

Systematics of the Genus *Pseudolychas* Kraepelin (Scorpiones: Buthidae)

LORENZO PRENDINI¹

Division of Invertebrate Zoology, American Museum of Natural History, Central Park West at 79th St.,
New York, NY 10024-5192

Ann. Entomol. Soc. Am. 97(1): 37-63 (2004)

ABSTRACT The endemic southern African buthid genus *Pseudolychas* Kraepelin, 1911 is revised for the first time after an examination of the type material and a large number of additional specimens in southern African, European, and American collections. Three species are considered valid: *Pseudolychas pegleri* (Purcell, 1901), *P. ochraceus* (Hirst, 1911), and *P. transvaalicus* Lawrence, 1961. *Pseudolychas pegleri nigrimanus* Kraepelin, 1911 and *P. multicaarinatus* Hewitt, 1925 (long regarded as *P. pegleri multicaarinatus*) are newly synonymized with *P. pegleri*. The identity of *P. ochraceus* is verified by examination of the holotype. Many specimens identified as *P. pegleri* by previous authors are actually conspecific with *P. ochraceus*. Specimens of *P. pegleri* have also been misidentified as *P. ochraceus*. Revised diagnoses and descriptions are provided for the species of *Pseudolychas*, together with a key to their identification, brief summaries of their ecology and conservation status, and a distribution map plotting all known locality records. *Pseudolychas ochraceus* is suggested to be a parthenogenetic species. A phylogenetic analysis, based on 21 morphological characters and using exemplar species of eight buthid genera as outgroup taxa, confirms the monophyly of *Pseudolychas* and its placement as the sister group of a larger monophyletic group including *Grosphus* Simon, 1888, *Parabuthus* Pocock, 1890, and *Uroplectes* Peters, 1861. The following scheme of relationships is retrieved among the species of *Pseudolychas*: (*P. ochraceus* (*P. pegleri* + *P. transvaalicus*)).

KEY WORDS *Pseudolychas*, Buthidae, Scorpiones, taxonomy, phylogeny

Pseudolychas Kraepelin, 1911 is an obscure genus of small, brown buthid scorpions that are endemic to the eastern half of southern Africa and recorded from South Africa, Swaziland, and Mozambique. These scorpions are restricted to humid habitats, including indigenous coastal and Afromontane forests, and may be found under stones, in or under rotten logs, and in leaf litter (Lawrence 1942, 1952, 1953, 1961, Newlands 1978). At least one species is very common in the suburban gardens of major cities on the South African Highveld (e.g., Bloemfontein, Johannesburg, and Pretoria), where it seems to have benefited from the artificially humid conditions in an otherwise fairly dry savanna-grassland. Specimens are regularly encountered indoors, trapped in baths and washbasins, where they seem to seek refuge during the dry winter season. Given their prevalence around human habitations, it is perhaps fortunate that, unlike some of their buthid relatives in the arid western half of southern Africa, *Pseudolychas* are docile, and their venom is mild. These scorpions are not considered medically important.

As currently recognized, *Pseudolychas* comprises three species and three subspecies, one of which is

nominotypic (Lamoral and Reynders 1975, Fet and Lowe 2000). All taxonomic work on *Pseudolychas* was conducted during the first half of the previous century. No taxonomic publications have appeared since the 1960s. Almost nothing is known about the biology of these scorpions.

The taxonomic history of *Pseudolychas* began when Purcell (1901) described *Lychas pegleri* as the first South African species of *Lychas* C.L. Koch, 1845. In Purcell's opinion, this species differed from all others in the genus on the basis of two, rather than one, external accessory granules flanking the enlarged basal granule of each oblique granular row on the pedipalp chela fingers.

A decade later, Kraepelin (1911) created *Pseudolychas* to accommodate *L. pegleri*, which he considered to have been misplaced in *Lychas*, and described a new variety, *P. pegleri nigrimanus*. Kraepelin regarded the new genus as intermediate between *Lychas* and *Odonturus* Karsch, 1879, differing from *Lychas* in the enlarged basal pectinal tooth of the female and the presence of two, rather than one, external accessory granules flanking the enlarged basal granule of each oblique granular row on the pedipalp chela fingers, and from *Odonturus* in the presence of one, rather

¹ E-mail: lorenzo@amnh.org.

than two, denticles on the ventral surface of the cheliceral fixed finger.

While Kraepelin (1911) published the diagnosis of *Pseudolychas*, Hirst (1911) described a second South African species, *Lychas ochraceus*. Hewitt (1918) later transferred this species to *Pseudolychas*, although he questioned the validity of *Pseudolychas*, instead suggesting that it might be a subgenus of *Lychas*. Hewitt (1925a: 256) later proposed that *Pseudolychas* was a "comparatively primitive representative" of the group of African buthid genera including *Babycurus* Karsch, 1886, *Odonturus*, and *Lychas*.

New locality records of *Pseudolychas* were provided by Hewitt (1918, 1925b), who also described another new species, *P. multicaarinatus* Hewitt, 1925. All subsequent work on *Pseudolychas* was conducted by Lawrence, who provided new locality records (Lawrence 1937, 1942, 1964, 1967), refined the generic diagnosis (Lawrence 1938), relegated *P. multicaarinatus* to a subspecies of *P. pegleri* (Lawrence 1942), provided a key to the species and subspecies (Lawrence 1955), and described another new species, *P. transvaalicus* Lawrence, 1961.

The key of Lawrence (1955) was never updated to include *P. transvaalicus*, and none of the species or subspecies of *Pseudolychas* have been revised since their description. Furthermore, most of the diagnostic characters proposed by Lawrence (1942, 1955) for separating the species and subspecies are unreliable, whereas important character systems (e.g., trichobothria and hemispermaphores) have never been studied in the genus. It is also clear that neither Hewitt nor Lawrence examined the type specimens of *P. pegleri nigrimanus* and *P. ochraceus*, both of which are deposited in European museums, and it is doubtful whether Kraepelin examined the type specimens of *P. pegleri*, deposited in the South African Museum. Given this situation, it would not be unlikely if some of the taxa presently recognized in the genus proved to be synonymous.

The monophyly of *Pseudolychas* also remains untested and its sister group relationships uncertain, beyond the conjectures of Kraepelin (1911) and Hewitt (1918, 1925a), although it seems likely that the genus is most closely related to three Afrotropical buthid genera—*Grosphus* Simon, 1888, from Madagascar; *Parabuthus* Pocock, 1890, from southern and northeastern Africa and Arabia; and *Uroplectes* Peters, 1861, from southern and central Africa.

This paper presents a revision and phylogenetic analysis of *Pseudolychas*. As a result of this investigation, three species are considered valid: *Pseudolychas pegleri*, *P. ochraceus*, and *P. transvaalicus*. *Pseudolychas pegleri nigrimanus* and *P. multicaarinatus* are newly synonymized with *P. pegleri*. The identity of *P. ochraceus* is verified by examination of the holotype. Many specimens identified as *P. pegleri* by previous authors are actually conspecific with *P. ochraceus*, whereas other specimens of *P. pegleri* have been misidentified as *P. ochraceus*. Revised diagnoses and descriptions are provided for the species of *Pseudolychas*, together with a key to their identification, brief summaries of their

ecology and conservation status, and a distribution map plotting all known locality records. A phylogenetic analysis, based on 21 morphological characters and using exemplar species of eight buthid genera as outgroup taxa, confirms the monophyly of *Pseudolychas* and its placement as the sister group of a larger monophyletic group including *Grosphus*, *Parabuthus*, and *Uroplectes*. The following scheme of relationships is retrieved among the species of *Pseudolychas*: (*P. ochraceus* (*P. pegleri* + *P. transvaalicus*)).

Materials and Methods

Material, Photography, Meristics, and Terminology. As in previous papers (e.g., Prendini 2001a), species are delimited here in accordance with the phylogenetic species concept, where a species is defined as a minimum diagnosable unit. All subspecies are considered to be junior synonyms of their respective species unless they can be separated on the basis of consistent somatic characters. In that case, they represent good species in the diagnostic sense and are raised accordingly. Nomenclatural changes are based primarily on the examination of type material. However, taxonomic decisions presented here are not derived solely from examination of the types. As many specimens as could be obtained were examined to assess the extent of geographical variation and identify characters that are consistent across the distributional range of each putative species.

