

## A new species of *Parabuthus* Pocock (Scorpiones: Buthidae), and new records of *Parabuthus capensis* (Ehrenberg), from Namibia and South Africa

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*Parabuthus muelleri* Prendini, sp. nov. is described and figured, based on two female specimens collected during a recent field trip to Namibia. The male is currently unknown. This new species is shown to be most closely related to *Parabuthus capensis* (Ehrenberg), a common, widespread species south of the Orange River (in South Africa). Meristic data for both the above species are tabulated, and a distribution map illustrates the range of *P. capensis*, including the first confirmed records of that species from north of the Orange River (in Namibia). An appendix lists all additional material examined.

### INTRODUCTION

*Parabuthus* Pocock, 1890 is an exclusively Old World genus of scorpions, one of 72 genera in the diverse, cosmopolitan family Buthidae (Fet & Lowe 2000). The genus displays a classic 'arid corridor' pattern of distribution (Balinsky 1962), with 19 species occurring in southwestern Africa and eight species occurring in northeast Africa and the Arabian peninsula (Fet & Lowe 2000). All but six of the southern African species have been reported from Namibia, three of which (*Parabuthus gracilis* Lamoral, 1979, *Parabuthus namibensis* Lamoral, 1979 and *Parabuthus stridulus* Hewitt, 1914), are endemic to the country. The recent discovery of a new species in Namibia, described in the present contribution, brings the total number of southern African species to 20, and the number of Namibian endemics to four. In addition, *Parabuthus capensis* (Ehrenberg, 1831), a common, widespread species south of the Orange River (in South Africa) has been confirmed to occur in Namibia. Although *P. capensis* was reported from north of the Orange River by earlier authors (e.g. Purcell 1901), it was omitted from Lamoral's (1979) revision of the scorpions of Namibia. Three Namibian specimens, representing the first confirmed records of *P. capensis*

**Table 1.** The species of *Parabuthus* Pocock (Scorpiones, Buthidae) recorded from Namibia. Endemic species are denoted as follows: <sup>1</sup>endemic to Namibia; <sup>2</sup>endemic or near-endemic to Namibia and South Africa (*P. kalaharicus* and *P. laevifrons* also occur in the southwestern Kgalagadi district of Botswana); <sup>3</sup>endemic to Namibia (and probably southern Angola); <sup>4</sup>endemic to Angola, Namibia and South Africa. Data compiled from Prendini (1995).

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1. *Parabuthus brevimanus* (Thorell, 1877)<sup>4</sup>
  2. *Parabuthus capensis* (Ehrenberg, 1831)<sup>2</sup>
  3. *Parabuthus gracilis* Lamoral, 1979<sup>1</sup>
  4. *Parabuthus granulatus* (Ehrenberg, 1831)
  5. *Parabuthus kalaharicus* Lamoral, 1977<sup>2</sup>
  6. *Parabuthus kraepelini* Werner, 1902<sup>3</sup>
  7. *Parabuthus kuanyamarum* Monard, 1937
  8. *Parabuthus laevifrons* (Simon, 1888)<sup>2</sup>
  9. *Parabuthus muelleri* Prendini, sp. nov.<sup>1</sup>
  10. *Parabuthus namibensis* Lamoral, 1979<sup>1</sup>
  11. *Parabuthus nanus* Lamoral, 1979<sup>2</sup>
  12. *Parabuthus raudus* (Simon, 1888)
  13. *Parabuthus schlechteri* Purcell, 1899<sup>2</sup>
  14. *Parabuthus stridulus* Hewitt, 1914<sup>1</sup>
  15. *Parabuthus villosus* (Peters, 1862)<sup>4</sup>
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from Namibia, were recently discovered in the collections of the National Museum of Namibia. Fifteen species of *Parabuthus* are now recorded from Namibia (Table 1).

#### MATERIAL AND METHODS

International abbreviations for scientific institutions, housing collections from which material was examined, are as follows: National Museum of Namibia, Windhoek (NMNW); Natal Museum, Pietermaritzburg, South Africa (NMSA); South African Museum, Cape Town (SAMC); Transvaal Museum, Pretoria, South Africa (TMSA).

The holotype of the new species is deposited in the NMNW, and the paratype in the SAMC. Specimens of *P. capensis* examined for comparative purposes are deposited in the collections of the NMNW, NMSA, SAMC and TMSA. The holotype was illustrated using a Wild stereomicroscope and camera lucida.

Measurements were made with Mitutoyo® digital calipers (model NTD12-6''C). Colour designation follows Smithe (1974, 1975, 1981), trichobothrial notation follows Vachon (1974), and mensuration follows 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, and Stahnke (1970), Lamoral (1979), and Sissom (1990) for the remaining features. However, the terms used by previous authors on the African fauna (Eastwood 1977; Lamoral 1977, 1979; FitzPatrick 1994) for certain metasomal carinae have been replaced with terms implying specific homology statements between carinae on segment V and those on the preceding segments. The term 'ventral' (segments I–V) is replaced with 'ventrosubmedian' (segments I–IV only) and 'ventromedian' (seg-

ment V only), and the terms 'dorsal' (segments I–IV only) and 'ventrolateral' (segment V only) are replaced with 'lateral', and the terms 'dorsal' (segments I–IV only) and 'dorsal accessory' (segment V only), are replaced with 'dorsosubmedian'.

