 2 juv. ♀ (SAMC 14267). Tarka District: Tarkastad [32°01′S 26°16′E], 1903, R. Broom, 1 ♀ (SAMC 12727); Towerkop (Toorkop), Tarkastad (31°51′S 26°19′E), ix.1976, V.B. Whitehead, under stone, 1 ♂ (SAMC C75). Willomore District: Kougakop, Langkloof (33°57′S 24°00′E), i.1975, Louw, 1 juv. ♂ (SAMC C1756); Willomore (33°18′S 23°29′E), 1901, H. Brauns, 2 ♂, 1 ♀, 3 subad. ♂, 3 juv. ♂, 2 juv. ♀ (SAMC 8871), 1901–1902, H. Brauns, 1 ♂, 1 ♀, 1 juv. ♂ (SAMC 8872). *Free State Province*: Smithfield District: Smithfield (30°13′S 26°32′E), 1912, Kannemeyer, 1 subad. ♂ (SAMC B549), 1914, Kannemeyer, 1 ♀ (SAMC B576), 4 juv. ♀ (SAMC B578); Tussen-die-Rivieren Game Reserve (30°28′S 26°12′E), 24.iii.2000, C. Haddad, under stones, 1 ♀, 1 subad. ♂ (AMNH). *Northern Cape Province*: Sutherland District: Sutherland (32°24′S 20°40′E), 4.i.1983, J. Visser, 3 ♂ (SAMC C3810, C3811, C3816), under rock, 1 ♀ (SAMC C3809), 23.v.1983, J. Visser, 3 ♀ (SAMC C3817, C3818, C3819), 16.ix.1983, J. Visser, 1 ♀ (SAMC C3821), 31.xii.1985, J. Visser, 1 ♀ (SAMC C3860), 30.x.1994, C.R. Owen, 1 juv. ♂ (TMSA 18745); Sutherland, 9 km S (32°28′S 20°39′E), J. Visser, 1 ♀ (SAMC C3865); Sutherland, 9 km S and 34 km E (32°22′S 20°52′E), J. Visser, 1 ♀ (SAMC C3863), 1 juv. ♂ (SAMC C3793); Sutherland, 10 km S (32°28′S 20°39′E), 11.i.1986, J. Visser, 1 ♀ (SAMC C3861). *Western Cape Province*: 'South Western Cape', M. Stiller, 2 ♂ (SAMC C1508), 1 ♂, 1 ♀ (SAMC C1509), 1 ♂ (SAMC C1507), 1 ♂ (SAMC C1511), 1 ♂ (SAMC C1512), 1 ♂ (SAMC C1516), 2 ♀ (SAMC C1517), 1 ♀ (SAMC C1505), 1 ♀ (SAMC C1510), 1 subad. ♂ (SAMC C1513). Beaufort West District: Beaufort West (31°48′S 19°18′E), 12.vi.1997, A. Harington, 1 subad. ♂ (AMNH [AH 5086]); Karoo National Park: [32°13′S 22°33′E], 7.iv.1994, J. Leeming, mid plateau, sympatric with *P. capensis*, 1 ♂ (SAMC C4569); Lammertjiesleegte [32°23′S 22°19′E], 6.iv.1994, A. Leroy, 1 ♀ (SAMC C4570). Bredasdorp District: Brandfontein Reserve [34°46′S 19°52′E], 16–18.x.1992, H.G. Robertson, under rock (Table Mountain sandstone), this species was also found in limestone region, 1 ♂ (SAMC C4531); Bredasdorp [34°32′S 20°02′E], H. Robertson, 1 ♀ (AMNH [AH 3909]), 19.v.1976, E.B. Eastwood, under stones, 2 ♂, 2 ♀, 1 subad. ♀ (SAMC C66), 8.vi.1977, E.B. Eastwood, under stone, 1 ♂ (SAMC C119), 15.i.1979, A. Harington, 2 ♀ (AMNH [AH 1120, 1121]); Cape Agulhas [34°50′S 20°00′E], 27.x.1940, V. Fitzsimons, 1 ♀ (TMSA 8402); De Hoop Nature Reserve, near Bredasdorp (34°28′S 20°30′E), i.1992, N. Larsen, 1 ♀ (SAMC C2424), 17–20.iv.1992, N. Larsen, under stone, 1 ♀ (SAMC C2522); De Hoop Nature Reserve, Koppie Alleen (34°28′S 20°30′E), 3–7.x.1994, S. van Noort, Strandveld, pitfall trap, 1 ♀ (SAMC C3501), 1 subad. ♂ (SAMC C3503); Elim (Mission Station) (34°35′S 19°45′E), 8.vi.1977, E.B. Eastwood, under stones, 7 ♂, 2 juv. ♂ (SAMC C118); Potberg, near Bredasdorp (34°22′S 20°33′E), i.1982, A. Robertson, 1 subad. ♂ (AMNH [AH 3178]); Soetendal's Vallei (Zoetendalsvlei, 34°43′S 19°59′E), 19–26.x.1940, V. Fitzsimons, 8 ♂ (TMSA 8404, 8417, 8423, 8425, 8426, 8428, 8430, 8432), 16 ♀ (TMSA 8403, 8405–8413, 8415, 8419, 8421–8422, 8424, 8431), 1 juv. ♂ (TMSA 8427), 22.x.1940, V. Fitzsimons, 2 juv. ♂ (TMSA 8568); Struisbaai (34°48′S 20°03′E), 8.vi.1977, E.B. Eastwood, under stones, 1 ♀ (SAMC C121), 5.iv.1994, Keuck, 1 ♀ (SAMC C3441). Caledon District: Caledon (34°13′S 19°25′E), v.1900, C.L. Leipoldt, 1 ♂, 2 ♀ (SAMC 5787); Greyton, Kanoberg Mts (34°01′S 19°36′E), vi.1988, C. & T. Stuart, on rocky plateau, 1000 m, 1 ♀ (NMSA 3668); Honingklip, near Botrivier (34°14′S 19°12′E), 14.vi.1970, J. Visser, 3 ♂, 1 subad. ♂, 2 juv. ♂ (NMSA 10005); Houw Hoek (34°13′S 19°10′E), v.1897, W.L. Sclater, 1 ♂ (SAMC 3006), 16.viii.1900, W.F. & Mrs W.F. Purcell, under stone near hotel, 1 ♂, 3 ♀ (SAMC 6412); River Zonde Ende, Caledon (34°09′S 19°54′E), 20.viii.1900, W.F. Purcell, under stone, 1 ♂ (SAMC 6409); Swartberg (Caledon), NW slope, near telephone tower, 34°13.510′S 19°25.868′E, 25.xii.2000, L. Prendini & E. Scott, mountain fynbos on sandstone, in shallow scrape under stone, 1 ♂ (AMNH); Viljoenspass, near Grabouw (34°06′S 19°03′E), 12.i.1979, A. Harington, 2 ♀ (AMNH [AH 1136, 1222]); Villiersdorp (33°59′S 19°17′E), 17.i.1963, C. Gow, 2 ♀ (SAMC C21); Villiersdorp Wildflower Reserve, entrance (33°58′S 19°15′E), 26.xii.2000, L. Prendini & E. Scott, mountain fynbos on sandstone, in shallow scrape under stone, 1 ♀ (AMNH). Calitzdorp District: Gamkaberg Nature Reserve (Inspection quarters) (33°40′S 21°53′E), 21.i.2000, Park staff, 1 ♀ (SAMC C4616). Ceres District: Hex River Mtn foothills, 40 km E Ceres (33°14′S 19°41′E), 23.xi.1981, C.A. Car, 1 ♂ (SAMC C2244); Spekrivierskloof (Hexrivierberge), N end (33°21′S 19°38′E), 5.i.2001, L. Prendini, C. Toffoli & H.M.B. Toffoli, mountain fynbos on sandstone, in shallow scrape under stone, 1 ♂ (AMNH). Hermanus District: Hermanus [34°25′S 19°14′E], 13.i.1979, A. Harington, 3 ♀ (AMNH [AH 1237–1239]); Onrus, Hermanus (34°24′S 19°11′E), 12.x.1975, V.B. Whitehead, 1 ♂, 4 ♀, 1 subad. ♂, 1 subad. ♀, 1 juv. ♀ (SAMC C1762). Ladismith District: Ladismith (33°29′S 21°16′E), 10.vi.1977, E.B. Eastwood, 2 ♀, 1 juv. ♂, 4 juv. ♀ (SAMC C126); Seven Weeks Poort (33°22′S 21°25′E), 17–18.xi.1940, V. Fitzsimons, 1 ♂ (TMSA 8462), 2 subad. ♂ (TMSA 8463, 8464); Seven Weeks Poort (33°24′S 21°24′E), 17–18.xi.1940, V. Fitzsimons, 2 ♂ (TMSA 8458, 8459), 1 ♀ (TMSA 8461); Vanwyksdorp (33°37′S 21°23′E), 10.vi.1977, E.B. Eastwood, under stones, 1 ♂, 1 ♀ (SAMC C120). Laingsburg District: Laingsburg (33°12′S 20°51′E), 17.viii.1903, W.F. Purcell, 1 juv. ♀ (SAMC 12949); Prinsrivierdam (33°31′S 20°45′E), 29.iii.1985, C.R. Owen, 1 ♂ (AMNH [AH 4100]). Montagu District: Ashton (33°49′S 20°03′E), i.1914, W.F. Purcell, 6 ♀ (SAMC B1748); Ashton, Zandvliet Farm (33°50′S 20°02′E), 1900, E. de Wet, 2 ♀ (SAMC 6423); Kogmanskloof, Ashton side (33°49′S 20°05′E), 27.viii.1900, W.F. Purcell, 2 juv. ♂ (SAMC 6421); Montagu (33°47′S 20°07′E), x.1919, R.W.E. Tucker, 3 ♀, 1 subad. ♂ (SAMC B3975); Montagu Baths (33°47′S 20°07′E), xi.1902, W.F. Purcell, 1 ♂ (SAMC 12034); Montagu Triangle (33°47′S 20°07′E), R.F. Lawrence, 2 ♀ (SAMC B5405), 12.x.1922, R.F. Lawrence, 1 ♀ (SAMC B5404). Mosselbaai District: Cloete’s Pass, Herbertsdale (33°57′S 21°47′E), 9.vi.1977, E.B. Eastwood, under stones, 1 ♀, 1 subad. ♂, 1 subad. ♀ (SAMC C125); Herbertsdale (34°01′S 21°46′E), iv.1976, E.B. Eastwood, 4 juv. ♂, 4 juv. ♀ (SAMC C82), 9.vi.1977, E.B. Eastwood, under stones, 1 ♂, 2 juv. ♂ (SAMC C132); Mossel Bay (34°11′S 22°08′E), 1896, W.F. Purcell, 3 ♂, 4 ♀, 3 subad. ♀ (SAMC 425), iv.1899, J.L. Drège, 3 ♀ (SAMC 5080), 28.v.19[?], E.B. Eastwood, under stone, 1 ♀ (SAMC C63); Mosselbaai (34°07′S 21°52′E), 20.i.1979, A. Harington, 2 ♀ (AMNH [AH 1240, 1241]), 18.i.1996, A. Harington, 1 ♂ (AMNH [AH 2954]), 3 ♀ (AMNH [AH 2951–2953]); Mossel Bay, Herbertsdale Road (34°07′S 21°52′E), 2.iii.1973, A.J. Prins, under stone, 1 ♂, 2 ♀, 1 subad. ♂ (SAMC C22); Ottershoek near Herbertsdale (34°01′S 21°46′E), 19.i.1979, A. Harington, 2 ♀ (AMNH [AH 920, 921]). Murraysburg District: turnoff to Richmond, between Murraysburg and Graaff-Reinet (31°58′S 24°04′E), 5.vii.1997, A. Harington, 1 ♂ (AMNH [AH 5139]). Oudtshoorn District: Cango Caves (33°24′S 22°13′E), 1.iv.1985, 1 subad. ♂ (AMNH [AH 3218]). Prince Albert District: Farm Zwartskraal (33°10′S 23°32′E), 1.ii.1979, S. Endrödy-Younga, 1 juv. ♀ (TMSA 11865); Prince Albert Poort (33°14′S 22°03′E), 1895, W.F. Purcell, 1 ♀, 3 juv. ♂ (SAMC 509). Riversdale District: Garcia Forest Station (34°00′S 21°15′E), 14–15.xi.1940, V. Fitzsimons, 1 ♂ (TMSA 8498), 1 ♀ (TMSA 8500); Garcia’s Pass road, Langeberg (33°52′S 21°07′E), 21.v.1976, A.J. Prins, under stone, 1 ♂ (SAMC C68); Gouritzmond (River mouth) [34°21′S 21°53′E], 8.vi.1977, E.B. Eastwood, under stones, 7 ♀ (SAMC C128); Gous River (34°05′S 21°15′E), 1910, H. Hermann, 1 ♂ (SAMC B1728); Jonkersberg, Attaquasberg (33°52′S 21°57′E), 22–28.xi.1940, V. Fitzsimons, 1 ♀ (TMSA 8460); Riversdale Mts, 2000–4500 ft. (33°52′S 21°07′E), x.1926, K.H. Barnard (see SAMC B610) (SAMC B6997); Stilbaai (34°22′S 21°24′E), 8–12.xi.1940, V. Fitzsimons, 7 ♂ (TMSA 8522–8525, 8527, 8529, 8531), 1 ♂, 1 ♀ (TMSA 8530), 1 ♂, 6 subad. ♂, 2 juv. ♂ (TMSA 8532), 3 ♀ (TMSA 8521, 8526, 8528); Stilbaai (34°22′S 21°25′E), 8–12.xi.1940, V. Fitzsimons, 5 ♂ (TMSA 8512, 8513, 8515, 8517, 8518), 1 ♂, 1 ♀ (TMSA 8520), 3 ♀ (TMSA 8514, 8516, 8519). Robertson District: Farm Viljoen (33°53′S 19°38′E), 30.x.1978, S. Endrödy-Younga, 5 ♂ (TMSA 11733, 11736–11739), 4 ♀ (TMSA 11727, 11731, 11743, 11744), 2 subad. ♂ (TMSA 11730, 11740), 3 subad. ♀ (TMSA 11734, 11742, 11748), 2 juv. ♂ (TMSA 11724, 11746), 3 juv. ♀ (TMSA 11728, 11729, 11747), 5.xii.1978, S. Endrödy-Younga, 13 ♂ (TMSA 11812, 11815, 11818–11821, 11824, 11825, 11827, 11832, 11833, 11835, 11836), 5 ♀ (TMSA 11810, 11813, 11823, 11826, 11834), 1 subad. ♂ (TMSA 11822), 1 subad. ♀ (TMSA 11811), 1 juv. ♂ (TMSA 11831), 2 juv. ♂, 3 juv. ♀ (TMSA 11817), 2 juv. ♂, 4 juv. ♀ (TMSA 11838), 3 juv. ♀ (TMSA 11829, 11830, 11837); Robertson (33°48′S 19°53′E), xi.1897, W.F. Purcell, 1 ♂, 2 subad. ♂, 2 subad. ♀, 2 juv. ♀ (SAMC 1752), 1901, R.J.M. Melle, 1 subad. ♂ (SAMC 6477), 1912, R.J.M. Melle, (see SAMC B610) (SAMC B642); Robertson, 10 km S (33°53′S 19°57′E), 29.x.1978, S. Endrödy-Younga, 2 ♂ (TMSA 11699), 1 ♂ (TMSA 11684), 2 ♀ (TMSA 11680, 11690), 5 subad. ♂ (TMSA 11683, 11689, 11692, 11695, 11702), 1 subad. ♀ (TMSA 11694), 8 juv. ♂ (TMSA 11685, 11697, 11703, 11704, 11706–11709), 1 juv. ♀ (TMSA 11687, 11688, 11691, 11696, 11710, 11711), 5.xii.1978, S. Endrödy-Younga, 11 ♂ (TMSA 11782, 11788, 11790, 11799–11806), 2 ♀ (TMSA 11776, 11807), 1 subad. ♂ (TMSA 11785), 7 juv. ♂ (TMSA 11781, 11783, 11784, 11789, 11795, 11798, 11808), 5 juv. ♂, 10 juv. ♀ (TMSA 11809), 2 juv. ♀ (TMSA 11786, 11793); Robertson, 15 km W (33°53′S 19°54′E), 29.x.1978, S. Endrödy-Younga, 2 ♂ (TMSA 11712, 11717), 1 subad. ♂ (TMSA 11721), 5.xii.1978, S. Endrödy-Younga, 1 ♂ (TMSA 11774), 1 subad. ♂ (TMSA 11762), 1 subad. ♀ (TMSA 11764), 1 juv. ♂ (TMSA 11765), 2 juv. ♀ (TMSA 11769, 11772); Vrolijkheid Nature Reserve, near Robertson (33°56′S 19°55′E), ix.1999, L. Prendini & E. Scott, under stones on clay flats near road, 3 juv. ♀ (AMNH). Sutherland District: 6.9 km from Farm Driefontein towards Sutherland on road from Oubergspas, near Farm Hottentotsfontein (32°27.650′S 20°30.875′E), 12.iii.2003, L. Prendini & E. Scott, 1564 m, central mountain renosterveld, shale and sandstone outcrop on roadside, under stones, 2 juv. ♂, 2 juv. ♀ (AMNH). Swellendam District: Bonnievale Farm, at Bushmansdrift on Breede River near Ashton (33°56′S 20°06′E), 1901, C. Groom, 2 ♀ (SAMC 6478); Bontebok National Park (34°04′S 20°27′E), 1.vi.1987, A.J. Prins & A. Roux, 2 juv. ♂ (SAMC C4530), 1 juv. ♂, 1 juv. ♀ (SAMC C1585), after 1 inch rain, 1 ♂, 1 ♀ (SAMC C1584); Infanta (34°25′S 20°51′E), 26.v.1975, E.B. Eastwood, under stone, 1 ♂, 1 ♀ (SAMC C16), 19.v.1976, E.B. Eastwood, under stones, 1 ♂, 4 ♀, 1 subad. ♂, 2 subad. ♀ (SAMC C67), 5 juv. ♂, 5 juv. ♀ (SAMC C69); Pass at Avontuur, River Zonder End Range, Swellendam (34°04′S 20°06′E), 21.viii.1900, Mrs W.F. Purcell, 1 ♀ (SAMC 6414); Swellendam (34°02′S 20°26′E), ix.1976, J.C. Allegrucci, under stone, 1 ♂ (SAMC C89), 4.i.1983, J. Visser, 1 juv. ♀ (SAMC C3780), 24.iii.1983, J. Visser, 1 ♂ (SAMC C3833), 1 ♀ (SAMC C3832), iv.1983, J. Visser, 1 ♀ (SAMC C3781), 3 juv. ♂ (SAMC C3782), 24.xi.1983, J. Visser, 1 ♀ (SAMC C3829), 30.xii.1983, J. Visser, 1 ♀ (SAMC C3831), 9.vi.1984, J. Visser, 3 ♂ (SAMC C3837, C3838, C3844), 8 ♀ (SAMC C3839–C3843, C3845–C3847), 4 juv. ♂ (SAMC C3784, C3789–C3791), 5 juv. ♀ (SAMC C3785–C3788, C3792), 23.vi.1984, J. Visser, 2 ♀ (SAMC C3849–C3850); Swellendam, 40 km S (34°22′S 20°22′E), 1.vii.1976, N. Smith, under stone, 1 ♀ (SAMC C88). Bontebok National Park (34°04′S 20°27′E), x–xii.1977, H. Braack, 2 ♀ (AMNH [AH 4090, 4091]), xi–xii.1977, J. Braack, 3 ♀ (AMNH), 5 ♀ (AMNH [AH 857–861]), 16.i.1979, A. Harington, 1 ♀ (AMNH [AH 870]). Tulbagh District: Piquetberg Road Station, Gouda (33°22′S 19°07′E), viii.1898, R.M. Lightfoot, 1 juv. ♂, 1 juv. ♀ (SAMC 3759); Tulbagh Road Station (33°19′S 19°06′E), 1895, F. Treleaven, 1 ♀ (SAMC 505), R.M. Lightfoot, 1 ♀ (SAMC 508). Wellington District: Bartholomeus Klip, Bo-Hermon (33°26′S 18°58′E), iii.1997, L. Prendini & E. Scott, under stones on ridge, sympatric with *P. capensis*, 1 ♂ (SAMC C4580). Worcester District: Brandvlei (33°44′S 19°24′E), 29.viii.1900, W.F. Purcell & I. Meiring, under stone on hillside, 5 ♀ (SAMC 6424); Breede River, at Darling Bridge (33°32′S 19°13′E), x.1902, H. Hermann, 1 ♂ (SAMC 12033); De Doorns (33°29′S 19°41′E), xii.1906, J. Paynter, 1 ♂, 1 ♀, 3 subad. ♂, 1 subad. ♀, 3 juv. ♂, 4 juv. ♀ (SAMC B610), 1 ♀ (SAMC B608); De Doorns, Touws River road (33°28′S 19°42′E), xi.1977, E.B. Eastwood, under stone in burrow, 1 subad. ♂ (SAMC C206); De Wet (33°36′S 19°40′E), 29.ix.1940, V. Fitzsimons, 4 ♂ (TMSA 8349, 8355, 8356, 8358), 9 ♀ (TMSA 8346–8348, 8350–8354, 8357); Hex River Valley (33°41′S 19°27′E), x.1898, F. Treleaven, 1 ♂, 3 ♀, 1 subad. ♀ (SAMC 4037); Karoo Botanical Garden, Worcester (33°37′S 19°25′E), 16.xi.1972, J. van Reenen, 1 juv. ♂ (TMSA 10681); Matroosberg Mts, Ceres, 4000 ft (33°23′S 19°40′E), xii.1917, R.W.E. Tucker, 1 ♂ (SAMC B3164); Matroosberg Mts. (33°22′S 19°37′E), xii.1916, R.W.E. Tucker, 1 ♀ (SAMC B3150), i.1917, R.W.E. Tucker, 1 ♀ (SAMC B3103), 18.i.1917, R.W.E. Tucker, 1 ♀, 35 juv. ♀ (SAMC B3108), 1 ♀ (SAMC B3106), (see SAMC B610) (SAMC B3107), 30.xi.1917, R.W.E. Tucker, 1 ♂ (SAMC B3157), 2 ♀ (SAMC B3154, B3155); Matroosberg Mts., 3500–3700 ft (33°22′S 19°37′E), 10.i.1917, R.W.E. Tucker, (see SAMC B610) (SAMC B3116); Matroosberg Mts., 4000 ft (33°23′S 19°40′E), 30.xi.1917, R.W.E. Tucker, 1 ♂, 1 ♀ (SAMC B3156); Matroosberg, Ceres (33°22′S 19°19′E), xii.1917, R.W.E. Tucker, (see SAMC B610) (SAMC B3165); Pienaarskloof (Hoek), Touws River (33°11′S 20°04′E), iv.1939, R. Smithers, 1 juv. ♂ (SAMC C3739); Rawsonville (33°41′S 19°19′E), ix.1976, G. McLachlin, under stones, 3 ♀, 1 subad. ♀ (SAMC C79); Touws River, on hill behind station (33°20′S 20°03′E), viii.1903, W.F. Purcell, 1 juv. ♂ (SAMC 12738); Touws River (33°20′S 20°03′E), xii.1904, J. Paynter,