Material examined, including type specimens, is deposited in the following collections: National Museum, Bloemfontein, South Africa (NMBA); South African Museum, Cape Town (SAMC); Albany Museum, Grahamstown, South Africa (AMGS); Natal Museum, Pietermaritzburg, South Africa (NMSA); National Collection of Arachnida, Plant Protection Research Institute, Pretoria, South Africa (PPRI); Transvaal Museum, Pretoria, South Africa (TMSA); Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany (ZMUH); The Natural History Museum, London (BMNH); American Museum of Natural History, New York (AMNH), including the Alexis Harington Scorpion Collection (AH); California Academy of Sciences, San Francisco (CASC); Musée Royal de l'Afrique Centrale, Tervuren, Belgium (MRAC); and Erich S. Volschenk Private Collection, Brisbane, Australia (ESV). Tissue samples of *P. ochraceus* and *P. pegleri* are stored (in the vapor phase of liquid nitrogen at -150°C) in the Ambrose Monell Collection for Molecular and Microbial Research (AMCC) at the AMNH.

Personally collected specimens were found by turning stones during the day, or by UV light detection at night. A portable UV lamp, comprised of two mercury-vapor tubes attached to a chromium parabolic reflector and powered by a rechargeable 7-Amp/h, 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.

Photographs were taken in visible light as well as under long-wave UV light using a digital photomicrography system (ML-1000; Microptics, Yonkers, NY). Measurements were taken using the ocular micrometer of a stereomicroscope (MZ16; Leica, Heerbrugg, Switzerland). Diagnostic percentages were based on a sample of six specimens where available (there were only 5 ♂ *P. ochraceus* and 3 ♂ *P. transvaalicus*). Color designation follows Smith (1974, 1975, 1981), trichobothrial notation follows Vachon (1974), sternum terminology follows Söglad and Fet (2003), and mensuration follows Stahnke (1970) and Lamoral (1979). Other morphological terminology follows previous papers on buthid scorpions (e.g., Prendini 2000a, 2001b, 2003a, b).

Mapping, Spatial Analysis, and Conservation Evaluation. A distribution map was 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) 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>).

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 collection 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 published by the Government Printer, and the GEOnet Names Server (http://164.214.2.59/gns/html/cntry_files.html). Names of South African provinces and magisterial districts listed in the material examined follow the most recent system (post-1994).

Spatial analyses were conducted using ArcView to determine the specific ecological correlates of the distributional ranges of each *Pseudolychas* species and to calculate statistics that could be used to define their conservation status. Coverages representing the topography, mean annual rainfall, biomes, vegetation types, and protected areas in South Africa, Lesotho, and Swaziland were used for these analyses.

The GTOPO30 raster grid coverage was used for spatial analysis of topography. A raster grid coverage of mean annual rainfall was obtained from the *South African Atlas of Agrohydrology and Climatology* (Schulze et al. 1997), produced by the Computing Centre for Water Research of the South African Water Research Commission (<http://www.wrc.org.za/wrcpublications/wrcreports/hydroclimatology.htm>). A polygon coverage of *Vegetation of South Africa, Lesotho and Swaziland*, by Low and Rebelo (1998), incorporating the biomes defined by Rutherford and

Westfall (1994), was obtained from the National Botanical Institute of South Africa. Coverages representing national and provincial protected areas in South Africa were obtained from the Western Cape Nature Conservation and KwaZulu-Natal Nature Conservation services of South Africa.

The three species of *Pseudolychas* were categorized according to their conservation priority. The number of known locality records, extent of the distributional range, occurrence inside and outside of protected areas, and prevailing land uses that might be construed as threats to the future survival of these species were used to evaluate their conservation status. Each species was assigned one of the IUCN Red List Categories (International Union for the Conservation of Nature 2001) on the basis of these criteria.

Cladistic Analysis. The cladistic matrix was comprised of 28 characters, 5 coded into multistates and 23 coded into binary states, scored for 11 species (Table 1). Multistate characters were treated as unordered/nonadditive (Fitch 1971). Trees were rooted using the outgroup method (Watrous and Wheeler 1981; Farris 1982; Nixon and Carpenter 1993). An exemplar species from each of three diverse Afrotropical buthid genera—*Grosphus*, *Parabuthus*, and *Uroplectes*—were included as outgroup taxa on the basis of morphological evidence that these genera are closely related to *Pseudolychas*. In addition, the monotypic Afrotropical buthid genus *Odonturus*, an exemplar species of the Afrotropical buthid genus *Babycurus*, and an Afrotropical exemplar species of *Lychas*, were included to test the putative relationship of *Pseudolychas* to these genera (Purcell 1901, Hirst 1911, Kraepelin 1911, Hewitt 1918, 1925a). Another recently described monotypic buthid genus, *Afroisometrus* Kovařík, 1997, also endemic to southern Africa, was included to test its relationship to *Pseudolychas*. The Neotropical buthid, *Centruroides gracilis* (Latreille, 1804), was included as the prime outgroup. Material examined for outgroup taxa is listed in Table 2, and material examined for ingroup taxa is listed in the "Material Examined" sections of the respective taxonomic treatments of *Pseudolychas* species.

Character data were edited, cladograms were prepared, and character optimizations were conducted using WinClada, version 0.9.9+ (Nixon 1999). Ambiguous optimizations were resolved using accelerated transformation (ACCTRAN) or Farris optimization, which favors reversals over parallelisms to explain homoplasy (Farris 1970, Swofford and Maddison 1987, 1992) and therefore maximizes homology (Griswold et al. 1998). Seven autapomorphies (characters 9, 13, 14, 17, 21, 25, and 26) were excluded from all analyses; hence, tree statistics are calculated from phylogenetically informative characters only (Bryant 1995).

Characters were not weighted *a priori*. Analyses with equal weighting were conducted using NONA version 2.0 (Goloboff 1997a), according to the following command sequence: *hold10000; hold/10; mult*100;* (hold 10,000 trees in memory; hold 10 starting trees in memory; perform tree-bisection-reconnection [TBR] branch-swapping on 100 random addition replicates).

Table 1. Distribution of 28 characters among the species of *Pseudolychas* Kraepelin, 1911 and eight buthid outgroup taxa

<i>Centruroides gracilis</i>	10010	10000	00000	00000	00000	000
<i>Afroisometrus minshullae</i>	1????	00010	10000	??10?	01001	000
<i>Lychas burdoi</i>	10100	00011	10002	10000	00000	000
<i>Babycurus jacksoni</i>	21021	11110	10001	00001	00000	000
<i>Odonturus dentatus</i>	21010	11110	10002	00001	00000	000
<i>Grosphus madagascariensis</i>	21021	31111	01002	00000	01000	010
<i>Parabuthus capensis</i>	21000	30011	00112	00000	11110	110
<i>Uroplectes triangulifer</i>	00100	21111	01002	00000	01110	000
<i>Pseudolychas ochraceus</i>	11010	01110	01002	10110	01000	001
<i>Pseudolychas pegleri</i>	11020	01110	01002	10110	01100	001
<i>Pseudolychas transvaalicus</i>	11021	01110	02002	11110	01100	001

Character states are scored 0–3 and ?, unknown. Seven autapomorphies, indicated by †, were excluded from all analyses. Unknown states in *A. minshullae* are attributed to the fact that the adult ♂ is presently unknown.