#### SYSTEMATICS

##### *Parabuthus muelleri* Prendini, sp. nov.

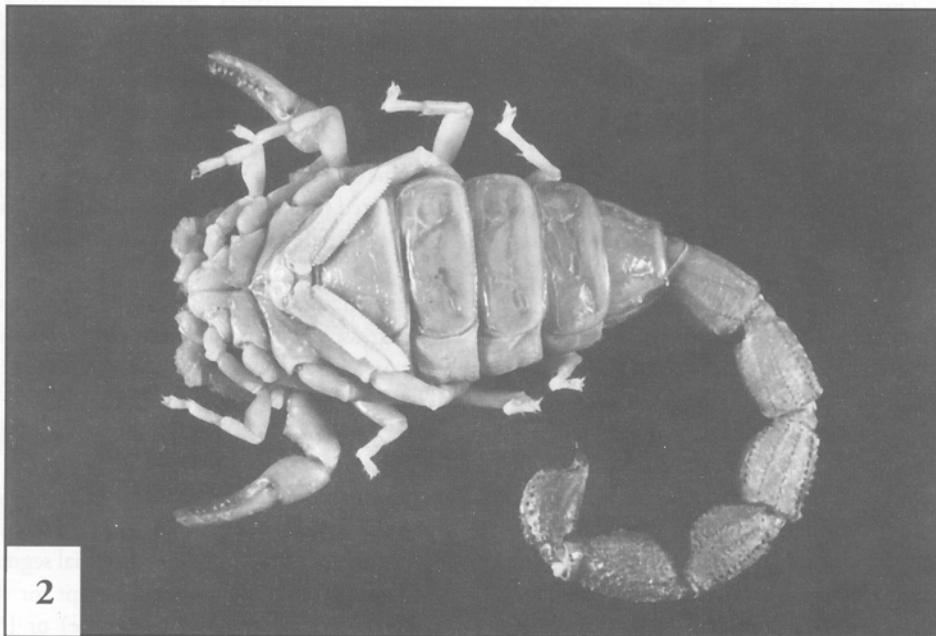
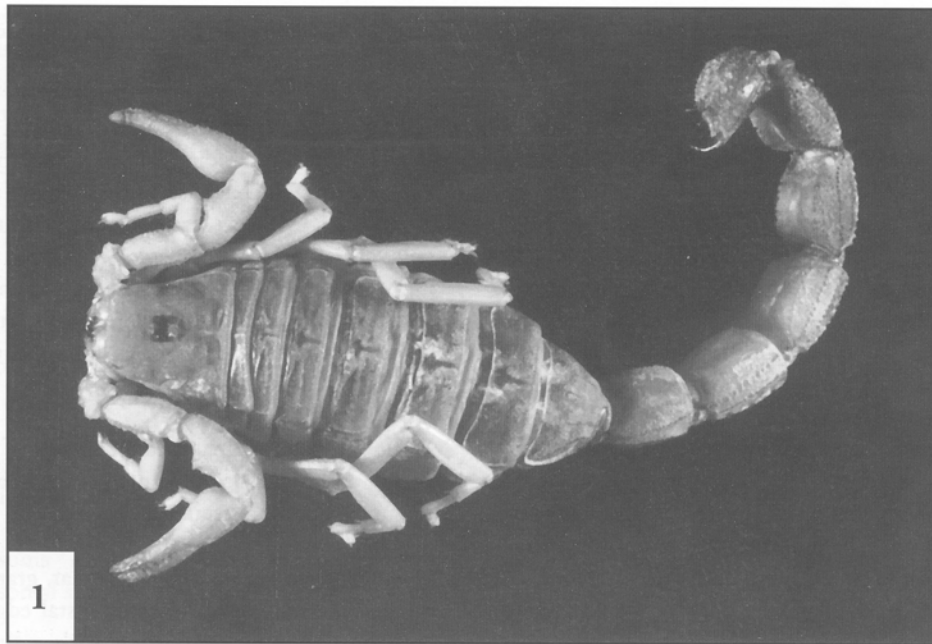
Figures 1-9

**MATERIAL:** Holotype ♀, 'NAMIBIA. Hardap Region, Maltahöhe Distr., 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, rocky flats (calcrete and dolomite) near roadside, excavated from burrow of *Opisthophthalmus opinatus* (Simon), which was partially consumed' (NMNW 1854). Paratype ♀, 'NAMIBIA. Karas Region, Lüderitz Distr., Farm Plateau 38, near Aus, 26°40.62'S 16°31.85'E, 1550 m, 30.xii.1997, L. Prendini & E. Scott, collected at night with UV light on rocky flats (dolomite) near farmhouse' (SAMC C4514).

**DESCRIPTION:** Detailed measurements are presented in Table 2.

The following description is based on the holotype and paratype of *P. muelleri* sp. nov., with differences between these specimens being noted. The two specimens are very similar in most respects, although the paratype is slightly smaller (as can be seen by the carapace dimensions). The ♂ of *P. muelleri* sp. nov. is currently unknown.

**Colour:** Carapace, chelicerae, tergites, sternites and metasomal segments I–III: Cinnamon No. 123A. Metasomal segments IV–V: Burnt Sienna No. 132. Telson: Maroon No. 31. Pedipalps and legs: Clay Color No. 123B. Pectines: Chamois No. 123D. Metasomal segments IV–V and telson are distinctly darker than segments I–III,



Figures 1-2. *Parabuthus muelleri* sp. nov. (Holotype ♀, NMNW 1854), habitus. 1, dorsal aspect; 2, ventral aspect. Scale bar = 10 mm.

whereas pedipalps and legs are distinctly lighter than carapace, mesosoma, metasoma and telson (Figures 1-2).

**Carapace:** Median ocelli considerably larger than lateral ocelli, situated anteromedially (Figure 1). Ocular tubercle with superciliary ridges well developed, protruding above median ocelli. Anterior margin of carapace slightly procurved, straight (holotype), or with small median projection (paratype). Carapace with sulci, without carinae, and covered entirely by uniform, fine granulation, except on the crests of the superciliary ridges.

**Pedipalps:** Pedipalps covered in short macrochaete setae. Femur finely and uniformly granular, with a few larger granules internally; carinae distinctly granular. Patella finely and uniformly granular; carinae weakly developed, granular. Chela smooth; carinae obsolete. Chela slender, length along ventro-external carina greater than chela width and chela height. Chela movable finger bent slightly downwards, leaving a distinct 'gap' proximally with fixed finger, when fingers are closed (Figure 3); chela fingers with dentate margins composed of 10-11 granular rows, each comprising 4-6 small granules and a large granule, flanked by an inner and an outer accessory granule; chela fingers each ending in a terminal denticle.

**Trichobothria:** Orthobothriotaxic, type A,  $\alpha$  configuration (Figures 3-6), with the 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 (the holotype has an accessory trichobothrium in the *Eb* series of the right-hand chela manus). Chela with *eb* and *esb* proximal to basal dentate margin of fixed finger; *dt* almost level with *et* (holotype) or slightly distal (paratype); *db* equidistant between *est* and *esb*. Patella with *esb*<sub>2</sub> distinctly distal to *esb*<sub>1</sub>. Femur with *d*<sub>2</sub> on proximo-

internal side of dorso-internal carina; *d*<sub>3</sub> distal to *d*<sub>2</sub>; *d*<sub>4</sub> closer to *d*<sub>3</sub> than to *d*<sub>5</sub>.

**Legs:** Retrolateral margins of basitarsi I-II and, to a lesser extent basitarsi III, each with row of long, fine macrochaete setae; retrolateral margins of tibia I-II with scattered macrochaete setae. Ventral surfaces of telotarsi I-IV each with numerous fine macrochaete setae. Telotarsal lateral lobes truncated; median dorsal lobes extending to unguis. Telotarsal unguis short, distinctly curved and of equal length.

**Pectines:** First proximal median lamella of each pecten sub-oval, mesially enlarged and lobate (Figure 2). Pectinal teeth: 31/31-32.

**Mesosoma:** Tergites entirely granular, granulation becoming coarser towards distal edge of each post-tergite; I-VII each with a single, weakly developed median carina, VII additionally with paired dorsosubmedian and dorsolateral carinae. Tergite VII with well-developed stridulatory region between dorsosubmedian carinae, consisting of round to slightly crescent-shaped fine granules reaching the posterior margin. Sternites entirely smooth; lateral and distal margins of sternites V-VII with a row of sparsely distributed macrochaete setae; sternite VII with four, weakly developed, costate carinae.