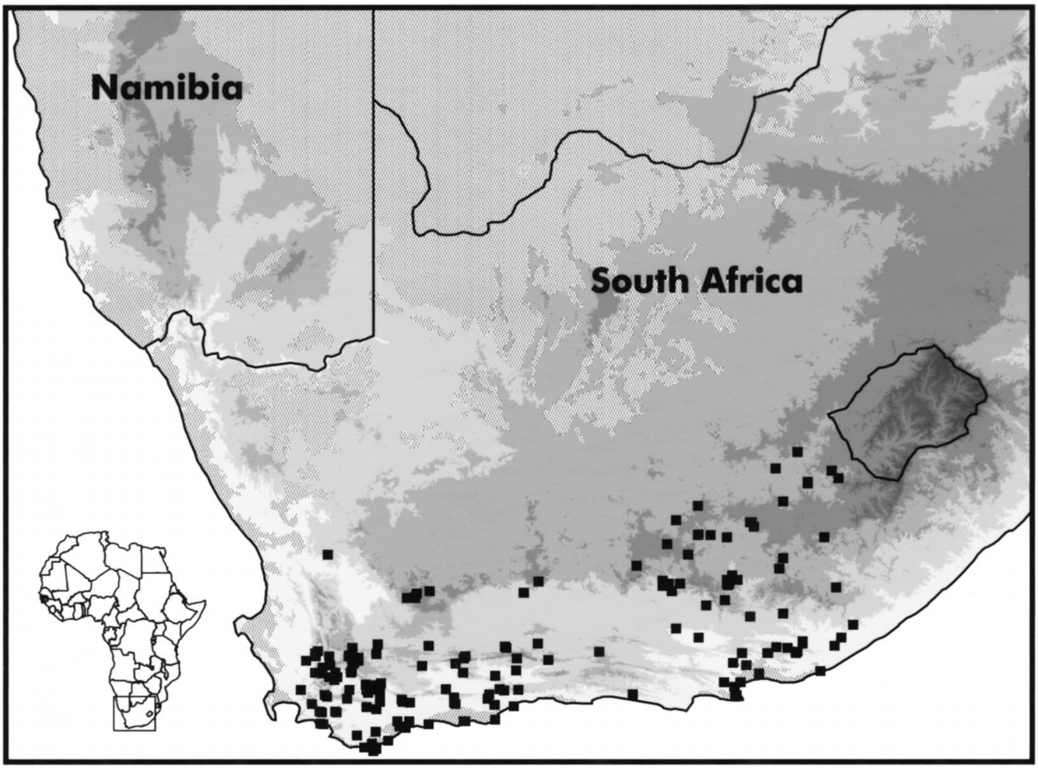


Figure 88.—The known distribution of *Parabuthus planicauda* (Pocock 1889) (■), which is endemic to South Africa. Contour interval = 500 m. Major sand systems stippled.