- Cheliceral fixed finger, number of denticles on ventral surface: none (0); one (1); two (2).
- Pedipalp chela (♂), manus: not incrassate (0); incrassate (1); unknown (?).
- Pedipalp chela (♂), fixed finger: curved dorsally (0); straight (1); unknown (?).
- Pedipalp chela (♂), movable finger, median lobe: absent (0); weak (1); well developed (2); unknown (?).
- Pedipalp chela (♂), fingers, when closed: no proximal "gap" (0); distinct proximal "gap" (1); unknown (?).
- Pedipalp chela fingers, granular rows, number of rows: 6–7 (0); 8–9 (1); 11 (2); 12–14 (3).
- Pedipalp chela fingers, granular rows: imbricated (0); not imbricated (1).
- Pedipalp chela fingers, granular rows, number of external accessory granules: one (1); two (2).
- † Pedipalp chela fingers, supernumary granules: present (0); absent (1).
- Pedipalp patella: dorsointernal, dorsoexternal and, to lesser extent, externomedian carinae distinct, granular (0); dorsointernal, dorsoexternal and externomedian carinae absent or obsolete (1).
- Pedipalp femur, dorsal trichobothria: α configuration (0); β configuration (1).
- Pectines (♀), basal pectinal tooth: unmodified (0); enlarged (1); reduced (2).
- † Pectines (♀), proximal median lamella: unmodified (0); enlarged and lobate (1).
- † Legs I and II, tibiae and telotarsi, macrosetal combs: absent (0); present (1).
- Legs III and IV, tibial spurs: absent, legs III and IV (0); present, leg IV only (1); present, legs III and IV (2).
- Hemispermaphore, *pars recta*: straight (0); coiled (1); unknown (?).
- † Hemispermaphore, *pars reflecta*: parallel to distal lamina (0); S-shaped (1); unknown (?).
- Mesosomal tergites III–VI, submedian carinae: absent or obsolete (0); present (1).
- Sternites VI and VII, surface macrosculpture: smooth, at least medially (0); granular (1).
- Sternite V (♂), posteromedial surface: unmodified (0); with raised, smooth area (1); unknown (?).
- † Metasomal segments I–III, dorsomedian surfaces, stridulatory granules: absent (0); present (1).
- Metasomal segment II, median lateral carinae: absent (0); present (1).
- Metasomal segment III, median lateral carinae: absent (0); present (1).
- Metasomal segment IV, median lateral carinae: absent (0); present (1).
- † Metasomal segment V, ventrolateral carinae: present (0); absent (1).
- Metasomal segment V, ventrolateral carinae, subdistal granules: unmodified (0); enlarged into laterally compressed, lobate processes (1).
- Telson, subaculear tubercle: present (0); absent (1).
- Telson, aculeus, length relative to telson vesicle: as long as, or longer than vesicle (0); considerably shorter than vesicle (1).

Additional swapping on up to 1,000 trees that are up to 5% longer than the shortest trees (command *jump 50*;) was performed to help the swapper move between multiple local optima ('islands' *sensu* Maddison 1991). Finally, trees found with this command were again swapped with TBR, using the command *max**; to retain only optimal trees.

Successive approximations character weighting (Farris 1969) and implied character weighting (Goloboff 1993, 1995) were conducted to assess the effects of weighting against homoplasious characters, and the resultant topologies were compared with the topology obtained by analysis with equal weights (see Prendini 2000b, 2001b, 2003a). Successive weighting was implemented with NONA by invoking the *swt.run* file (command sequence: *run swt.run hold10000; hold/10; mult*100; jump50; max**;) . Pee-Wee version 2.6 (Goloboff 1997b) was used for analyses with implied weighting, applying the command sequence: *hold1000; hold/10; mult*100; jump50; max**;. Analyses with implied weighting investigated the use of six values for the concavity constant, *k*, spanning the input range permitted by Pee-Wee (command *conc N*;) .

The relative degree of support for each node in the tree obtained with equal weighting was assessed with branch support or decay indices (Bremer 1988, 1994, Donoghue et al. 1992). Branch support indices up to three extra steps were calculated with NONA, by means of the following command sequence: *h1000; sub1; find**; *h2000; sub3; find**; *bsupport**;

Results and Discussion

Analysis of the 21 informative characters located a single most parsimonious tree (MPT) with equal weights (Topology A, Fig. 1; Table 3). The same topology was retrieved in the analyses with implied weights when values for the concavity constant were moderate to mild, i.e., *k* = 4–6 (Table 3). Although topologically identical, the MPTs obtained by the analyses with implied weights under *k* = 4–6 were 2–4% fitter than the MPT obtained by analysis with equal weights.

Analysis with implied weights under strong concavity (*k* = 1–2) located a single MPT that was two steps longer and 2–9% less fit than the MPTs obtained by the other analyses. This MPT differed from topology

Table 2. Material examined for outgroup taxa included in cladistic analysis of the genus *Pseudolychas* Kraepelin, 1911

<i>Centruroides gracilis</i> (Latreille, 1804):	
MÉXICO:	Quintana Roo: Posada Pamul, 17-V-1976, R. Mitchell and L. Faulkenberry, 1 ♂ 2 ♀ 1 subad. ♂ (AMNH).
<i>Afroisometrus minshullae</i> (FitzPatrick, 1994):	
SOUTH AFRICA:	Limpopo Province: Lukin, Tshipise area, 8-VI-1985, A. Harington, 1 ♀ (AMNH [AH 4240]); same data, except '8-9-VI-1985', 1 ♀ (AMNH [AH 4332]).
<i>Lychas burdoi</i> (Simon, 1882):	
MALAWI:	Chintheche, 2-III-1978, R. Jocqué, 3 ♀ (AMNH [AH 544, 546, 547]).
SOUTH AFRICA: Northern Province: Kruger National Park, Pafuri, 22°27'S 31°17'E, 1-X-1980, L. Braack, 2 ♂ (NMSA 13902).	
<i>Babycurus jacksoni</i> (Pocock, 1890):	
TANZANIA:	IV-2002, ex R. MacInnes, 1 ♀ (AMNH), 6-VI-2002, ex R. MacInnes, 1 ♂ (AMNH).
<i>Odonturus dentatus</i> Karsch, 1879:	
KENYA:	5 km W Machakos, 8-VIII-2000, R. West, 1 ♀ (AMNH).
TANZANIA: XI-1999, ex R.D. Gaban, 1 ♂ 2 ♀ (AMNH).	
<i>Grosphus madagascariensis</i> (Gervais, 1843):	
MADAGASCAR:	N.E. Ambatondradama, VIII-1931, Bluntschli, 1 ♂ 3 ♀ (AMNH).
<i>Parabuthus capensis</i> (Ehrenberg, 1831):	
SOUTH AFRICA:	Western Cape Province: Port Nolloth, 29°17'S 16°51'E, IV-1972, J. Visser, 2 ♂ 3 ♀ 4 subad. ♂ 2 subad. ♀ 3 juv. ♂ 2 juv. ♀ (NMSA 10358); Table View, Cape Town, 33°49'S 18°29'E, 29-IV-1986, Louw, 1 ♀ 1 juv. ♂ (SAMC C1618).
<i>Uroplectes triangulifer</i> (Thorell, 1876):	
SOUTH AFRICA:	Limpopo Province, Potgietersrus, 24°11'S 29°01'E, IV-1934, R.F. Lawrence, 1 ♂ 1 ♀ (SAMC B8227). North West Province: Lichtenburg, 27-VII-1975, A. Harington, 2 ♀ (AMNH). Eastern Cape Province: Karoo Nature Reserve, Graaff-Reinet, 32°12'S 24°28'E, 8-9-IX-1987, S. van Noort, 1 ♂ (SAMC C3754).

Material examined for ingroup taxa is listed in the taxonomic section. Depositories for specimens examined are abbreviated as follows: AMNH, American Museum of Natural History (New York, NY); AH, Alexis Harington Collection (deposited in the AMNH); NMSA, Natal Museum (Pietermaritzburg, South Africa); SAMC, South African Museum (Cape Town, South Africa).

A in the placement of *A. minshullae* as the sister group of *Pseudolychas* and in the placement of (*G. madagascariensis* (*P. capensis* + *U. triangulifer*)) in a monophyletic group with (*B. jacksoni* + *O. dentatus*) rather than with *Pseudolychas* (Topology B, Table 3).

Analysis with implied weights under $k = 3$ retrieved two MPTs. One of these was identical to topology A, and the other was identical to topology B (Table 3).

A single MPT was also obtained by analysis with successive weights, but was two to four steps longer and 3–9% less fit than the MPTs obtained by the other analyses. The topology of this MPT was similar to topology A, but differed in the placement of (*G. madagascariensis* + *P. capensis*) in a monophyletic group with (*B. jacksoni* + *O. dentatus*), leaving *U. triangulifer* in a monophyletic group with *Pseudolychas* (Topology C, Table 3).