**Metasoma and telson:** Metasomal segments I-V progressively decreasing in width, segment V 8% narrower than segment I; width percentage of length 77% (75-79%) for I, 76% (75-77%) for II, 73% (72-74%) for III, 69.5% (65-74%) for IV, and 55.5% (54-57%) for V, giving the metasoma a slender appearance. Telson vesicle not distinctly narrower than metasomal segment V, width 89% (87-91%) of metasomal segment V. Metasoma entirely granular, except for ventral surfaces of segment I (holotype) or I-III (paratype), and dorsal surfaces of IV-V and telson (holotype) or III-IV and telson (paratype). Metasomal segments I-II each with

**Table 2.** Meristic data for the type specimens of *Parabuthus muelleri* sp. nov., and two ♀♀ *Parabuthus capensis* (Ehrenberg), from Piekenierskloof Pass, Western Cape Prov., South Africa (SAMC C98), and Richtersveld National Park, Northern Cape Prov., South Africa (SAMC C4513), included for comparison. Measurements following Stahnke (1970) and Lamoral (1979). <sup>1</sup>Sum of carapace, tergites I–VII, metasomal segments I–V and telson.

		<i>P. muelleri</i> sp. nov.		<i>P. capensis</i> (Ehrenberg)	
		Holotype	Paratype	SAMC C98	SAMC C4513
Total length <sup>1</sup>		69.96	61.82	92.77	90.08
Carapace	length	7.41	6.76	9.95	9.72
	anterior width	4.48	4.35	5.82	5.68
	posterior width	8.22	7.03	10.74	10.19
Mesosoma	total length	20.73	16.26	26.37	25.01
Sternite VII	length	4.79	4.31	6.7	5.87
	width	7.36	6.39	9.85	9.81
Metasoma	total length (incl. telson)	41.82	38.8	56.45	55.35
Metasomal segment I	length	6.19	5.74	8.29	7.81
	width	4.88	4.3	6.79	6.95
Metasomal segment II	length	6.38	5.98	8.47	8.26
	width	4.9	4.46	6.88	7.25
Metasomal segment III	length	6.75	6.06	8.22	8.2
	width	5.02	4.36	7.13	7.28
Metasomal segment IV	length	6.77	6.47	9.1	9.24
	width	5.04	4.22	7.03	7.11
Metasomal segment V	length	7.9	7.35	10.85	10.36
	width	4.51	3.97	6.36	6.08
Telson	total length	7.83	7.2	11.52	11.48
	aculeus length	2.05	2.04	4.19	4.5
	vesicle length	5.78	5.16	7.33	6.98
	vesicle width	3.92	3.62	5.44	5.25
	vesicle height	3.5	3.01	4.32	4.38
Pedipalp	total length	22.2	21.64	30.14	31.24
Femur	length	4.74	4.64	6.64	7.22
	width	2.3	1.86	2.59	2.45
Patella	length	5.4	5.4	6.89	7.42
	width	2.69	2.44	3.57	3.64
Chela	length	9.68	9.22	12.73	13.58
	width	2.62	2.26	2.94	3.24
	height	2.45	2.29	3.03	3.05
	length of ventro-external carina	3.55	3.54	4.57	5.18
	length of movable finger	6.03	6.08	8.28	8.83
Pectines	total length	7.31	7.12	8.95	10.6
	length along dentate margin	6.62	6.51	8.5	9.14
	tooth count (left/right)	31/32	31/31	32/32	37/38

a well-developed stridulatory region on the dorsal surface, consisting of round to slightly crescent-shaped fine granules extending to the posterior margin (Figure 7); segment III with stridulatory region narrow, virtually obsolete, consisting of a few granules in the proximal third of the segment; posterodorsal edge of segment II and, to a much lesser extent, segment III, elevated and slightly curved forward medially, forming a subtriangular 'lip' (Figure 7). Metasoma sparsely covered with long macrochaete setae, especially on the ventral surface of the telson. Metasomal segments with ten carinae on segments I–IV; segment IV with ventrosubmedian and median lateral carinae becoming obsolete distally; segment V with seven carinae, including a single, distally obsolete ventromedian carina, a pair of distinct ventrolateral carinae, a pair of dorsolateral carinae, distinct only in the proximal half of the segment, and a pair of dorsosubmedian carinae reduced to a few prominent rounded granules. 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, lateral carinae diverging in segment V. All metasomal carinae granular to costate granular, except for ventrosubmedian and ventrolateral carinae of segment I, which are costate. Metasomal segments I–IV with distal granules of dorsosubmedian carinae very slightly enlarged; segments II–III with distal granules of ventrosubmedian carinae and, to a lesser extent, ventrolateral carinae, distinctly enlarged, obtuse and elevated; segment V with subdistal granules of ventrolateral carinae enlarged into laterally compressed, lobate processes. Telson with a distal 'bulge' and a very short, sharply curved aculeus (Figure 8); aculeus length percentage of vesicle length 37.5% (35–40%).

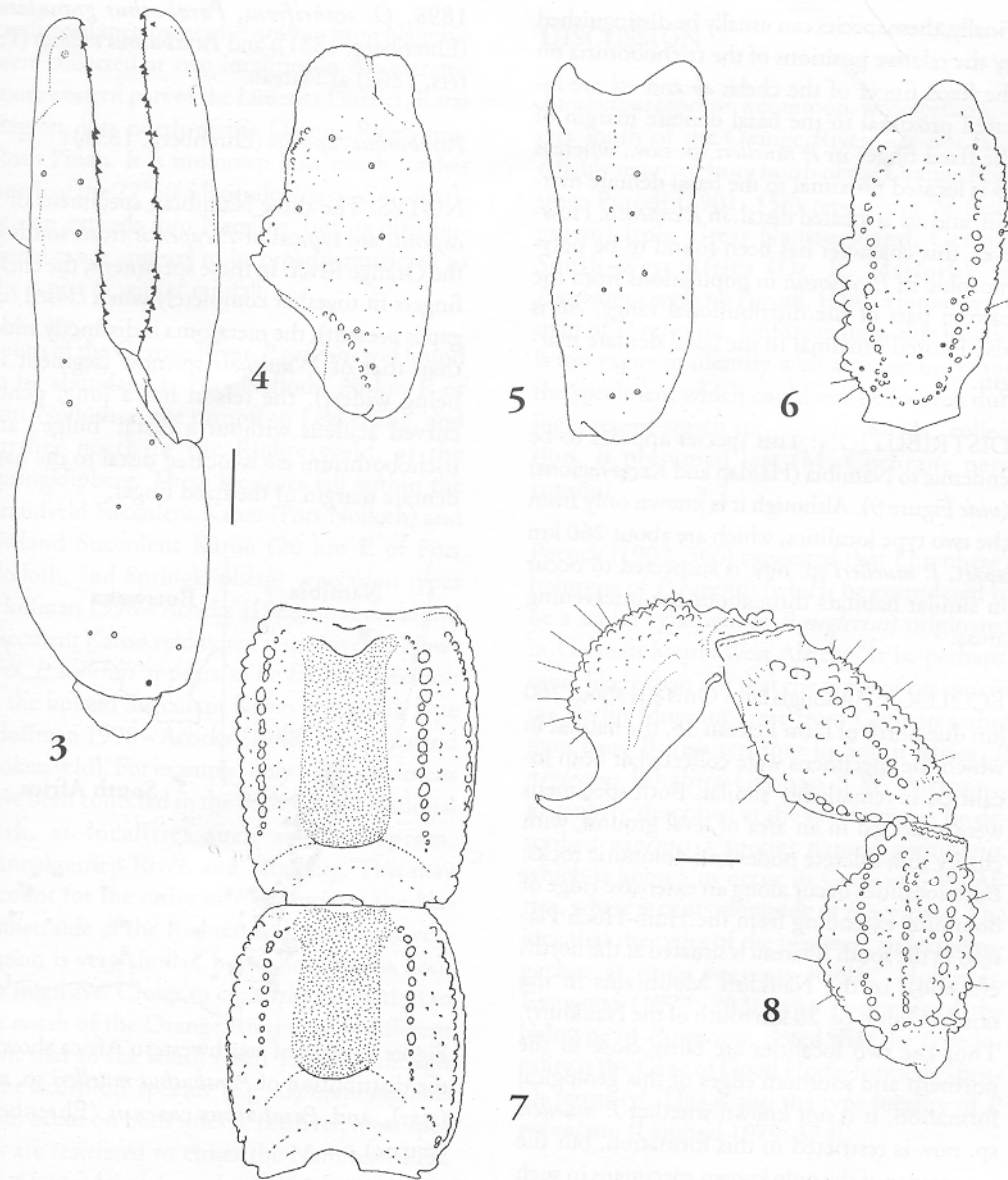
**ETYMOLOGY:** This new Namibian species is named after Dr. Gerbus J. Müller (Department of Pharmacology, University of Stellenbosch),