1 ♀ (SAMC 14264), xii.1905, J. Paynter, 1 ♂, 1 ♀ (SAMC 14379), 1974, M.A. Cluver, under stones, 1 ♂, 2 ♀ (SAMC C71), 23.i.1981, C.A. Car, under stone, 1 juv. ♂ (SAMC C210); Triangle (33°26′S 19°46′E), 30.v.1898, R.M. Lightfoot, 1 ♀ (SAMC 2989); upper Hex River (33°22′S 19°37′E), ix.1903, J. Paynter, 1 ♂, 20 ♀ (SAMC 12821); upper Hex River Valley, Matroosberg (33°23′S 19°46′E), x.1899, F. Treleaven, 1 subad. ♂ (SAMC 5201); Waaihoek Kloof, Goudini (33°30′S 19°20′E), 25.v.1928, K.H. Barnard, 1 ♀ (SAMC B7289); Worcester, near village (33°39′S 19°25′E), 30.v.1898, R.M. Lightfoot, 3 ♀ (SAMC 2986); Worcester (33°39′S 19°25′E), 1896, W.F. Purcell, 1 ♂ (SAMC 513), 1900, I. Meiring, 1 ♀ (SAMC 6471).

Parabuthus raudus (Simon 1888)

Buthus villosus var. β *dilutus* Thorell 1876b: 103–107 (NEW SYNONYMY)

Buthus raudus Simon 1888: 377.

Parabuthus raudus: Kraepelin 1899: 32; Kraepelin 1908: 252–254; Kraepelin 1914: 110; Hewitt 1918: 108, 178; Monard 1930: 40, 41; Schenkel 1932: 386; Hewitt 1935: 468, 469; Monard 1937: 257, 258; Lawrence 1955: 228; Lawrence 1961: 153; Lamoral & Reynders 1975: 521, 522; Lamoral 1979: 598–602, figs. 173–180; Newlands & Martindale 1980: 55–57, fig. 15; FitzPatrick 1994: 11, 12; Kovařík 1998: 117; Fet & Lowe 2000: 209; Prendini 2001a: 17; Prendini 2001b: 136; Dyason et al. 2002: 769; Prendini 2003: 21.

Parabuthus scobinifer Hewitt 1915: 102–104 (synonymized by FitzPatrick 1994: 11); Lamoral & Reynders 1975: 522.

Type material: Buthus villosus var. β *dilutus*: Holotype ♀ (NHRS), ‘‘Patria ignota’’.

Buthus raudus: Lectotype ♀ (MNHN), NAMIBIA: ‘‘sud-ouest Afrique’’, 1884–1886, Dr H. Schinz. Simon’s (1888) male and female syntypes were presumed lost according to Hewitt (1918) until the female was rediscovered in the MNHN collection (Lamoral 1979) and designated as lectotype. Both Hewitt (1918) and Lawrence (1955) maintained that the syntypes of *P. raudus* were collected in the Kalahari. Lawrence (1955) stated further that the type locality may be between Damaraland (northwestern Namibia) and Lake Ngami (northern Botswana).

Parabuthus scobinifer: Holotype: 1 juv. ♂ (BMNH 1915.5.28.1), ZIMBABWE: N.W. Rhodesia, presented by Dr L. Colyer.

Diagnosis.—*Parabuthus raudus* is most closely related to *P. schlechteri* (Fig. 1). Both species share the following combination of characters: pedipalp chela (adult male), fixed finger strongly curved dorsally, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); metasomal segments broad (length IV/width IV: 1.2–1.5); metasomal segment I, stridulatory surface (dorsal aspect) extended forwards in V-shape onto anterior surface; metasomal segment II, stridulatory surface (dorsal aspect) not reaching posterodorsal margin; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules noticeably more pronounced than preceding granules; metasomal segment IV, median lateral carinae continuous and distinct; metasomal segment V, dorsosubmedian carinae distinct, comprising sharp spiniform granules, dorsolateral carinae continuous to distal edge of segment.

Parabuthus raudus may be separated from *P. schlechteri* by means of the following combination of characters: carapace, mesosoma, metasoma and legs with uniform pale yellow to light brown coloration (segments III–V and telson may be infuscated, i.e., darker than segments I and II); metasomal segment V, ventrolateral carinae comprising fine spinose processes subdistally; metasomal segment V, ventrolateral carinae converging distally.

Remarks.—*Parabuthus raudus* was revised by Lamoral (1979) as part of his revision of the scorpions of Namibia but Lamoral (1979) did not address possible synonyms described from beyond Namibian borders. Newlands & Martindale (1980) subsequently reviewed the buthid species of Zimbabwe, provided additional diagnostic differences between *P. raudus* and other members of *Parabuthus*, and synonymized *P. scobinifer* with *P. mossambicensis* (discussed above). However, FitzPatrick (1994) recently demonstrated that *P. scobinifer* is actually a junior synonym of *P. raudus*.

Kraepelin (1899) synonymized *Buthus villosus* var. β *dilutus* with *P. villosus*. When the holotype of *B. villosus* var. β *dilutus,* was obtained for study during the present investigation, it was found to be conspecific with *P. raudus*, not with *P. villosus*. *Buthus villosus* var. β *dilutus* is therefore a senior synonym of *P. raudus*. However, this name has not been used since its description, whereas *P. raudus* has won general acceptance. Therefore, it seems prudent to retain use of the name *P. raudus*.

Distribution.—Associated with the Kalahari sand system and sandy deposits along the banks of the Orange River (distribution extends across the latter). Recorded from Angola, Botswana, Namibia, South Africa, Zambia, and Zimbabwe.

Ecology.—*Parabuthus raudus* is a semi-psammophilous species, inhabiting unconsolidated to semi-consolidated sand dunes, where it excavates burrows in open ground and at the base of shrubs and grass tufts. Comb-like rows of long macrosetae (‘‘sand combs’’) on the retrolateral margins of the basitarsi of legs I and II indicate a semi-psammophilous ecomorphotype.

Parabuthus raudus is syntopic with *P. granulatus* and *P. kuanyamarum* throughout its distributional range and with *P. kalaharicus* and *P. laevifrons* in the southwestern part of its range. It is the most commonly found species in the Kalahari sand system, where it is more common in the interdune valleys than on the dune crests.

This species is allopatric with its sister species, *P. schlechteri,* but sympatric with *P. villosus* along the banks of the Orange River. However, *P. villosus* is a semi-lithophilous species, restricted to rocky slopes in the Orange River valley, whereas *P. raudus* inhabits the alluvial sand dunes along its banks, hence these species are not syntopic.

Material examined.—NAMIBIA: *Khomas Region*: Windhoek District: Farm Frischgewaagd 289 (22°32′S 17°50′E), 20.iii.1976, B. Lamoral, 8 ♂, 5 ♀, 1 subad. ♀, 3 juv. ♂, 1 juv. ♀ (NMSA 10817). SOUTH AFRICA: *Northern Cape Province*: Gordonia District: Kalahari Gemsbok National Park: Mata Mata (25°53′S 20°01′E), iv.1970, B.H. Lamoral, 1 ♀ (NMSA 10444) [homotype designated by Lamoral (1979)]; Mata Mata, 3 miles N (25°43′S 20°00′E), 24.iv.1970, B. Lamoral, 1 ♀, 2 subad. ♂ (NMSA 10931). Namaqualand District: Richtersveld, Swaartpoort near Ochta

Diamond Mine, 28°07′S 16°56′E, ii.1974, R. Faber, 3 ♂, 2 ♀ (NMSA 10924).

Parabuthus schlechteri Purcell 1899
Fig. 24

Parabuthus schlechteri Purcell 1899b: 434; Purcell 1901: 164–168; Pocock 1902: 367; Hewitt 1912: 301, 302; Hewitt 1913: 146; Lampe 1917: 193; Hewitt 1918: 107, 108, 178, pl. XIX, fig. 2; Lawrence 1955: 228; Lawrence 1962: 220; Lamoral & Reynders 1975: 522; Lamoral 1979: 602–606, figs. 181–187; Kovařík 1998: 117; Fet & Lowe 2000: 209, 210; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 21.

Type material.—Holotype ♀ (damaged) (SAMC 2177), SOUTH AFRICA: between Henkries (28°54′S 18°08′E) and Wolftoon (29°03′S 18°13′E), Little Bushmanland (*Northern Cape Province*: Namaqualand District), 1.xii.1897, M. Schlechter. Lamoral (1979) erroneously referred to syntypes. Purcell (1899b, 1901) clearly specified an adult female (SAMC 2177) as the holotype. The holotype is completely dismembered, as is the male specimen from the same locality, the dismembered pieces of both specimens residing in the same jar, with the same accession number. As the holotype is not destroyed, a neotype cannot be designated. Lamoral (1979) therefore designated a homotype.