Topologies B and C are longer and less fit than topology A; therefore, they are considered to be sub-optimal. Topology A, obtained by weighting regimens that minimized length as well as those that maximized fit (Table 3), is instead regarded as the optimal hypothesis. Synapomorphies are indicated on this topology in Fig. 1, which also provides branch support values for nodes. The length, fit (f_i), consistency in-

dices, retention indices, and final successive weights of informative characters on this topology are listed in Table 4.

All analyses confirmed the monophyly of *Pseudolychas*, on the basis of five unambiguous synapomorphies (characters 1, 16, 18, 19, and 28). No evidence was found for a close relationship with *Lychas*, thus refuting the suggestion of Hewitt (1918) that it might be a subgenus of the latter. Lawrence (1938) provided a synopsis of the diagnostic characters differentiating *Pseudolychas* from *Lychas*.

The majority of analyses placed *Pseudolychas* as the sister group of a larger monophyletic group including *Grosphus*, *Parabuthus*, and *Uroplectes* (supported by three unambiguous synapomorphies: characters 11, 12, and 22), previously proposed by Prendini (2001b, 2003a). No evidence was found to support the conjecture of Kraepelin (1911) that *Pseudolychas* is "intermediate" between *Lychas* and *Odonturus* or the conjecture of Hewitt (1925a) that *Pseudolychas* forms a monophyletic group with *Babycurus*, *Odonturus*, and *Lychas*.

The following scheme of relationships among the species of *Pseudolychas* was obtained in all analyses: (*P. ochraceus* (*P. pegleri* + *P. transvaalicus*)). The sister group relationship between *P. pegleri* and *P. transvaalicus* was first proposed by Lawrence (1961).

Pseudolychas Kraepelin

(Figs. 1–44)

Pseudolychas Kraepelin, 1911: 59, 60; type species by original designation *Lychas pegleri* Purcell, 1901 [= *Pseudolychas pegleri* (Purcell, 1901)].

Pseudolychas. Birula 1917a: 164; Birula 1917b: 55; Hewitt 1925a: 255; Werner 1934: 271; Lawrence 1938: 292; Kästner 1941: 232; Lawrence 1953: 340; Lawrence 1955: 230; Lawrence 1961: 126; Lawrence 1964: 35; Lawrence 1967: 85; Stahnke 1972: 128; Lamoral and Reynders 1975: 524; Newlands 1978: 689; Francke 1985: 12, 16; Sissom 1990: 102; Nenilin and Fet 1992: 16; Kovařík 1998: 117; Fet and Lowe 2000: 214.

Diagnosis. *Pseudolychas* is the sister group of a larger monophyletic group including the Afrotropical buthid genera *Grosphus*, *Parabuthus*, and *Uroplectes* (Fig. 1). Species of *Grosphus*, *Pseudolychas*, and *Uroplectes* usually display an enlarged (and often elongated) basal pectinal tooth in the female (Pocock 1890, Kraepelin 1908, Werner 1934). The basal pectinal tooth is reduced in one species of *Pseudolychas* (Lawrence 1961). It is unmodified in *Parabuthus*, all except two species of which exhibit a lobate proximal median lamella in the female that is probably homologous with the enlarged basal tooth of female *Grosphus*, *Pseudolychas*, and *Uroplectes* (Pocock 1890, Prendini 2001b).

Although superficially similar to the African genus *Uroplectes*, *Pseudolychas* is readily separated from it and from *Grosphus* and *Parabuthus*, according to the number of denticles on the ventral surface of the cheliceral fixed finger. In *Pseudolychas*, there is a single

Table 4. Length (steps), fit (f_i), consistency indices (CIs), retention indices (RIs), and final successive weights (SW) of 21 informative characters scored among the species of *Pseudolychas* Kraepelin, 1911 and eight buthid outgroup taxa

Character	Steps	Fit	CI	RI	SW
1	3	7.5	66	66	4
2	2	7.5	50	50	2
3	2	7.5	50	0	0
4	5	5.0	40	25	1
5	3	6.0	33	0	0
6	4	7.5	75	66	5
7	2	7.5	50	66	3
8	2	7.5	50	66	3
10	2	7.5	50	66	3
11	2	7.5	50	66	3
12	3	7.5	66	66	4
15	2	10.0	100	100	10
16	2	7.5	50	66	3
18	2	7.5	50	66	3
19	1	10.0	100	100	10
20	1	10.0	100	100	10
22	2	7.5	50	66	3
23	2	7.5	50	66	3
24	1	10.0	100	100	10
27	2	7.5	50	0	0
28	1	10.0	100	100	10

fingers, α (rather than β) configuration of the femoral dorsal trichobothria, submedian carinae on tergites III–VI, median lateral carinae on metasomal segments II and III, a modified (enlarged or reduced) basal pectinal tooth in the female, and sexually dimorphic

pedipalp chelae in the adult male. *Pseudolychas* may be separated from *Afroisometrus* by the presence of a configuration of the femoral dorsal trichobothria, tibial spurs on legs III and IV, a modified basal pectinal tooth in the female, and a subaculear tubercle.

Remarks. Three species are recognized in this revision of *Pseudolychas*. *Pseudolychas pegleri nigrimanus* and *P. multicaeratus* (long regarded as *P. pegleri multicaeratus*) are newly synonymized with *P. pegleri*.

Distribution. *Pseudolychas* is endemic to the southern African subregion and presently recorded only from South Africa, Swaziland, and southern Mozambique (Fig. 2). Kraepelin’s (1911: 60) Zimbabwean type locality for *P. pegleri nigrimanus*, given as “Umfuli River im Mashonaland”, and adopted by subsequent authors (Hewitt 1918, 1925b, Lawrence 1955, Lamoral and Reynders 1975, Fet and Lowe 2000) is erroneous. According to the original label, the type locality is ‘Umfuli River, Zululand’, which is actually the Imfuli or Mfuli River in the KwaZulu-Natal Province of South Africa. No records of *Pseudolychas* are confirmed from Zimbabwe, and Newlands and Martindale (1980) omitted *Pseudolychas* from their review of the buthid scorpion fauna of that country.

Hewitt (1925b: 292) mentioned a “young female [*Pseudolychas*] from Amatongas Forest, P.E.A.” [Amatongas, 19°10’S 33°45’E, Mozambique] but “hesitate[d] to refer this to any species yet described.” This specimen was apparently deposited in the AMGS col-

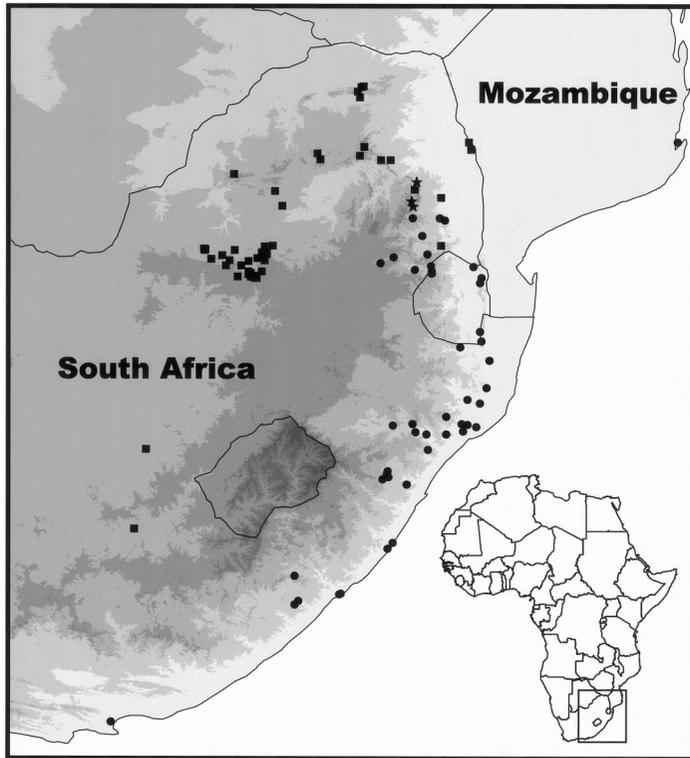


Fig. 2. The known distributions of *Pseudolychas ochraceus* (Hirst, 1911) (■), *P. pegleri* (Purcell, 1901) (●), and *P. transvaalicus* Lawrence, 1961 (★) in southern Africa (contour interval 500 m).

lection but could not be located for study, and given the known distribution of *Pseudolychas* species, it is doubtful whether it is referable to this genus.