in honour of his contribution to an understanding of the clinical symptomatology of *Parabuthus* envenomation in southern Africa.

**DIAGNOSIS:** *Parabuthus muelleri* sp. nov. is most closely related to *P. capensis*, with which it shares a unique synapomorphy: the posterodorsal edge of metasomal segment II, and to a lesser extent III, is elevated and slightly curved forward medially, forming a subtriangular 'lip'. These two species can be separated from all other *Parabuthus* on the basis of this character.

*Parabuthus muelleri* sp. nov. can be readily distinguished from *P. capensis* by the following characters. The chelae of *P. muelleri* sp. nov. have a distinctive shape because the fingers do not fit completely together when closed, i.e. a proximal 'gap' is present, compared with *P. capensis*, in which no gap is present. A proximal gap occurs in the ♂ sex of several *Parabuthus* species, e.g. *Parabuthus granulatus* (Ehrenberg, 1831), *Parabuthus kalaharicus* Lamoral, 1977 and *Parabuthus laevifrons* (Simon, 1888), but is uncommon in the ♀ sex. A proximal gap does not occur in the ♂ or ♀ of *P. capensis*.

In addition, *P. muelleri* sp. nov. has a characteristically narrow metasoma, in which the median width:length percentage for metasomal segments I–V is 77%, 76%, 73%, 69.5%, and 55.5%, compared with the metasoma of *P. capensis*, in which the median width:length percentage is 85.5%, 83.5%, 89%, 77%, and 57% ( $n = 6$ ). Metasomal segment III is characteristically wider than segments I–II in *P. capensis*, but this is not the case in *P. muelleri* sp. nov. The new species is further distinguished by the unusual shape of the telson, which differs from all known *Parabuthus* species in the presence of a distal 'bulge' and a very short, sharply curved aculeus. The median percentage of aculeus length:telson length in *P. muelleri* sp. nov. is 37.5%, compared with 60.5% in *P. capensis*.



Figures 3-8. *Parabuthus muelleri* sp. nov. (Holotype ♀, NMNW 1854), diagnostic characters. 3-6. Distribution of trichobothria on the right-hand pedipalpal segments. 3, dorsal aspect of chela (trichobothrium *it* indicated with dotted circle; accessory trichobothrium in *Eb* series indicated with solid circle); 4, dorsal aspect of patella; 5, external aspect of patella; 6, dorsal aspect of femur. 7-8. Metasomal segments and telson. 7, dorsal aspect of segments I-II, showing stridulatory region (shaded) and subtriangular 'lip'; 8, lateral aspect of segments IV-V and telson. Scale bars = 10 mm.

Finally, these species can usually be distinguished by the relative positions of the trichobothria on the fixed finger of the chela: *eb* and *esb* are located proximal to the basal dentate margin of the fixed finger in *P. muelleri* sp. nov., whereas *eb* is located proximal to the basal dentate margin, and *esb* is located distal, in *P. capensis*. However, this character has been found to be polymorphic in *P. capensis*: in populations from the eastern part of the distributional range, *esb* is also located proximal to the basal dentate margin.

**DISTRIBUTION:** This species appears to be endemic to Namibia (Hardap and Karas regions) (*vide* Figure 9). Although it is known only from the two type localities, which are about 260 km apart, *P. muelleri* sp. nov. is suspected to occur in similar habitats throughout the intervening areas.

**ECOLOGY:** Although farm Onis 8 is about 260 km due north of farm Plateau 38, the habitat in which the specimens were collected at both localities, is remarkably similar. Both specimens were collected in an area of level ground, with chalky soil, calcrete nodes and dolomitic rocks. Both localities occur along an extensive ridge of dolomite, extending from the Huib-Hoch Plateau in the south (Plateau is situated at the northern end), to the Naukluft Mountains in the north (Onis is *ca.* 20 km south of the Naukluft). Thus the two localities are fairly close to the northern and southern edges of this geological formation. It is not known whether *P. muelleri* sp. nov. is restricted to this formation, but the occurrence of the only known specimens in such similar, albeit distantly located habitats, suggests that this may be the case.

*Parabuthus muelleri* sp. nov. was found to be syntopic with *Opisththalmus opinatus* (Simon, 1888) and *Opisththalmus scabrifrons* Hewitt, 1918 at Onis, and with *Hadogenes tityrus* (Simon, 1888), *Opisththalmus gigas* Purcell,

1898, *O. scabrifrons*, *Parabuthus granulatus* (Ehrenberg, 1831), and *Parabuthus villosus* (Peters, 1862) at Plateau.

*Parabuthus capensis* (Ehrenberg, 1831)

**NOTES:** The three Namibian specimens of *P. capensis* are typical of *P. capensis* from south of the Orange River. In these specimens, the chelal fingers fit together completely when closed (no gap is present), the metasoma is distinctly wider than that of *P. muelleri* sp. nov. (segment III being widest), the telson has a long, gently curved aculeus without a distal 'bulge', and trichobothrium *esb* is located distal to the basal dentate margin of the fixed finger.

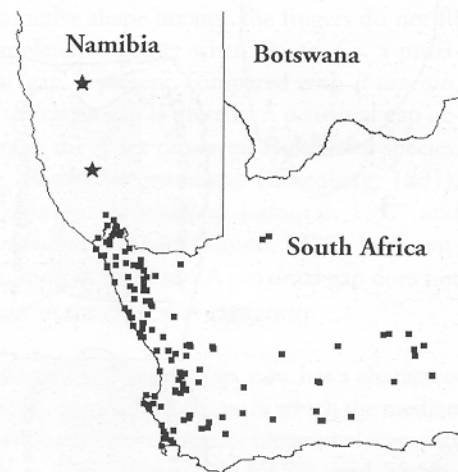


Figure 9. Map of southwestern Africa showing the distribution of *Parabuthus muelleri* sp. nov. (star), and *Parabuthus capensis* (Ehrenberg) (square).