Diagnosis.—*Parabuthus schlechteri* is most closely related to *P. raudus* (Fig. 1). Both species share the following combination of characters: pedipalp chela (adult male), fixed finger strongly curved dorsally, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); metasomal segments broad (length IV/width IV: 1.2–1.5); metasomal segment I, stridulatory surface (dorsal aspect) extended forwards in V-shape onto anterior surface; metasomal segment II, stridulatory surface (dorsal aspect) not reaching posterodorsal margin; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules noticeably more pronounced than preceding granules; metasomal segment IV, median lateral carinae continuous and distinct; metasomal segment V, dorsosubmedian carinae distinct, comprising sharp spiniform granules, dorsolateral carinae continuous to distal edge of segment.

Parabuthus schlechteri may be separated from *P. raudus* by means of the following combination of characters: carapace, mesosoma and metasoma, dark brown to black in color, contrasting with pale pedipalps and legs; metasomal segment V, ventrolateral carinae comprising coarse spinose processes subdistally; metasomal segment V, ventrolateral carinae diverging distally.

Parabuthus schlechteri is easily confused with *P. transvaalicus* and *P. villosus*, but may be separated from these species by means of the following character: metasomal segment II, stridulatory surface (dorsal aspect) not reaching posterodorsal margin. It may also be separated from *P. transvaalicus* and some populations of *P. villosus* by means of coloration: pale pedipalps and legs pale contrasting with dark brown to black carapace, mesosoma, and metasoma.

Remarks.—Newlands (1974a) suggested that *P. schlechteri* is a junior synonym of the closely related *P. raudus*, a subject that he indicated would be further examined in a future taxonomic paper. The latter contribution never appeared, and *P. schlechteri* and *P. raudus* were subsequently revised by Lamoral (1979), who provided diagnostic differences for both species. However, the two species are very similar morphologically and it remains to be seen whether they will be upheld as more data (including DNA sequences) accrue.

Distribution.—Endemic to sandy areas in southern Namibia (Hardap and Karas regions) and the Northern Cape Province of South Africa. The distribution of this species extends across the Orange River.

Ecology.—*Parabuthus schlechteri* is a semi-psammophilous species, inhabiting semi-consolidated to consolidated sandy and gritty substrata, where it excavates burrows in open ground and at the base of shrubs and grass tufts. Comb-like rows of long macrosetae (‘‘sand combs’’) on the retrolateral margins of the basitarsi of legs I and II indicate a semi-psammophilous ecomorphotype. There appears to be little evidence to support Lamoral’s (1979) statement that *P. schlechteri* excavates shallow scrapes under rocks—specimens are seldom, if ever, collected in rocky habitats.

Parabuthus schlechteri is syntopic with *P. brevimanus*, *P. granulatus*, and *P. laevifrons* throughout its range and with *P. nanus* and *P.*

stridulus in part of its range. The species is allopatric with its sister species, *P. raudus*.

Material examined.—NAMIBIA: *Karas Region*: Keetmanshoop District: Keetmanshoop, Farm Noachabeb (27°26′S 18°31′E), 7–12.i.1972, 1 ♂, 1 ♀ (NMSA 11406). Lüderitz District, Diamond Area I: Farm Tsirub 13, 26°52′S 16°02′E, 3.iii.1976, B. Lamoral, 1 ♀, 1 subad. ♂, 1 subad. ♀ (NMSA 10730). SOUTH AFRICA: *Northern Cape Province*: Namaqualand District: Aggeneys (29°15′S 18°50′E), 6−8.xii.1997, L. Prendini, G.J. Müller, K. Rostoll, & J. du Plessis, 1 ♂, 1 ♀ (SAMC C4609); S of Goodhouse (29°00′S 18°13′E), 30.i.1973, B.H. Lamoral, 1 ♂ (NMSA 10935) [homotype designated by Lamoral (1979)]. *Western Cape Province*: Prince Albert District: Gamkaskloof Nature Reserve (33°31′S 21°37′E), 21.ii.1997, M. de Jager, 1 ♂ (SAMC C4610).

Parabuthus stridulus Hewitt 1913
Figs. 5, 12, 19, 33

Parabuthus stridulus Hewitt 1913: 146, 147; Lamoral 1979: 606–610, figs. 188–197; Kovařík 1998: 117; Fet & Lowe 2000: 209; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 21, 22.

Parabuthus laevifrons: Kraepelin 1914: 109 (specimens from Lüderitzbucht, see Hewitt 1918: 105).

Parabuthus laevifrons militum Hewitt 1918: 105, 176, pl. XIX, fig. 5 (synonymized by Lamoral 1979: 606); Lawrence 1955: 227, pl. XIX, fig. 5; Lamoral & Reynders 1975: 519.

Parabuthus laevifrons concolor Hewitt 1918: 176, 177 (synonymized by Lamoral 1979: 606); Lawrence 1955: 227; Lamoral & Reynders 1975: 519.

Type material.—*Parabuthus stridulus:* Holotype ♂ (TMSA 1868, formerly TMSA 1030), NAMIBIA: Lüderitzbucht, South West Africa [*Karas Region*: Lüderitz District: 26°35′S 15°10′E), 26.xi.1912.

Parabuthus laevifrons militum: Holotype ♂ (AMGS), NAMIBIA: Aus, South West Africa [*Karas Region*: Lüderitz District: 26°40′S 16°16′E].

Parabuthus laevifrons concolor: Syntypes: 2 ♀ (AMGS, MMKZ) [♂ syntypes, also listed in the original description, are presumed lost], NAMIBIA: Keetmanshoop [dubious locality], South West Africa, [*Karas Region*: Keetmanshoop District: 26°35′S 18°08′E], E. Murray.

Diagnosis.—*Parabuthus stridulus* is most closely related to *P. laevifrons* (Fig. 1). The two species may be separated from all other species of *Parabuthus* by means of the following combination of characters: surface of median ocular tubercle (male, female) and surrounding surfaces of carapace (female), smooth and shiny; pedipalp chela, asetose; chela manus, smooth and shiny; chela (adult male), fixed and movable fingers strongly curved, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); chela movable finger of female, short, compared with manus (measured along ventroexternal carina), length finger/length carina: ± 1.50; metasomal segments slender (length IV/width IV: 1.7–2.11), virtually asetose; metasomal segments I and II, stridulatory surface extended anteriorly beyond anterodorsal edge of segment, giving a step-like appearance in lateral aspect; metasomal segments IV and V, lateral intercarinal surfaces smooth; metasomal segment IV, median lateral carinae poorly developed; metasomal segment V, dorsosubmedian carinae and dorsolateral carinae absent, but ventrolateral carinae distinct.

Parabuthus stridulus may be separated from *P. laevifrons* by means of the following characters: pedipalp chela fixed finger with trichobothrium *dt* situated in line with or distal to *et*; metasomal segment II dorsal stridulatory surface composed of transverse ridges, some of which extend across the surface; metasomal segments III–V and telson weakly infuscated, contrasting in color only slightly with segments I and II; metasomal segment V, ventrolateral carinae comprising spinose processes subdistally; telson vesicle very distinctly and deeply excavated along longitudinal half of dorsoproximal surface.

Remarks.—Kraepelin (1914) evidently misidentified specimens of *P. stridulus* as *P. laevifrons* (Hewitt 1918). *Parabuthus laevifrons* was revised by Lamoral (1979), who synonymized Hewitt’s (1918) subspecies, *P. laevifrons militum* and *P. laevifrons concolor*, with *P. stridulus*.

Distribution.—Endemic to Namibia (Lüderitz, Maltahöhe and Swakopmund districts). Although *P. stridulus* has been recorded at Oranjemund, on the northern bank of the Orange River, no records are known from south of the river. The species is absent from the Central Namib Sand Sea and from the sand systems of the northern Namib.

Ecology.—*Parabuthus stridulus* is a psammophilous species, which excavates burrows in open ground, at the base of shrubs, grass tufts and shrub coppice dunes. The species displays several ecomorphological adaptations to its sandy habitat: unequal telotarsal ungues; basitarsi of legs I and II dorsoventrally compressed, with comb-like rows of long macrosetae (‘‘sand combs’’) on the retrolateral margins.

Parabuthus stridulus is syntopic with *P. gracilis*, *P. granulatus*, *P. namibensis* and *P. schlechteri* in part of its range, but allopatric with its sister species, *P. laevifrons*.