Ecology. All species of *Pseudolychas* are lapidicolous, hiding under stones and tree bark, in or under rotten logs, and in leaf litter (Lawrence 1942, 1952, 1953, 1961, Newlands 1978, Prendini 2001c). These scorpions are restricted to humid habitats, including indigenous coastal and Afromontane forests, bush thickets on south-facing slopes, and suburban gardens.

Key to the Species of *Pseudolychas* Kraepelin

- 1. Pectines of ♂ each with 15–17 teeth; pedipalp chela manus of ♂ slightly incrassate (Fig. 16), length along ventroexternal carina 38–45% greater than width and 46–48% greater than height; metasoma of ♂ 84–85% longer than carapace (Fig. 12); metasomal segments, median lateral carinae distinct to obsolete on segment II, obsolete or absent on segment III *Pseudolychas ochraceus*
- Pectines of ♂ each with fewer than 15 teeth; pedipalp chela manus of ♂ markedly incrassate (Figs. 27 and 38), length along ventroexternal carina 30–33% greater than width and 30–40% greater than height; metasoma of ♂ 81–82% longer than carapace (Figs. 23 and 34); metasomal segments, median lateral carinae distinct on segment II, distinct to obsolete on segment III 2
- 2. Pectines of ♂ each with 12–14 teeth, of ♀ each with 11–13 teeth; basal pectinal tooth of ♀ enlarged (longer and wider than other teeth), lobate (Fig. 7); pedipalp chela fixed finger of ♂ without lobe medially, proximal dentate margin linear (i.e., no proximal “gap” is evident) when chela fingers are closed (Fig. 27); *pars recta* of ♂ hemispermatophore straight *Pseudolychas pegleri*
- Pectines of ♂ each with 11–12 teeth, of ♀ each with 9–11 teeth; basal pectinal tooth of ♀ reduced (shorter and narrower than other teeth), triangular (Fig. 11); pedipalp chela fixed finger of ♂ with small, rounded lobe medially, proximal dentate margin emarginate (i.e., a proximal “gap” is evident) when chela fingers are closed (Fig. 38); *pars recta* of ♂ hemispermatophore S-shaped *Pseudolychas transvaalicus*

***Pseudolychas ochraceus* (Hirst)**
(Figs. 2–5 and 12–22)

Lychas ochraceus Hirst, 1911: 466.
Pseudolychas ochraceus. Hewitt 1918: 115, 116 (part); Hewitt 1925a: 256 (part); Werner 1934: 271; Lawrence 1955: 230 (part); Lamoral and Reynders 1975: 524 (part); Kovařík 1998: 117; Fet and Lowe 2000: 214; Prendini 2001c: 136.

Pseudolychas pegleri (misidentification: TMSA 1213).
Hewitt 1918: 115, 116; Lawrence 1955: 230; Lamoral and Reynders 1975: 524.

Type Material. HOLOTYPE: ♀ (BMNH 1905.3.30.45–54), Bethulie [30°30'S 25°58'E], Orange Free State [Bethulie District, Free State], South Africa, Miss Leppan. The holotype is discolored and very brittle. The telson and one pedipalp are disarticulated, and one chelicera is missing.

Diagnosis. *Pseudolychas ochraceus* is sister to the monophyletic group comprising *P. pegleri* and *P. transvaalicus* (Fig. 1). It may be separated from these species by means of the following combination of characters: pectines (♂) each with 15–17 teeth; pedipalp chela manus (♂) slightly incrassate, length 38–45% greater than width and 46–48% greater than height; metasoma (♂) 84–85% longer than carapace; metasomal segments, median lateral carinae distinct to obsolete on segment II, obsolete or absent on segment III.

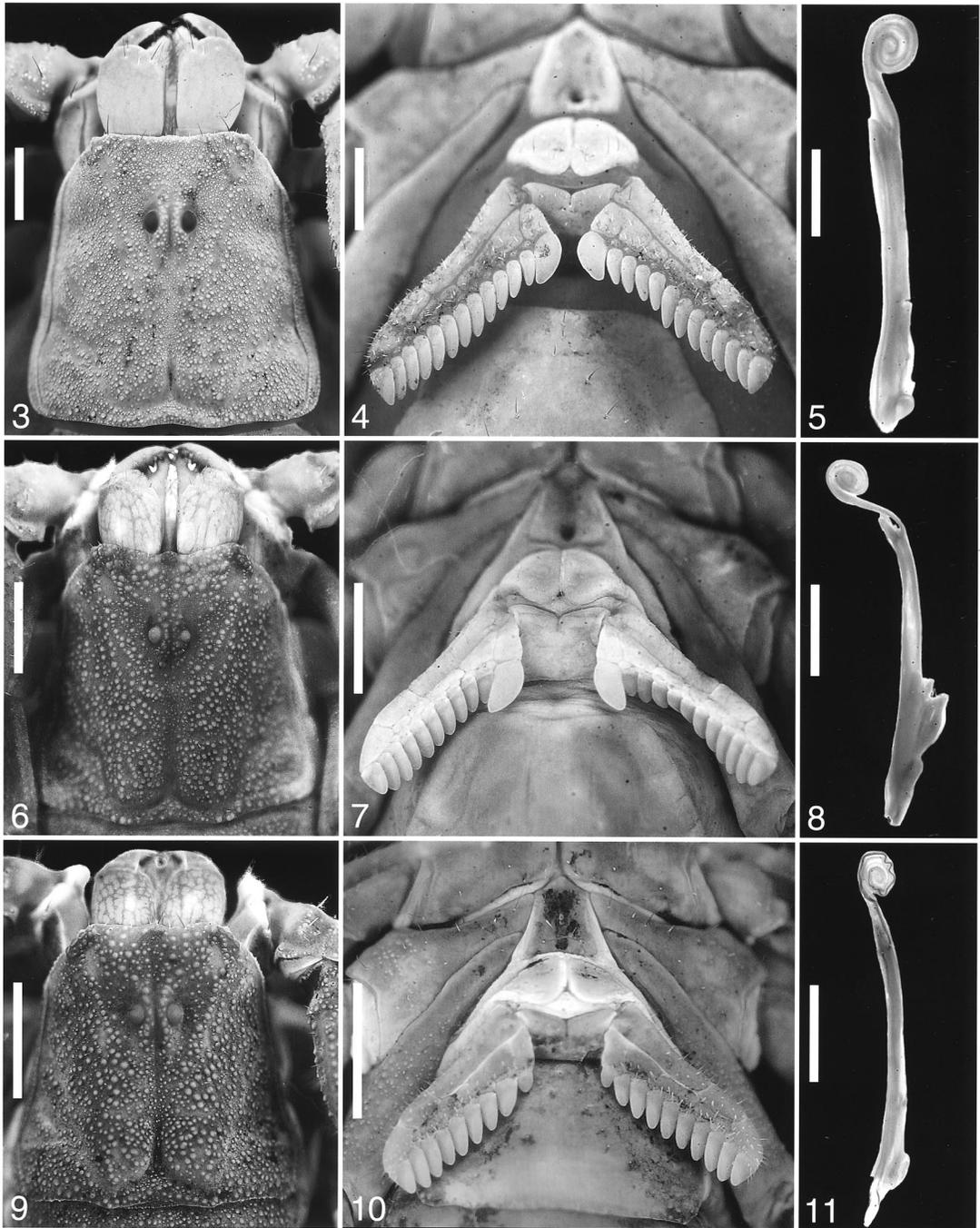
Description. The following redescription supplements Hirst’s (1911) original description. It is based on the holotype and several additional ♂ and ♀ specimens (AMNH [AH 584, 2263, 5142]).