**DISTRIBUTION:** *Parabuthus capensis* is endemic to South Africa (*vide* Figure 9). Although the distributional range of this species is concentrated in the Western Cape and Northern Cape provinces, a few specimens have also been collected in the Cradock, Graaff-Reinet, Middelburg, Steynsburg and Willomore districts of the Eastern Cape province. Thus far, the only three



confirmed specimens of *P. capensis* from Namibia were collected at two localities in the extreme southwestern part of the Lüderitz District, Karas Region, just north of the Orange River, near Rosh Pinah. It is unknown how much further north of the 27°50'S latitude this species' distribution extends into Namibia, but its distributional range appears to be broadly restricted to the limits of winter rainfall.

South of the Orange River, *P. capensis* was found to be abundant at Port Nolloth, 20 km E of Port Nolloth at the turnoff to Lekkersing, and further north in the Richtersveld, at the Springklipberg. These localities fall within the strandveld Succulent Karoo (Port Nolloth) and lowland Succulent Karoo (20 km E of Port Nolloth, and Springklipberg) vegetation types (Hoffman 1998 = Acocks' [1988] strandveld and Succulent Karoo veld types, respectively). However, *P. capensis* appears to be far less common in the upland Succulent Karoo vegetation type (Hoffman 1998 = Acocks' [1988] Namaqualand broken veld). For example, only a few specimens have been collected in the Richtersveld National Park, at localities such as Potjiespram, Gannakouriep River, and Tatasberg. This may account for the rarity of *P. capensis* on the Namibian side of the Richtersveld, where the vegetation is very similar, but collecting has been less intensive. Closer to coast, the vegetation to the north of the Orange River is very different from that to the south (Irish 1994). Although some scorpion species (e.g. *Opisththalmus gigas*) occur on both sides of the river, most species are restricted to either the Namibian side, e.g. *Opisththalmus adustus* Kraepelin, 1908 and *Parabuthus stridulus* Hewitt, 1914, or the South African side, e.g. *Opisththalmus ammopus* Lamoral, 1980 and *Parabuthus distridor* Lamoral, 1980 (Prendini 1995). Thus, although *P. capensis* may also be expected to occur in the southwestern part of Diamond Area 1, this cannot be predicted with certainty.

## DISCUSSION

*Parabuthus capensis*, a common, widespread species south of the Orange River, has not been reliably reported from north of the Orange River since Purcell (1901: 158) reported a "♀ (half-grown) from Great Namaqualand, German South-West Africa (Dr. R. Marloth)" as *Parabuthus neglectus* Purcell, 1899 (a junior synonym of *P. capensis*). Unfortunately, this locality is too vague to identify with any certainty, and the specimen, which could not be located during a recent search through the SAMC collection, is presumed lost (M. Cochrane pers. comm.).

Pocock (1902: 366) suggested that Ehrenberg's holotype of *P. capensis* (which he considered to be a senior synonym of *P. neglectus*) originated in German South-West Africa: "It is, perhaps, more likely than not that the types of *capensis* in the Berlin Museum came from German rather than from British territory in South Africa. *P. neglectus* inhabits German S.W. Africa ... Ehrenberg described at the same time as he described *capensis* a species named *granulatus*, which is known to occur in German S.W. Africa, where it exists alongside of *P. neglectus*. The idea that the types of the two were collected together at once suggests itself." However, Eastwood (1977: 203), who re-examined the holotype of *P. capensis*, noted that the type locality is the Cape of Good Hope, formerly 'British territory'. This is also the type locality of *P. granulatus* (Lamoral 1979: 574).

Werner (1936: 178) reported *P. capensis* from Omaruru, Windhoek, Lüderitz and Post Aris, while Roewer (1943: 207), reported the species from Gobabis and Windhoek. As noted by Lawrence (1955: 226), these records are highly unlikely. All available evidence indicates that *P. capensis* is restricted to the extreme southwestern part of the Karas Region in Namibia, prob-

ably south of the 27°50'S latitude. These authors most likely confused *Parabuthus kraepelini* Werner, 1902 or *Parabuthus raudus* (Simon, 1888) for *P. capensis*. Lamoral & Reynders (1975: 515) also concurred with Lawrence's (1955) view, and Lamoral (1979) subsequently omitted *P. capensis* from his revision of the Namibian scorpions.

Although Purcell's (1901) original record of *P. capensis* from Namibia has now been confirmed, *P. capensis* appears to be extremely uncommon north of the Orange River. For example, Lamoral (1979: 501) examined approximately 5700 specimens for his revision, only two of which (NMNW 480 and NMNW 487) were identified as *P. capensis*. In the twenty years since Lamoral's revision appeared, extensive collecting has been conducted throughout Namibia using long term pitfall traps, UV detection methods, and a variety of other techniques. UV detection, in particular, has been shown to greatly increase collecting yields, and has resulted in the discovery of numerous undescribed species, even in previously well-collected areas (e.g. Lamoral 1979; Sissom *et al.* 1990; Williams 1980). Nevertheless, a thorough search through the collections of the NMNW, NMSA, SAMC and TMSA has revealed no additional specimens of *P. muelleri* sp. nov., and only the abovementioned three specimens of *P. capensis*. The rarity of *P. capensis* in Namibia may be explained by the fact that the Namibian records are at the northern periphery of its distributional range (*vide* Figure 9). However, a similar explanation cannot account for the rarity of *P. muelleri* sp. nov. Perhaps this species is highly cryptic, only appearing on the surface for brief periods during particular environmental conditions, and has thus never been collected. Future collecting efforts should concentrate on the type localities, and other localities with similar habitat, using a variety of collecting methods, so that an adult ♂ specimen of *P. muelleri* sp. nov. can be obtained for comparative systematic purposes.

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**Appendix.** New records of *Parabuthus capensis* (Ehrenberg, 1831) from Namibia and South Africa (*vide* Figure 9 for distribution map). International abbreviations for scientific institution are as follows: National Museum of Namibia, Windhoek (NMNW); Natal Museum, Pietermaritzburg, South Africa (NMSA); South African Museum, Cape Town (SAMC); Transvaal Museum, Pretoria, South Africa (TMSA).

#### MATERIAL

NAMIBIA: Karas Region, Lüderitz Distr., ♂ (NMNW 480), Farm Namuskluft 88 [27°53'S 16°50'E], 12–15.ix.1973, E. Mokgoabone, under stones; ♀ (NMNW 487), Farm Namuskluft 88, 21–22.ix.1973, C.G. Coetzee, J. Batista, and E. Mokgoabone, in sand; ♂ (NMNW 1509), Boomrivier [Fish River Canyon National Park, 28°01'S 17°04'E], 13–26.ix.1992, E. Marais, preservative pitfall trap.