Material examined.—NAMIBIA: *Erongo Region*: Swakopmund District: Cape Cross, 5 km N, 21°43′S 13°56′E, 25.iii.1976, B. Lamoral & L. Ferguson, 1 ♂ (NMSA 10904), 1 ♀ (NMSA 10907). *Karas Region*: Lüderitz District: Agate Beach [26°36′S 15°10′E], Lüderitz, ii.1973, B. Lamoral, 1 ♂, 2 ♀ (NMSA 10573); Farm Plateau 38, near Aus (26°38.63′S 16°30.77′E), 30.xii.1997, L. Prendini & E. Scott, 1 ♂, 1 ♀ (SAMC C4611); Kolmanskop, 12 km E Lüderitz (26°43′S 15°17′E), iii.1973, C.J. Coetzee, 1 ♂, 1 subad. ♂ (NMSA 10501).

Parabuthus transvaalicus Purcell 1899

Figs. 6, 9, 21

Scorpio teter Müller 1828: 64 (NEW SYNONYMY); Hemprich & Ehrenberg 1829: 349; Peters 1861: 507.

Androctonus teter: Kraepelin 1891: 68 (in synonymy with *Heterobuthus liosoma*); Kraepelin 1899: 31.

Parabuthus transvaalicus Purcell 1899b: 434, 435; Purcell 1901: 162–164; Hewitt 1912: 302; Hewitt 1918: 107, 179, pl. XXI, fig. 30; Werner 1933: 323; Hewitt 1935: 466, 467; Lawrence 1938: 289; Lawrence 1955: 228; Lawrence 1961: 153; Lawrence 1964: 37; Lawrence 1967: 85; Lamoral & Reynders 1975: 522, 523; Newlands & Martindale 1980: 57, 58, fig. 16; FitzPatrick 1994: 12–14; Kovařík 1998: 117; Fet & Lowe 2000: 210; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 22.

Parabuthus obscurus Penther 1900: 154, 155 (synonymized by Kraepelin 1914: 112; Newlands 1970: 203); Lawrence 1955: 228; Newlands 1970: 203.

Parabuthus pachysoba Penther 1900: 155, 156 (synonymized by Kraepelin 1914: 112; Newlands 1970: 203, 204); Lawrence 1955: 228; Newlands 1970: 203, 204.

Type material.—*Scorpio teter:* Holotype (ZMHB?), locality unknown.

Parabuthus transvaalicus: Lectotype ♀ (SAMC 3003), SOUTH AFRICA: ‘‘Transvaal.’’ Paralectotypes: 1 ♀ (SAMC 3003), 3 ♀ (TMSA), same data as lectotype. Purcell (1899b) did not specify type specimens, but based his description on ‘‘a couple of’’ females (SAMC 3003) from the Transvaal. The larger of the two female syntypes in SAMC 3003 is hereby designated as the lectotype of *P. transvaalicus*, the remaining specimens in the SAMC and TMSA collections, as paralectotypes.

Parabuthus obscurus: Syntypes: 1 juv. ♂, 2 juv. ♀ (NHMW 2090), BOTSWANA: Britisch-Betschuanaland, vii.1893, A. Penther.

Parabuthus pachysoba: Holotype ♂ (NHMW 2089), BOTSWANA: Britisch-Bechuanaland, vii.1893, A. Penther.

Diagnosis.—*Parabuthus transvaalicus* is most closely related to *P. villosus* (Fig. 1). Both species share the following combination of characters: pedipalp chela (adult male), fixed finger strongly curved dorsally, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); metasomal segments broad (length IV/width IV: 1.2–1.5); metasomal segment I, stridulatory surface (dorsal aspect) extended forwards in V-shape onto anterior surface; metasomal segment II, stridulatory surface (dorsal aspect) reaching posterodorsal margin; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules noticeably more pronounced than preceding granules; metasomal segment IV, median lateral carinae continuous and distinct; metasomal segment V, dorsosubmedian carinae distinct, comprising sharp spiniform granules, dorsolateral carinae continuous to distal edge of segment.

Parabuthus transvaalicus may be separated from *P. villosus* by means of the following combination of characters: carapace not dorsoventrally compressed; metasomal segments I–V and telson sparsely to moderately setose; metasomal segments I–IV, becoming wider distally, metasomal segment I narrower than segment IV; metasomal segments I and II, stridulatory surface (lateral aspect) truncated at anterodorsal edge of segment.

Parabuthus transvaalicus is easily confused with *P. schlechteri*, but may be separated from the latter by means of the following characters: metasomal segment II, stridulatory surface (dorsal aspect) reaching posterodorsal margin; carapace, mesosoma, metasoma, pedipalps and legs uniform dark brown to black in color.

Remarks.—Purcell (1901) suggested that *P. obscurus* and *P. pachysoba* are synonymous with *P. transvaalicus*, differing only in having a relatively shorter and stouter metasoma, but did not examine the type specimens. Kraepelin (1908) examined the types, and concurred with Purcell's view, but did not list them in formal synonymy until later (Kraepelin 1914). Although both synonyms were accepted by Hewitt (1918) and Lawrence (1955), the types were not actually examined by a South African worker until Newlands (1970), who also accepted the synonyms and is often mistakenly credited for them (e.g., by Lamoral & Reynders 1975). Newlands & Martindale (1980) later revised *P. transvaalicus*, and FitzPatrick (1994) provided additional diagnostic differences between this species and other members of the genus.

The name *Scorpio teter* was first mentioned by Müller (1828) with reference to the Berlin Museum (ZMHB). Kraepelin (1891: 68) incorrectly referred to it as ''*Androctonus teter* Nordm., 1839'' and placed it (under question) as a synonym of *P. leiosoma* (as *Heterobuthus liosoma*). Kraepelin (1899) later suggested that this name was a *nomen nudum* [Moritz & Fischer (1980) also omitted this name from their list of type specimens in the ZMHB], but proceeded to describe the type specimen, which he regarded as a dark color variety of *P. capensis*. However, the characters of this specimen, and another described by Kraepelin (1899) from the Hamburg Museum (ZMUH), viz. the dark reddish-brown coloration and the well developed spiniform granules of the dorsosubmedian carinae on metasomal segment V, are diagnostic for *P. transvaalicus*. The collection locality that Kraepelin mentions for the ZMUH specimen (Delagoa Bay, Mozambique) also occurs within the distributional range of *P. transvaalicus*. It is clear from this description that *Scorpio teter* is a senior synonym of *P. transvaalicus*, not of *P. leiosoma* or *P. capensis*. However, as noted by Fet & Lowe (2000), Müller's name has never been used since its description. In contrast, *P. transvaalicus* has won general acceptance. Therefore, it seems prudent to retain use of the name *P. transvaalicus*.

Distribution.—Recorded from east of the Kalahari sand system in Botswana, Mozambique, South Africa, and Zimbabwe.

Ecology.—*Parabuthus transvaalicus* is a semi-psammophilous species, inhabiting semi-consolidated to consolidated sandy, gritty and loamy substrata, where it excavates burrows under stones or fallen trees. Comb-like rows of long macrosetae (''sand combs'') on the retrolateral margins of the basitarsi of legs I and II indicate a semi-psammophilous ecomorphotype.

Parabuthus transvaalicus is sympatric with *P. mossambicensis* throughout its range and with *P. granulatus* and *P. kuanyamarum* in part of its range. Where they occur in sympatry (e.g., Langjan Nature Reserve in the Limpopo Province of South Africa), *P. granulatus*, *P. kuanyamarum* and *P. mossambicensis* are generally found in open sandy habitats, whereas *P. transvaalicus* frequents rocky habitats. The species is allopatric with its sister species, *P. villosus*.

Conservation.—Refer to the discussion under *P. mossambicensis*.

Material examined.—SOUTH AFRICA: *Limpopo Province*: Pietersburg District: Dendron [23°23′S 29°20′E], Soutpansberg, 18.iii.1970, 1 ♀ (NMSA 11449). Sekgosese District: Mphakane, S, granite koppies 1 km from turnoff to Munnik (23°32.20′S 29°42.42′E), 29.xii.1999, L. Prendini & E. Scott, 1 ♂, 1 ♀ (SAMC 4612). Soutpansberg District: Kruger National Park, Pafuri (22°27′S 31°17′E), 18.x.1980, L. Braack, 1 ♀ (NMSA 13899); Langjan Nature Reserve (22°51′S 29°13′E), i.2000, L. Prendini & E. Scott, 1 ♂ (SAMC C4613).

Parabuthus villosus (Peters 1862)

Figs. 7, 8, 15, 18, 32

Scorpio australis (*nec* Linnaeus 1758; misidentification): Herbst 1800: 48–52, pl. IV, fig. 1.

Prionurus (*Androctonus*) *villosus* Peters 1862: 26, 27.