Color. Carapace and tergites: Olive-Brown No. 28. Chelicerae and legs: Brownish Olive No. 29. Pedipalps and metasoma: Amber No. 36 (♂) to Olive-Brown No. 28 (♀). Telson: Tawny No. 38 (♂) to Yellow Ochre No. 123C (♀). Sternites: Buff No. 124. Pectines: Cream Color No. 54.

Carapace. Carapace covered entirely by uniform, coarse granulation. Anterior margin of carapace sublinear, with small median projection; posterior margin procurved (Fig. 3). Five pairs of lateral ocelli. Median ocelli considerably larger than lateral ocelli, situated anteromedially. Ocular tubercle with pair of granular superciliary carinae, protruding slightly above median ocelli. Anteromedian sulcus shallow to absent; posteromedian sulcus deep; posterolateral furrows shallow, wide, 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 single denticle on the ventral surface.

Pedipalps. Pedipalps sparsely covered in short macrosetae (Figs. 16–22). Femur finely and uniformly granular (Fig. 22); pentacarinatate, all carinae distinct, granular, except for internomedian carina, comprising spiniform granules. Patella sparsely and finely granular to smooth (Figs. 20 and 21); tetracarinatate, dorsoexternal, dorsointernal and ventrointernal carinae distinct, granular, to obsolete, internomedian carina comprising spiniform granules. Chela smooth (Figs. 16–19); carinae absent. Chela long, slender (♀) or slightly incrassate (♂), length along ventroexternal carina 38–45% greater than chela width and 46–48% greater than chela height (Table 5); length of movable finger 14–23% (♂) to 31–40% (♀) greater than length along ventroexternal carina. Chela (♂) movable finger with



Figs. 3–11. Diagnostic characters of *Pseudolychas* species. (3–5) *Pseudolychas ochraceus* (Hirst, 1911), ♂ (TMSA 2263) and ♀ (AMNH [AH 5142]). (6–8) *Pseudolychas pegleri* (Purcell, 1901), ♂ (ZMUH 100, syntype of *P. pegleri nigrimanus* Kraepelin, 1911) and ♀ (NMSA 727). (9–11) *Pseudolychas transvaalicus* Lawrence, 1961, paratype ♂ (NMSA 7290) and paratype ♀ (NMSA 18678). (3, 6, and 9) Carapace, dorsal aspect, ♀. (4, 7, and 10) Sternum, genital operculum, and pectines, ventral aspect, ♀. (5, 8, and 11) Hemispermatophore, ental aspect, ♂. Scale bars = 1 mm.

a weak, rounded lobe medially; fixed finger slightly curved dorsally, with a corresponding notch, but without a smaller, rounded lobe distal to the notch; proximal dentate margin linear (i.e., no proximal “gap” is evident) when fingers are closed (Fig. 16).

Chela (♀) fixed and movable fingers straight, such that proximal dentate margin linear (i.e., no proximal “gap” is evident) when fingers are closed (Fig. 17). Dentate margins of chela fixed and movable fingers with six and seven oblique granular rows, re-

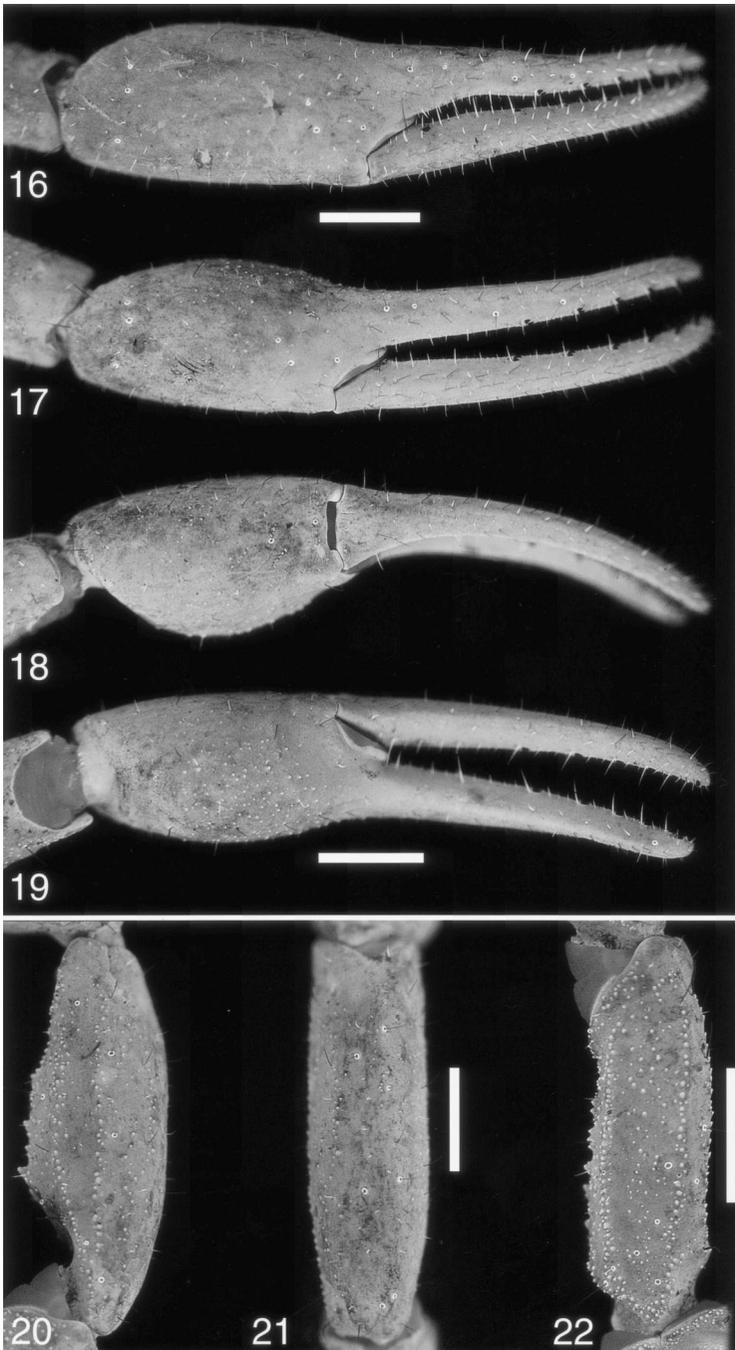


Figs. 12–15. *Pseudolychas ochraceus* (Hirst, 1911), habitus of ♂ (AMNH [AH 584]) and ♀ (ESV 2408). (12) Dorsal aspect, ♂. (13) Ventral aspect, ♂. (14) Dorsal aspect, ♀. (15) Ventral aspect, ♀. Scale bars = 10 mm.

spectively; all except the basal row flanked proximally by one internal and two external accessory granules; two granules, proximal to the enlarged terminal denticle, flank the first row of each finger; supernumerary granules absent.

Trichobothria. Orthobothriotaxic, type A, α configuration (Figs. 16–22), 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. Chela with *eb* located proximal to basal dentate margin of fixed finger, and *esb* located distal; *dt* distal to *et*; *db* level with *est*. Patella with *esb*₂ slightly distal to *esb*₁. Femur with *d*₂ on proximo-external side of dorso-internal carina; *d*₃ distal to *d*₂; *d*₄ closer to *d*₃ than to *d*₅.



Figs. 16–22. *Pseudolychas ochraceus* (Hirst, 1911), distribution of trichobothria and macrosetae on the dextral pedipalpal segments of ♂ (AMNH [AH 584]) and ♀ (AMNH [AH 5142]). (16) Chela, dorsal aspect, ♂. (17) Chela, dorsal aspect, ♀. (18) Chela, ventral aspect, ♀. (19) Chela, internal aspect, ♀. (20) Patella, dorsal aspect, ♀. (21) Patella, external aspect, ♀. (22) Femur, dorsal aspect, ♀. Scale bars = 1 mm.