SOUTH AFRICA: ♂ (SAMC C4533), Eastern Cape Prov., Graaff-Reinet Distr., 5 ♂♂ 2 ♀♀ 2 juv ♀♀ (SAMC 12010), Graaff-Reinet and Kruidfontein, 8 mi from Graaff-Reinet [32°22'S 24°36'E], ix.1902, J. Paynter; Willomore Distr., ♀ (SAMC 8873), Willowmore [33°18'S 23°29'E], 1901, H. Brauns; Northern Cape Prov., Calvinia Distr., 2 ♀♀ juv ♂ 5 juv ♀♀ (SAMC 12710), Calvinia [31°25'S 19°45'E], i.1903, G. French; 2 ♂♂ subadult ♂ subadult ♀ juv ♀ (SAMC 4035), Nieuwoudtville, Bokkeveld Mts. [31°23'S 19°06'E], ix.1898, F. Treleaven; 2 ♀♀ (SAMC 1200), Onder Bokkeveld, Oorlogskloof [31°26'S 19°09'E], 1897, M. Schlechter; ♂ (TMSA 6550), Van Rhyn's Pass, Nieuwoudtville [31°23'S 19°01'E], 5.iv.1933, V. Fitzsimons; Gordonia Distr., ♂ 3 ♀♀ 5 subadult ♂♂ (SAMC B8943), Upington [28°27'S 21°15'E], Boonstra & Thorne, Kalahari Expedition; Hanover Distr., juv ♂ (SAMC 9992), Eierfontein, 8–9 mi W of Hanover [31°05'S 24°18'E], xii.1901, S.C. Schreiner; 2 ♀♀ (SAMC 9989), Hanover [31°04'S 24°27'E], ix.1901, O. Schreiner; Namaqualand Distr., ♀ subadult ♀ juv ♂ (SAMC C1376), viii.1972; ♀ juv ♂ (SAMC C1743), 1897, L. Mally; ♂♀ (SAMC 472), 1885, L. Péringuey; ♀ subadult ♂ (SAMC B9450), T. Wellington; ♀ (SAMC C3824), 10 km E of Aenous Pass [29°14'S 17°42'E], 10.x.1983, J. Visser; subadult ♂ (SAMC C4557), 20 km E of Port Nolloth at turnoff to Lekkersing [29°13'S 17°06'E], iii.1997, L. Prendini & E. Scott, red sand flats, collected at night with UV light; juv ♀ (SAMC C4554), same locality, but 16.i.1999, G.J. Müller, J.J. van der Walt, *et al.*, collected at night with UV light; ♀ (SAMC C37), 20 km E of Kamieskroon [30°12'S 18°03'E], 19.xi.1975, E.B. Eastwood, under stone; ♂ (SAMC C3830), 3 km W of Springbok [29°40'S 17°52'E], 25.xi.1983, J. Visser; ♂ (SAMC C3823), 30 km S of Springbok [29°55'S 17°53'E], 10.x.1983, J. Visser; ♀ (SAMC B568), 36 mi up rail from Port Nolloth [29°11'S 17°23'E], i.1911, C.L.L. Biden; ♂ (SAMC 2948), Aggeneyns [29°12'S 18°51'E], 2.iii.1880, M.

Schlechter; 2 ♀♀ (SAMC 1711), between Springbokfontein and Steinkopf [29°22'S 17°52'E], 1897, M. Schlechter; ♀ (SAMC 1702), Concordia [29°32'S 17°57'E], 1897, M. Schlechter; 2 ♂♂ ♀ 5 subadult ♂♂ subadult ♀ 4 juv ♂♂ 2 juv ♀♀ (SAMC 5198), Concordia, 1899, J.H.C. Krapohl; juv ♀ (TMSA 11660), Farm Gembokvlakte [30°30'S 17°24'E], 1.ix.1977, S. Endrödy-Younga; ♀ (TMSA 12285), subadult ♂ (TMSA 12286), Farm Perdekraal [30°46'S 17°53'E], 24.viii.1979, S. Endrödy-Younga; subadult ♂ (TMSA 11654), juv ♂ (TMSA 11655), Farm Quaggafontein [30°08'S 17°38'E], 9.viii.1977, S. Endrödy-Younga; 2 subadult ♂♂ (TMSA 12287, 12289), Farm Rondabel [30°47'S 17°50'E], 24.viii.1979, S. Endrödy-Younga; ♀ (TMSA 12294), Farm Rooidam [31°04'S 17°48'E], 6.viii.1979, S. Endrödy-Younga; 2 subadult ♀♀ (TMSA 12290, 12292), 2 juv ♀♀ (TMSA 12291, 12293), Farm Waterval [31°03'S 17°46'E], 25.viii.1979, S. Endrödy-Younga; ♀ 2 subadult ♂♂ (SAMC 1703), Garies [30°33'S 17°59'E], 1897, M. Schlechter; 4 ♀♀ juv ♀ (SAMC B7295), Garies, v.1928, B. Peers; juv ♂ (SAMC C43), Garies, 18.xi.1975, E.B. Eastwood; juv ♂ (SAMC C1337), Groenriviermond [30°51'S 17°35'E], 30.xi.1976, V.B. Whitehead, under stone; juv ♂ (SAMC 1713), Hartebeestfontein, near Steinkopf [29°14'S 17°48'E], 1897, M. Schlechter; subadult ♂ (TMSA 17646), Helskloof Pass, Richtersveld [28°47'S 17°29'E]; ♀ (TMSA 12303), Hoekbaai, 2 km ENE [31°11'S 17°47'E], 27.viii.1979, S. Endrödy-Younga; subadult ♂ (SAMC C3867), Hoits Mine, 10 km E of Springbok [29°54'S 17°57'E], 18.iv.1986, J. Visser; ♀ (SAMC C3856), Holgat, Port Nolloth [29°17'S 16°51'E], 9.iii.1985, J. Visser; ♀ (SAMC C49), Jakkalsputs, Richtersveld [28°40'S 16°57'E], 21.xi.1975, V.B. Whitehead, on red sand dunes at night; ♂ ♀ (SAMC B7314), Kamies [30°17'S 18°04'E], vii.1929, B. Peers; ♀ 2 subadult ♂♂ subadult ♀ (SAMC B7338), Kamieskroon [30°12'S 17°56'E], ix.1930, Museum expedition; ♀ (SAMC C3877), Kinderlê, 8 km N of Steinkopf [29°11'S 17°48'E], 16.x.1987, J. Visser; subadult ♂ (TMSA 12297), Klein Kogelfontein [31°10'S 17°50'E], 27.viii.1979, S. Endrödy-Younga; ♂ (SAMC C3878), ♀ (SAMC C3881), Kleinsee [29°40'S 17°05'E], ix.1987, J. Visser; juv ♂ (SAMC 5152), Klipfontein, [29°14'S 17°39'E], 1899, R.H. Howard; 4 ♀♀ (TMSA 12273, 12278, 12283–12284), 4 subadult ♂♂ (TMSA 12274–12275, 12277, 12279), juv ♂ (TMSA 12281), Kotzesrus [30°57'S 17°50'E], 23.viii.1979, S. Endrödy-Younga; ♂ 2 ♀♀ subadult ♂ (SAMC B571), Kuboos [Khubus], Richtersveld [28°27'S 17°00'E], i.1911, C.L.L. Biden; ♂ (SAMC B8944), Kuboos, R. Smithers; ♀ (TMSA 14089), Lekkersing [29°00'S 17°06'E], 30.xi.1962; ♀ subadult ♂ (SAMC 1701), Okiep [29°36'S 17°53'E], 1897, M. Schlechter; 2 ♂♂ 3 ♀♀ 4 subadult ♂♂ 2 subadult ♀♀ 3 juv ♂♂ 2 juv ♀ (NMSA 10358), Port Nolloth [29°17'S 16°51'E], iv.1972, J. Visser; ♂ (SAMC C3825), Port