Buthus craturus: Thorell 1876a: 7, *nomen nudum* (no description published) (see Thorell 1876b: 103).

Buthus villosus: Thorell 1876b: 103; Pocock 1889: 343, 344; Simon 1890: 130.

Heterobuthus liosoma villosa: Lenz 1894: 97.

Parabuthus villosus: Pocock 1895: 309, pl. IX, figs. 6a, b; Kraepelin 1899: 31, 32; Kraepelin 1901:

267; Purcell 1901: 158–162; Werner 1902: 598; Simon 1904: 444; Kraepelin 1908: 252; Hewitt 1913: 146; Kraepelin 1914: 112; Werner 1916: 82; Lampe 1917: 193; Hewitt 1918: 107, 178, pl. XIX, fig. 1; Werner 1934: 269; Werner 1936: 178; Roewer 1943: 208; Lawrence 1955: 228; Lawrence 1962: 220; Lawrence 1965: 4; Lamoral & Reynders 1975: 523, 524; Lamoral 1979: 610–616, figs. 198–204, 206, 207; Harington 1984: 393–406; Kovařík 1998: 117; Fet & Lowe 2000: 210, 211; Prendini 2001a: 17; Prendini 2001b: 137; Dyason et al. 2002: 769; Prendini 2003: 22.

Parabuthus brachystylus Lawrence 1928: 270 (NEW SYNONYMY); Lawrence 1955: 225; Lawrence 1961: 153; Lamoral & Reynders 1975: 514; Lamoral 1979: 616–618, figs. 205, 207; Kovařík 1998: 116.

Parabuthus villosus dilutus: Roewer 1943: 208.

Parabuthus villosus brachystylus: Harington 1984: 405; Fet & Lowe 2000: 211.

Parabuthus villosus villosus: Fet & Lowe 2000: 211.

Type material.—*Prionurus* (*Androctonus*) *villosus*: Lectotype ♂ (ZMHB 2303) [designated by Lamoral (1979)], NAMIBIA: Neu Barmen, Otjimbingue [*Erongo Region*: Karibib District: 22°21′S 16°08′E], Hahn. Paralectotype ♀ (ZMHB 2304), same data as lectotypes. The syntypes of *P. villosus* were presumed lost until rediscovered in the collection of the ZMHB (Lamoral 1979). Lamoral selected one as a lectotype, but Moritz & Fisher (1980) omitted *P. villosus* from their list of type specimens in the ZMHB collection.

Parabuthus brachystylus: Lectotype ♀ (SAMC B6087) [designated by Lamoral (1979)], NAMIBIA: Kamanjab, South West Africa (*Kunene Region*: Outjo District: 19°34′S 14°48′E), 1926, R.F. Lawrence. Paralectotypes: 1 juv. ♀ (SAMC B6072), 1 ♀, 3 subad. ♂, 3 juv. ♂, 2 juv. ♀ (SAMC B6794), 2 juv. ♂ (SAMC B6989), 2 juv. ♂, 1 juv. ♀ (SAMC B6072/B6087/B6794/B6989), NAMIBIA: Kaoko Otavi, South West Africa *Kunene Region*: Opuwo District (18°18′S 13°42′E), 1926, R.F. Lawrence.

Diagnosis.—*Parabuthus villosus* is most closely related to *P. transvaalicus* (Fig. 1). Both species share the following combination of characters: pedipalp chela (adult male), fixed finger strongly curved dorsally, such that proximal dentate margin distinctly emarginate when fingers are closed (i.e., a proximal ‘‘gap’’ is evident); metasomal segments broad (length IV/width IV: 1.2–1.5); metasomal segment I, stridulatory surface (dorsal aspect) extended forwards in V-shape onto anterior surface; metasomal segment II, stridulatory surface (dorsal aspect) reaching posterodorsal margin; metasomal segments II–IV, dorsosubmedian carinae with distal spiniform granules noticeably more pronounced than preceding granules; metasomal segment IV, median lateral carinae continuous and distinct; metasomal segment V, dorsosubmedian carinae distinct, comprising sharp spiniform granules, dorsolateral carinae continuous to distal edge of segment.

Parabuthus villosus is easily confused with *P. schlechteri* and *P. transvaalicus* but may be separated from these, and all other species of *Parabuthus*, by means of the following combination of characters: carapace dorsoventrally compressed; metasomal segments I–V and telson very densely setose (mesosomal tergites often also densely setose); metasomal segments I–IV becoming narrower distally, metasomal segment I wider than segment IV; metasomal segments I and II, stridulatory surface extended anteriorly beyond anterodorsal edge of segment, giving a step-like appearance in lateral aspect. Most populations of *P. villosus* may also be separated from *P. transvaalicus* on the basis of coloration: pale pedipalps and legs pale contrasting with dark brown to black carapace, mesosoma, and metasoma.

Remarks.—Kraepelin (1899) synonymized Thorell’s *Buthus villosus* var. β *dilutus* with typical *P. villosus*. However, when the holotype of *B. villosus* var. β *dilutus* was examined for the present investigation, it was instead found to be conspecific with *P. raudus* and synonymized accordingly (see above).

Lamoral (1979) revised *P. brachystylus* and *P. villosus* and regarded them as sibling species (Paterson 1985). Lamoral (1979) maintained that *P. brachystylus* can be separated from *P. villosus* on the following combination of morphological characters, originally proposed by Lawrence (1928): dorsal stridulatory surface of metasomal segment II reaching the posterior margin; metasomal segment I 106% (103–109%) wider than long. Lamoral (1979) noted that, in *P. villosus*, the dorsal stridulatory surface of metasomal segment II does not reach the posterior margin and metasomal segments I–III are 95% (92–98%) longer than wide. The two species were further distinguished by differences in the number of haemolymph protein bands in electrophoregrams.

Harington (1984) conducted a detailed reinvestigation of morphological, morphometric and electrophoretic variation across the distributional ranges of *P. brachystylus* and *P. villosus*. According to Harington (1984), electrophoresis of venom and haemolymph on Sodium Dodecyl Sulphate polyacrylamide gels failed to reveal significant differences between *P. brachystylus* and *P. villosus*. Nondenaturing disc electrophoresis of haemolymph did not show any differences either. On re-examination, Lamoral's (1979) ''diagnostic'' morphological characters proved to be subject to extensive variation, particularly in an area juxtaposed between the main distributions of the two species. Two ratios, width/length of metasomal segment I and length of stridulatory surface/length of metasomal segment II, were calculated to track the change in morphology. These parameters were then plotted against latitude. In addition, the discriminant scores of three classes, namely *P. villosus*, intermediates and *P. brachstylus*, were plotted against latitude because the discriminant score gives a more inclusive assessment of morphological differences than simple ratios. The three most important characters used in the calculation of the discriminant scores were length of metasomal segment III, length of stridulatory surface and length of metasomal segment I. Neither the qualitative morphological characters nor any of the 15 meristic characters tested by Harington (1984) could be considered truly diagnostic. Harington (1984) therefore concluded that the various color morphs of *P. villosus* and *P. brachystylus* are conspecific.

Despite his evidence of intermediates, Harington (1984) did not synonymize *P. brachystylus* with *P. villosus*, although credited as such by Fet & Lowe (2000: 211), but instead retained it as a subspecies of the latter. As these taxa cannot be viewed as phylogenetic species in the diagnostic sense, I hereby synonymize *P. brachystylus* with *P. villosus*. The possibility that *P. villosus* is a complex of sibling species nevertheless remains. For example, I. Engelbrecht (pers. comm.) recently discovered two color forms of *P. villosus* (also differing in setation and several morphometric parameters) in syntopy at Klein Pella (Northern Cape Province, South Africa). A thorough investigation of species limits within *P. villosus* is now underway using DNA sequence data.

Distribution.—Endemic to Namibia and South Africa. The distribution of *P. villosus* extends across the Orange River. This species has not been recorded from north of the Kunene River (Prendini 1995), but its association with rocky mountain desert in the Kaokoveld of northwestern Namibia (Kunene Region) suggests that this may be due to undersampling, and that it may yet be discovered in the Namibé Province of southwestern Angola.

Ecology.—*Parabuthus villosus* is a semi-lithophilous species, inhabiting consolidated sandy, gritty and clayey substrata in extremely rocky habitats. This species excavates burrows under rocks or stones and never in open ground. Dorsoventral compression (especially of the carapace), reduction in the macrosetal combs of basitarsi I and II, and increased curvature of the telotarsal ungues indicate a semi-lithophilous ecomorphotype (Eastwood 1977; Prendini 2001a, b).

Parabuthus villosus is unusual among species of the genus, and indeed among scorpions generally, in that it is commonly active during the day (Newlands 1974a; Harington 1982). This species is an errant forager that may be observed actively hunting for prey from midday through the afternoon and on into the night.