Mesosoma. Pretergites entirely finely granular. Posttergites entirely coarsely granular, except for paired submedian depressions, granulation becoming coarser distally; I–VI each with a strongly developed,

granular median carina; III–VI additionally with a pair of slightly weaker, granular submedian carinae, restricted to posterior portion of tergite and projecting beyond the posterior margin (Figs. 12 and 14); VII



Figs. 23-26. *Pseudolychas pegleri* (Purcell, 1901), habitus of ♂ (NMSA 722) and ♀ (NMSA 727). (23) Dorsal aspect, ♂. (24) Ventral aspect, ♂. (25) Dorsal aspect, ♀. (26) Ventral aspect, ♀. Scale bars = 10 mm.

with a strongly developed, granular median carina and pairs of strongly developed, costate granular submedian and lateral carinae. Sternites III and IV entirely smooth; V and VI smooth to entirely sparsely and coarsely granular, except for submedian depressions; VII sparsely to densely and coarsely granular; lateral and distal margins of each sternite with a row of sparsely distributed macrosetae; sternite VII with weakly developed pairs of granular to costate granular submedian and lateral carinae (Figs. 13 and 15).

Sternum. Type I, subtriangular. Median longitudinal furrow Y-shaped, shallow to obsolete anteriorly, forming a deep, circular pit posteriorly (Fig. 4).

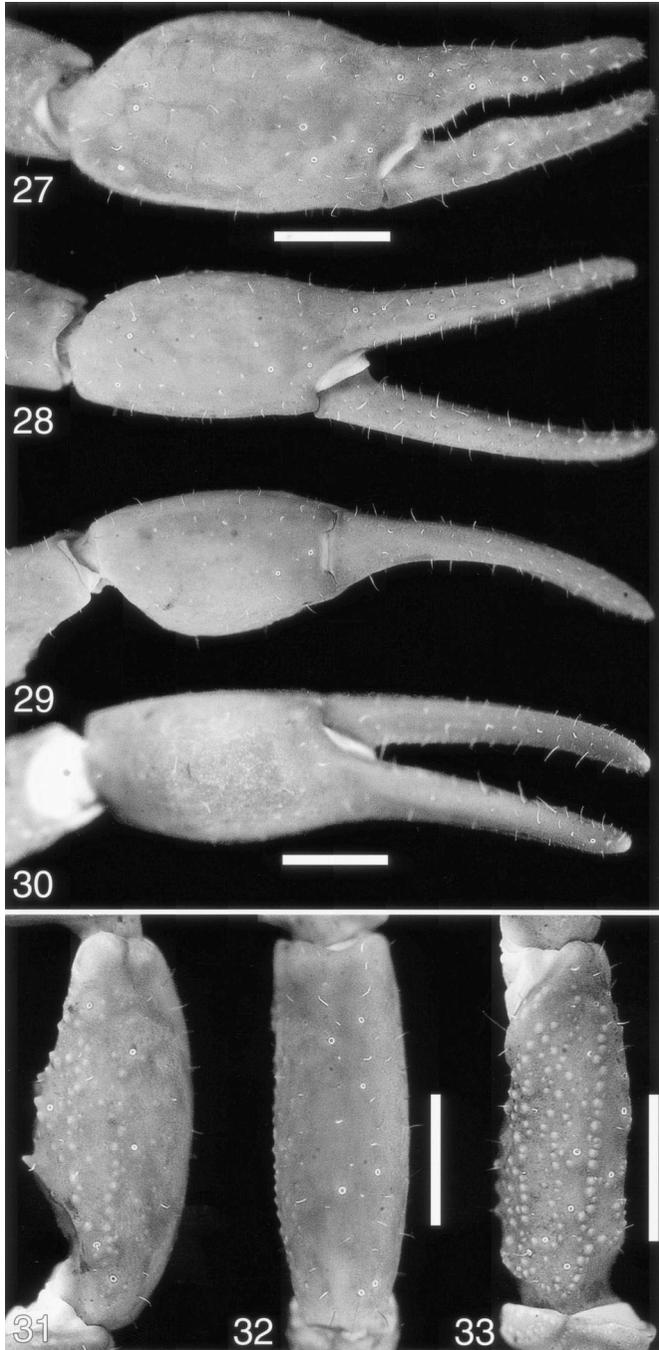
Genital operculum. Completely divided longitudinally. Genital papillae present (♂), absent (♀).

Pectines. Basal tooth of each pecten enlarged (longer and wider than other teeth), lobate in ♀, unmodified in ♂ (Fig. 4). Pectinal teeth: 15-17 (♂), 10-14 (♀).

Legs. Tibiae III and IV with spurs. Basitarsi I and II, prolateral margins each with a row of fine macrosetae; retrolateral margins each with a few scattered macrosetae. Telotarsi each with paired ventrosubmedian rows of fine macrosetae. Telotarsal laterodistal lobes

truncated; median dorsal lobes not extending to ungues. Telotarsal ungues short, distinctly curved, and equal in length.

Metasoma and Telson. Metasomal segments I-V width/length ratio progressively decreasing, width percentage of length 59-64% (♂) to 72-73% (♀) for I, 50-51% (♂) to 62-63% (♀) for II, 42-48% (♂) to 53-56% (♀) for III, 38-40% (♂) to 48-53% (♀) for IV, and 30-34% (♂) to 33-36% (♀) for V (Table 5). Telson oval, elongate, height 34-39% (♂) to 35-44% (♀) of length, with flattened dorsal surface and rounded ventral surface; vesicle slightly narrower than metasomal segment V, width 73-75% (♂) to 73-83% (♀) of metasomal segment V. Metasoma uniformly finely granular, except for segment V (♂), which is almost smooth; telson smooth or nearly so. Metasoma and telson sparsely covered with macrosetae (Figs. 12-15). Metasomal segments I and II each with ten carinae; segments III and IV with eight carinae (median lateral carina absent, rarely obsolete on III); segment V with five carinae (a single ventromedian and paired dorsolateral and ventrolateral carinae), dorsosubmedian carinae obsolete in ♂. Dorsosubmedian carinae converging distally on segments



Figs. 27-33. *Pseudolychas pegleri* (Purcell, 1901), distribution of trichobothria and macrosetae on the dextral pedipalpal segments of ♂ (NMSA 722) and ♀ (NMSA 727). (27) Chela, dorsal aspect, ♂. (28) Chela, dorsal aspect, ♀. (29) Chela, ventral aspect, ♀. (30) Chela, internal aspect, ♀. (31) Patella, dorsal aspect, ♀. (32) Patella, external aspect, ♀. (33) Femur, dorsal aspect, ♀. Scale bars = 1 mm.

I-III, subparallel on segments IV and V; ventrolateral carinae converging distally on segments I and V, subparallel on segments II-IV. All metasomal carinae granular to costate granular. Distal granules of dorso-

submedian carinae on segments I-IV or II-IV slightly enlarged, subspiniform. Aculeus short, shallowly curved, 29-32% of vesicle length; with a sharp, conical subaculear tubercle.



Figs. 34–37. *Pseudolychas transvaalicus* Lawrence, 1961, habitus of ♂ (AMGS [NMSA 7295]) and ♀ (AMNH [AH 2252]). (34) Dorsal aspect, ♂. (35) Ventral aspect, ♂. (36) Dorsal aspect, ♀. (37) Ventral aspect, ♀. Scale bars = 10 mm.