- Nolloth, 17.xii.1983, J. Visser; ♂ (SAMC C3855), same data, except 9.iii.1985; subadult ♀ juv ♂ (SAMC C4525), Port Nolloth, v.1986, A.J. Prins; ♀ (SAMC C4558), ♀ (SAMC C4562), Port Nolloth, ii.1997, L. Prendini & G.J. Müller, collected at night with UV light; juv ♂ (TMSA 12222), juv ♀ (TMSA 12221), Richtersveld, Doringpoort [28°34'S 16°56'E], 7.ix.1976, S. Endrödy-Younga; 2 ♂♂ 2 ♀♀ (SAMC C4553), Richtersveld National Park [28°15'S 17°05'E], x-xiii.1994, H. Braack; 2 juv ♀♀ (SAMC C4555), Richtersveld National Park [28°12'S 17°07'E], 14.i.1999, G.J. Müller, J.J. van der Walt, *et al.*, collected at night with UV light; ♀ (SAMC C4563), Richtersveld National Park, Gannakouriep River bed [28°23'S 17°10'E], ii.1997, L. Prendini, G.J. Müller, *et al.*, collected at night with UV light; ♂ (SAMC C4560), Richtersveld National Park, Potjiespram [28°10'S 16°53'E], 7.ii.1997, L. Prendini, G.J. Müller, *et al.*, collected at night with UV light; ♀ (SAMC C4513), Richtersveld National Park, S of Peilkop, ix.1996, P. Lloyd, collected at night with UV light; ♀ (SAMC C4559), Richtersveld National Park, Tatasberg [28°19'S 17°15'E], ii.1997, L. Prendini, G.J. Müller, *et al.*, collected at night with UV light; ♀ (SAMC C3871), Richtersveld, 8 km N of Kinderlé [29°05'S 17°47'E], v.1987, J. Visser; subadult ♀ (TMSA 12218), Rietfontein [28°48'S 16°35'E], 2.ix.1976, S. Endrödy-Younga; ♀ (SAMC C3822), S of Springbok [29°54'S 17°52'E], 10.ix.1983, J. Visser; ♂ (SAMC C4561), Springbok [29°40'S 17°53'E], xii.1997, L. Prendini & E. Scott, collected at night with UV light; ♂ (SAMC C3852), ♀ (SAMC C3851), Springbok to Aggeney's [29°30'S 18°10'E], iii.1985, G. Behr; ♀ (SAMC C4556), Springklipberg, Richtersveld [28°37'S 16°52'E], red sand dunes 2 km E, ii.1997, L. Prendini & G.J. Müller, collected at night with UV light; ♂ 2 ♀♀ (SAMC 567), Steinkopf [29°16'S 17°44'E], 1897, W.H. Turlé; ♂ (SAMC 1704), Steinkopf, 1897, M. Schlechter; subadult ♂ (TMSA 11652), Wildepaardchoek, 28.viii.1977, S. Endrödy-Younga; Sutherland Distr., ♀ (SAMC C3866), Verlatenkloof, S of Sutherland [32°32'S 20°36'E], J. Visser; Victoria West Distr., ♂ (SAMC C3820), Victoria West [31°24'S 23°07'E], 7.ix.1983, J. Visser; Williston Distr., ♀ (SAMC B1753), Zak River [31°37'S 21°37'E], xi.1916, F.M. Wilson; Northern and Western Cape provinces, Calvinia, Vanrhynsdorp, Clanwilliam and Namaqualand districts, 2 ♂♂ ♀ 2 juv ♂♂ juv ♀ (SAMC 1721), 1897, L. Mally; Western Cape Prov., ♀ (SAMC C1518), Great Karroo, M. Stiller; 2 ♀♀ subadult ♀ 3 juv ♂♂ (SAMC 11506), Hermanuspetrusfontein, near village, 17.ii.1902, R.M. Lightfoot; 2 ♀♀ (SAMC 11511), Hermanuspetrusfontein, on flats near village, ii-iii.1902, R.M. Lightfoot & H. Herman; Beaufort West Distr., juv ♂ (SAMC 14361), Beaufort West [32°21'S 22°35'E], 24-30.x.1905, W.F. Purcell; ♂ (SAMC C195), Beaufort West, ii.1958, Museum expedition; ♂ (SAMC C4524), Karoo National Park [32°23'S 22°38'E], 13.vii.1988, A.J. Prins; ♂ (SAMC C4545), Karoo National Park, 1.iv.1994, J. Leeming, mid plateau, sympatric with *Parabuthus planicauda* (Pocock); Bellville Distr., ♀ (SAMC C4547), Belhar [33°57'S 18°38'E], 1998, ex G.J. Müller, brought into Tygerberg hospital; ♀ (SAMC C4546), Japonica Steet, Belhar, 28.iii.1998, ex G.J. Müller, brought into Tygerberg hospital; Cape Distr., ♀ 2 subadult ♂♂ 3 subadult ♀♀ 3 juv ♂♂ juv ♀ (SAMC 12813), Devil's Mt., above Woodstock, Park Road [33°55'S 18°26'E], viii.1903, Dreyer; ♂ (SAMC C3885), Silverstrand, 45 km N of Cape Town [33°34'S 18°22'E], 7.iii.1993, J. Visser; ♀ juv ♂ (SAMC C1618), Table View, Cape Town [33°49'S 18°29'E], 29.iv.1986, Louw; Clanwilliam Distr., 2 ♂♂ ♀ (SAMC C4548), 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; ♀ (SAMC 3760), Blikhuis, 15-20 mi S of Clanwilliam to Modderfontein [32°26'S 18°57'E], viii.1898, R.M. Lightfoot; ♀ (TMSA 12639), Bidouws Pass [32°02'S 19°24'E], 25.ix.1973, L. Schulze; ♀ 3 juv ♂♂ (SAMC 1199), Boontjies River, near Pakhuisberg [32°34'S 19°01'E], 1897, M. Schlechter; ♂ (SAMC 5206), Cedar Mountains near Pakhuis [32°07'S 18°52'E], xi.1899, R.M. Lightfoot; ♂ (SAMC C4549), Clanwilliam [32°13'S 18°55'E], xii.1997, L. Prendini & E. Scott, collected at night with UV light; ♀ (SAMC C4550), Clanwilliam, 6.ix.1997, J.J. van der Walt, collected at night with UV light; subadult ♀ [black form] (SAMC C36), Clanwilliam, 25 km N [32°08'S 18°51'E], 18.xi.1975, E.B. Eastwood, in burrow under stone; ♀ (SAMC 3754), Keurboschkraal Riv., Cedar Mts., Clanwilliam [32°40'S 18°45'E], viii.1898, R.M. Lightfoot; subadult ♂ [black form] (SAMC C1382), Lambert's Bay [32°06'S 18°19'E], 29.v.1978, sand and bushes; subadult ♂ [black form] (SAMC C3887), Lambert's Bay, J. Visser; subadult ♂ [black form] (SAMC C3796), same data, except v.1982; subadult ♀ [black form] (SAMC C3797), same data, except 4.vi.1982; subadult ♂ (SAMC C3795), Matjiesfontein [32°23'S 19°23'E], 13.vi.1982, J. Visser; ♂ (SAMC C3800), same data, except 17.viii.1982; 4 ♂♂ (SAMC 4048), Olyvenboschkraal, near Bergvlei, N of Piketberg Mts. [32°19'S 18°50'E], 1898, C.L. Leipoldt; ♂ (SAMC 3755), Onderbergvlei Farm, in Zuid Zandvelt Wyk [32°36'S 18°45'E], 24.viii.1898, C.L. Leipoldt; juv ♂ (SAMC 1198), Rondegat, 5 miles SSE of Clanwilliam [32°14'S 18°54'E], 1897, M. Schlechter; Hopefield Distr., 2 subadult ♀♀ (SAMC C80), Donkergat [33°04'S 18°00'E], ix.1976, G. McLachlin; subadult ♀ [black form] (SAMC C1624), Hopefield [33°04'S 18°21'E], v.1987, H. Schelten; ♂ [black form] (SAMC C2246), Hopefield, 16.iii.?, A.J. Prins; subadult ♂ (SAMC C3826), 2 subadult ♂♂ (SAMC C3827-3828), Langebaan [33°06'S 18°02'E], 21.x.1983, J. Visser; subadult ♂ (SAMC C6), Langebaanweg [32°58'S 18°09'E], vii.1973, B. Kensley; juv ♂ (SAMC C4526), Saldanha Bay [33°00'S 18°03'E], 1980, A.J. Prins; ♂ (SAMC C2285), Saldanha Bay, viii.1991, N. Larsen, under stone; Kuils River Distr., ♀ (SAMC C4551), Kuilsrivier