Parabuthus villosus is sympatric with *P. brevimanus*, *P. granulatus* and *P. raudus* in parts of its distributional range. However, due to its occurrence in extremely rocky habitats, *P. villosus* is rarely found in syntopy with other species of *Parabuthus*. The species is allopatric with its sister species, *P. transvaalicus*.

Material examined.—NAMIBIA: *Karas Region*: Lüderitz District: Farm Plateau 38, 26°40′S 16°30′E, 29.ii.1976, B. Lamoral, 1 ♂, 3 ♀ (NMSA 10805). *Kunene Region*: Khorixas District: Farm Grootberg 191, 19°46′S 14°15′E, 2.iv.1976, B. Lamoral & L. Ferguson, 1 subad. ♂ (NMSA 10913). Opuwo District: Sesfontein, 3 km N clinic, 19°07′S 13°36′E, 3.iv.1976, B. Lamoral, 1 ♀ (NMSA 10738). Outjo District: Kamanjab, 3 km W, 19°37′S 14°48′E, 5.iv.1976, B. Lamoral & L. Ferguson, 1 ♀ (NMSA 10833). SOUTH AFRICA: *Northern Cape Province*: Namaqualand District: Pella pumpstation [28°59′S

19°10′E], iii.1997, L. Prendini & G.J. Müller, 2 ♂ (SAMC C4614); Vioolsdrift, 28°46′S 17°37′E, ii.1973, B.H. Lamoral, 1 ♂ (NMSA 10531) [homotype designated by Lamoral (1979)].

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Appendix 1

Characters and character states used for cladistic analysis of the genus *Parabuthus* Pocock 1890 (Prendini 2003). Character states were scored 0–2, ? (unknown), – (inapplicable) or * (polymorphic). Multistate characters were treated as unordered (nonadditive). Three autapomorphies, indicated by †, were excluded from the analysis.

General

1. Adult general size: large, carapace length 6.5−17.0 mm (0); small, carapace length 2.5−5.0 mm (1).
2. Color of carapace, mesosoma and metasoma: pale yellow to light brown (0); dark brown to black (pedipalps and legs may be dark or pale) (1); polymorphic (*).
3. Color pattern of metasoma: metasomal segments I–V and telson uniformly colored (0); metasomal segments III–V and telson infuscated (i.e., darker than segments I and II) (1); polymorphic (*).

Carapace

4. †Carapace dorsoventrally compressed: absent (0); present (1).
5. Granulation of median ocular tubercle (♂, ♀) and surrounding surfaces (♀): entire (0); smooth areas (1).

Pedipalps

6. Pedipalps, setation: setose (0); smooth (1).
7. Chela manus, surface: smooth (0); granular (1).
8. Chela movable finger, length compared with length of manus (measured along ventroexternal carina), in ♀: long (length finger/length carina: 1.70–2.00) (0); short (length finger/length carina: ± 1.50) (1).
9. Chela manus, shape in adult ♂, compared with adult ♀: similar (0); sexually dimorphic (1).
10. Chela fixed finger, shape in adult ♂: straight or slightly curved dorsally, such that proximal dentate margin linear when fingers are closed (0); strongly curved dorsally, proximal dentate margin distinctly emarginate when fingers are closed (1).
11. Chela movable finger, shape in adult ♂: straight, proximal dentate margin linear when fingers are closed (0); curved ventrally, proximal dentate margin distinctly emarginate when fingers are closed (1).
12. Chela fixed and movable fingers with basal lobe in adult ♂: absent (0); present (1).

Trichobothria

13. Pedipalp femur, position of e_1: level with or distal to d_5 (0); almost halfway between d_4 and d_5 (1).
14. Pedipalp patella, position of esb_2: distinctly distal to esb_1 (0); level with or slightly distal to esb_1 (1).
15. Chela fixed finger, position of *dt*: in line with or distal to *et* (0); proximal to *et* (1).

Pectines

16. Proximal median lamella of pectines, in ♀: arcuate (0); enlarged and lobate (dilate) (1).

17. Proximal median lamella of pectines, in ♂: subrectangular (0); weakly lobate (dilate) (1); strongly lobate (dilate) (2).

Legs

18. Legs IV, length: moderately long, not reaching to posterior edge of metasomal segment III (0); very long, reaching past posterior edge of metasomal segment III (1).
19. Basitarsi of legs I and II, macrosetal combs: absent (0); weakly developed (1); strongly developed (2).
20. Basitarsi of legs I and II, dorsoventrally compressed: absent (0); present (1).
21. †Basitarsi of legs III and IV, prolateral surfaces with dense tufts of macrosetae: absent (0); present (1).
22. Telotarsal ungues, relative length: equal (0); subequal (1).

Hemispermatophore

23. Hemispermatophore, *pars recta*: parallel to axis (0); S-shaped (1).

Mesosoma

24. Sternites, surface: smooth (0); punctate (1).
25. Sternite III, ‘‘pit’’ organ at proximal apex: absent (0); present (1).
26. Sternite VII, carinae: present (0); absent (1).

Metasoma

27. Metasomal segments I–V and telson, setation: virtually asetose (0); sparsely to moderately setose (1); very densely setose (2).
28. Metasomal segments, width relative to length: much narrower (length IV/width IV: 1.7–2.11) (0); slightly narrower (length IV/width IV: 1.2–1.5) (1).
29. Metasomal segments, width from I–IV: becoming narrower distally, metasomal segment I wider than segment IV (0); becoming wider distally, metasomal segment I narrower than segment IV (1).
30. Metasomal segments I–III, dorsal stridulatory surface: absent from I–III (0); strongly developed on I–III (1); strongly developed on I and II, weakly developed to absent on III (2).
31. Metasomal segment I, shape of stridulatory surface (if present) in dorsal aspect: narrow, parallel-sided (0); broad, rounded anteriorly, with posterior constriction (1); inapplicable (–).
32. Metasomal segments I, and to a lesser extent II, shape of stridulatory surface (if present) in lateral aspect: truncated at anterodorsal edge of segment (0); rounded, extended beyond anterodorsal edge of segment (1); inapplicable (–).
33. Metasomal segment I, extent of stridulatory surface (if present) in dorsal aspect: terminating at anterodorsal edge of segment (0); extended forwards in V-shape onto anterior surface (1); inapplicable (–).
34. Metasomal segment II, extent of stridulatory surface (if present) in dorsal aspect: reaching posterodorsal margin (0); not reaching posterodorsal margin (1); inapplicable (–); polymorphic (*).
35. Metasomal segment II, nature of stridulatory surface (if present): fine to coarse granules (0); horizontal ridges (1); inapplicable (–).
36. Metasomal segments II and III, posterodorsal edge: straight (0); anteromedially curved in a V-shape (1).
37. Metasomal segments IV and V, lateral intercarinal surfaces: granular (0); smooth (1).
38. Metasomal segments I–IV, dorsosubmedian carinae: present (0); absent (1).
39. Metasomal segment IV, dorsosubmedian carinae (if present): continuous (0); discontinuous (1); inapplicable (–).
40. Metasomal segments II–IV, distal spiniform granules of dorsosubmedian carinae (if present), size relative to preceding granules: equally developed (0); noticeably more pronounced (1); inapplicable (–).
41. Metasomal segment IV, ventrosubmedian and ventrolateral carinae: present and continuous to edge of segment (0); present but ventrosubmedian carinae becoming obsolete distally (1); absent (2).
42. Metasomal segment IV, median lateral carina: absent to proximally obsolete (0); continuous but poorly developed (1); continuous and distinct (2).
43. Metasomal segment V, dorsosubmedian carinae: absent (0); present, poorly developed with blunt, rounded granules (1); present, distinct with sharp, spiniform granules (2).
44. Metasomal segment V, dorsolateral carinae: absent, except for a few proximal granules (0); distally obsolete (1); continuous to distal edge of segment (2).
45. Metasomal segment V, ventrolateral carinae: converging distally (0); subparallel to diverging distally (1).
46. Metasomal segment V, distal half of ventrolateral carinae: with spinose processes (0); with lobate processes (1).
47. Metasomal segment V, ventrosubmedian carinae: absent or indistinct from surrounding granules (0); distinct (1).
48. Metasomal segment V, ventromedian carina: present (may be indistinct) (0); absent (1).

Telson

49. Telson vesicle, width relative to width of metasomal segment V: approximately equal (0); considerably narrower (1).
50. †Telson vesicle, dorsoproximal surface: very shallowly excavated along longitudinal half (0); deeply excavated (1).
51. Telson aculeus, shape: gently curved (0); abruptly bent (1).

Behavior

52. Diurnal retreat: hides under rocks (0); burrows under rocks (1); burrows in open ground (2); unknown (?); polymorphic (*).
53. Foraging strategy: sit-and-wait (0); errant (1); unknown (?).

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