- [34°02'S 18°42'E], 1997, ex G.J. Müller, brought into Tygerberg Hospital; Laingsburg Distr., subadult ♀ (SAMC 12809), Matjiesfontein [33°14'S 20°35'E], viii.1903, W.F. Purcell; juv ♀ (SAMC 14363), same data, except 1–3.xi.1905; Malmesbury Distr., ♀ (SAMC C3798), ♀ (SAMC C3799), subadult ♀ (SAMC C3801), 2 juv ♂♂ (SAMC C3778–3779), Klipheuwel, N Durbanville [33°42'S 18°42'E], 5.viii.1982, J. Visser; juv ♀ (SAMC C4552), Melkbosstrand [33°44'S 18°26'E], v.1997, M.D. Picker; Montagu Distr., ♀ (SAMC B3979), Montagu [33°47'S 20°07'E], xi.1919, R.W.E. Tucker; Piketberg Distr., 2 ♀♀ (SAMC B8934), Eendekuil [32°41'S 18°53'E], Muller; ♂ 2 subadult ♀♀ subadult ♂ [black form] (SAMC C74), Laaipele [32°46'S 18°10'E], ix.1976, G. McLachlin, in sand dune; ♂ subadult ♀ [black form] (SAMC C4564), Laaipele, near Velddrif, xii.1998, Zoology Department, University of the Western Cape, under stones, ♂ attempted to mate with ♀ of typical *P. capensis*; ♀ subadult ♀ 3 juv ♀♀ (SAMC C98), Piekenierskloof Pass [32°37'S 18°57'E], 30.xi.1976, E.B. Eastwood, under stones; Simon's Town Distr., ♀ (SAMC B545), Cape Peninsula (dubious) [34°07'S 18°22'E], 26.v.1907, C.J. French; Prince Albert distr., ♀ (TMSA 12310), subadult ♂ (TMSA 12256), 2 subadult ♀♀ (TMSA 12261, 12369), 2 juv ♂♂ (TMSA 12266, 12340), 2 juv ♀♀ (TMSA 12349, 12352), Farm Zwartskraal [33°10'S 22°32'E], 15.xii.1979, S. Endrödy-Younga; subadult ♂ (TMSA 12235), Swartberg [33°25'S 22°40'E], 17.xii.1978, S. Endrödy-Younga; Tulbagh Distr., ♀ juv ♂ (SAMC 3758), Piquetberg Road Station, Gouda [33°22'S 19°07'E], viii.1898, R.M. Lightfoot; ♀ (SAMC 504), Tulbagh Road Station [33°19'S 19°06'E], 1895, J.P. Cregoe; Vanrhynsdorp Distr., ♂ (SAMC C3874), 60 km N of Vanrhynsdorp [31°10'S 18°25'E], v.1987, J. Visser; subadult ♂ (TMSA 12271), Farm Rietpoort [30°59'S 18°06'E], 22.viii.1979, S. Endrödy-Younga; subadult ♂ (SAMC C4566), Klawer [31°47'S 18°37'E], v.1996, L. Prendini, collected at night with UV light; juv ♂ (SAMC C41), Kliprand [30°36'S 18°42'E], 21.xi.1975, A.J. Prins, under stone; juv ♂ (TMSA 17645), Vanrhynsdorp [31°37'S 18°44'E], 5.vi.1968, G.R. McLachlan; ♂ (SAMC C4565), Vanrhynsdorp, 12 km N, near Varschrievier [31°33'S 18°32'E], xii.1997, L. Prendini & E. Scott, red sand, collected at night with UV light; Vredenburg Distr., subadult ♂ juv ♀ (SAMC C27), Jacobsbaai, N of Saldanha Bay [32°58'S 17°54'E], 21.viii.1975, V. Branco, under stones; juv ♀ (SAMC C170), Jacobsbaai, 14.viii.1977, E.B. Eastwood; ♀ juv ♂ (SAMC C4523), Jacobsbaai, xii.1985, A.J. Prins; subadult ♀ juv ♂ 4 juv ♀♀ (SAMC 11501), Steenberg's Cove, St. Helena Bay [32°04'S 18°02'E], v.1902, J.E.C. Goold; 3 ♀♀ (SAMC 10007), Stompneus, St. Helena Bay [32°44'S 17°58'E], ii–iii.1902, J.E.C. Goold; 2 juv ♂♂ (SAMC 10009), same data, except v.1902; ♀ (SAMC 11500), same data, except vi.1902; ♀ 3 juv ♂♂ 2 juv ♀♀ (SAMC 12807), same data, except vii.1903; Vredendal distr., 3 ♀♀ (TMSA 12304, 12308–12309), 2 subadult ♂♂ (TMSA 12305–12306), Koekenaap [31°32'S 18°14'E], 30.viii.1979, S. Endrödy-Younga; Wellington Distr., 2 ♀♀ 2 subadult ♂♂ (SAMC C4567), Bartholomeus Klip, Bo-Hermon [33°26'S 18°58'E], 3.v.1997, L. Prendini & E. Scott, under stones on ridge, sympatric with *Parabuthus planicauda* (Pocock); Worcester Distr., 6 ♂♂ 12 ♀♀ juv ♂ 5 juv ♀♀ (SAMC B609), De Doorns [33°29'S 19°41'E], xii.1906, J. Paynter; ♀ (SAMC 14365), Touws River [33°20'S 20°03'E], 5.xi.1905, W.F. Purcell; ♀ (SAMC 14378), Touws River, xii.1905, J. Paynter; ♀ (SAMC 14263), Touws River station, xii.1904, J. Paynter.