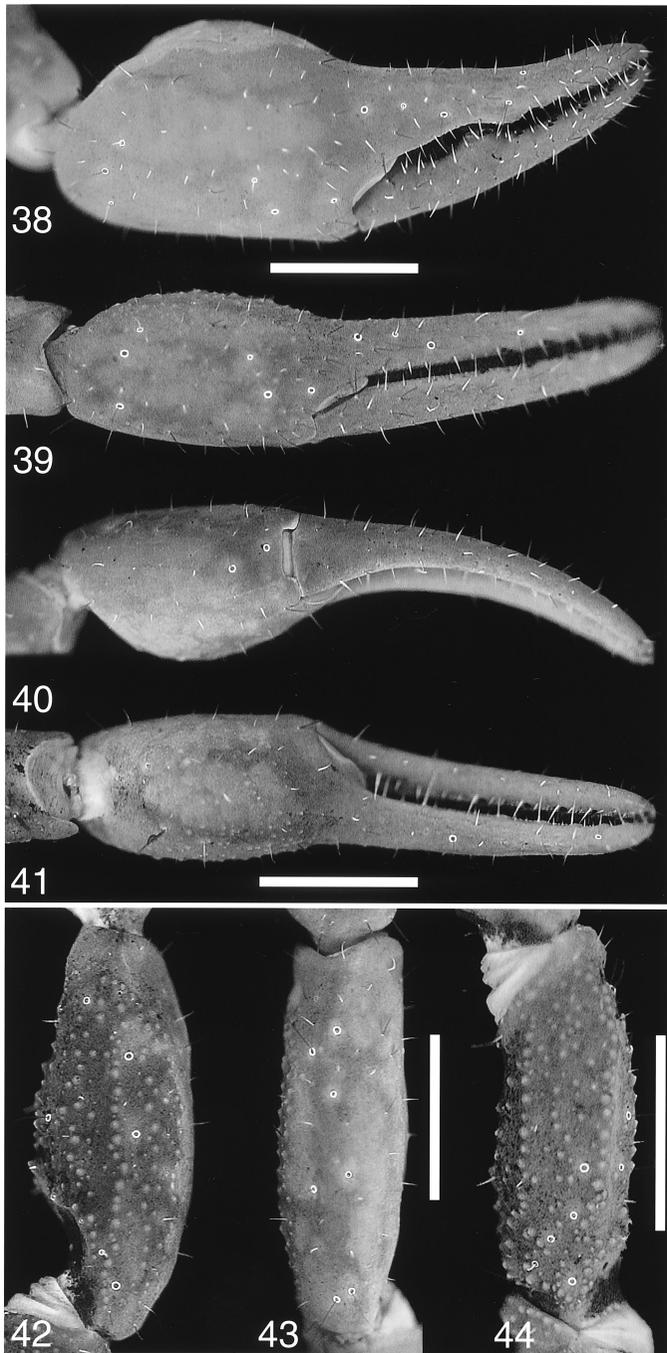
Hemispermatothore. Flagelliform; *pars reflecta* coiled distally; *pars recta* parallel to axis of distal lamina (Fig. 5).

Geographic Variation. Across its distributional range, *P. ochraceus* exhibits limited variation in size, color, granulation, development of the metasomal carinae, and pectinal tooth count. Specimens from the northern part of the distributional range (e.g., Limpopo Province) tend to be smaller and paler in color than specimens from further south (e.g., Gauteng Province), whereas specimens from the eastern part of the distributional range (e.g., Mpumalanga Province) tend to be more granular, with more strongly developed pedipalpal and metasomal

carinae. The holotype is unusual in displaying a much lower pectinal tooth count than most other specimens, but is otherwise fairly similar to specimens from the central part of the distributional range (Gauteng Province).

Ontogenetic Variation. As in other species of *Pseudolychas*, ♂ resembles ♀ very closely until the final instar. However, juveniles and subadults may be readily sexed by examination of the pectines and genital aperture.

Sexual Dimorphism. Besides the abovementioned characters, *P. ochraceus* is sexually dimorphic with respect to the shape of the pedipalp chela manus, as in other species of *Pseudolychas*. The chela manus of



Figs. 38–44. *Pseudolychas transvaalicus* Lawrence, 1961, distribution of trichobothria and macrosetae on the dextral pedipalpal segments of paratype ♂ (NMSA 7290) and paratype ♀ (NMSA 18678). (38) Chela, dorsal aspect, ♂. (39) Chela, dorsal aspect, ♀. (40) Chela, ventral aspect, ♀. (41) Chela, internal aspect, ♀. (42) Patella, dorsal aspect, ♀. (43) Patella, external aspect, ♀. (44) Femur, dorsal aspect, ♀. Scale bars = 1 mm.

adult ♂ is slightly incrassate (swollen), compared with that of adult ♀, which is more slender (Figs. 16 and 17). In addition, the chela of adult ♂ presents a weak, rounded lobe on the movable finger and a corresponding notch in the fixed finger, which are absent in adult

♀. Finally, adult ♂ are proportionally more slender than adult ♀ (Figs. 12 and 14).

Remarks. Confusion has surrounded the identity of *P. ochraceus*. Hewitt (1918, 1925a, b) misidentified specimens of *P. pegleri* from Redhouse (AMGS 1548,

Table 5. Meristic data for *Pseudolychas ochraceus* (Hirst, 1911), *P. pegleri* (Purcell, 1901), and *P. transvaalicus* Lawrence, 1961

Specimen	<i>P. ochraceus</i>				<i>P. pegleri</i>				<i>P. transvaalicus</i>			
	♀	♀	♂	♂	♀	♀	♂	♂	♀	♀	♂	♂
	BMNH 1905.3.30.45-54 holo	AMNH AH 5142	AMNH AH 2263	AMNH AH 584	NMSA 727	NMSA 3607	SAMC 5789 lecto	NMSA 722	NMSA 7290 holo	AMNH AH 2252	AMGS NMSA 7295	NMSA 7290 para
Total length ^a	34.0	37.3	36.0	41.9	28.8	29.0	24.9	29.3	22.8	22.9	16.3	25.1
Carapace												
Length	3.5	4.0	3.3	4.1	3.0	3.3	2.6	3.2	2.5	2.6	1.9	2.7
Anterior width	1.6	1.9	1.4	1.7	1.5	1.3	1.4	1.6	1.1	1.2	0.9	1.2
Posterior width	3.0	3.9	3.2	3.8	3.1	3.2	2.6	3.0	2.5	2.6	1.8	2.7
Mesosoma												
Total length ^b	10.8	10.9	10.4	11.4	8.9	9.0	8.0	8.5	6.6	7.2	4.3	7.6
Sternite VII												
Length	2.2	2.5	2.0	2.5	1.8	1.7	1.5	1.8	1.3	1.4	1.2	1.5
Width	3.3	3.9	2.4	3.1	3.1	3.1	2.3	2.6	2.4	2.3	1.6	2.2
Metasoma												
Total length ^c	19.7	22.4	22.3	26.4	16.9	16.7	14.3	17.6	13.7	13.1	10.1	14.8
Metasoma I												
Length	2.2	2.9	2.5	3.2	2.0	2.0	1.7	2.1	1.7	1.6	1.2	1.8
Width	1.6	2.1	1.6	1.9	1.7	2.0	1.3	1.7	1.5	1.5	1.1	1.7
Metasoma II												
Length	2.6	3.0	3.0	3.7	2.3	2.3	1.9	2.4	1.8	1.7	1.3	2.0
Width	1.6	1.9	1.5	1.9	1.6	1.9	1.3	1.7	1.5	1.5	1.1	1.7
Metasoma III												
Length	3.0	3.4	3.6	4.0	2.6	2.5	2.1	2.7	2.0	1.8	1.4	2.2
Width	1.6	1.9	1.5	1.9	1.5	1.9	1.3	1.7	1.5	1.5	1.1	1.7
Metasoma IV												
Length	3.3	3.6	4.0	4.7	2.8	2.8	2.4	3.0	2.2	1.9	1.7	2.5
Width	1.6	1.9	1.5	1.9	1.5	1.8	1.3	1.7	1.5	1.5	1.1	1.7
Metasoma V												
Length	4.5	5.0	5.0	5.9	3.7	3.6	3.3	3.9	3.0	3.1	2.3	3.2
Width	1.5	1.8	1.5	2.0	1.4	1.7	1.3	1.7	1.4	1.4	1.0	1.6
Telson												
Total length	4.1	4.5	4.2	4.9	3.5	3.5	2.9	3.5	3.0	3.0	2.2	3.1
Aculeus length	1.0	1.1	1.0	1.1	1.1	1.0	0.9	1.0	0.9	1.0	0.7	1.0
Vesicle length	3.1	3.4	3.2	3.8	2.4	2.5	2.0	2.5	2.1	2.0	1.5	2.1
Vesicle width	1.1	1.5	1.1	1.5	1.1	1.2	1.0	1.2	1.0	0.9	0.6	1.0
Vesicle height	1.1	1.5	1.1	1.5	1.0	1.2	1.0	1.2	1.0	0.9	0.6	1.0
Pedipalp ^d												
Total length	14.9	14.8	13.4	15.8	11.8	11.8	11.0	12.1	9.1	9.5	7.2	9.9
Femur												
Length	3.2	3.3	3.0	3.5	2.6	2.4	2.3	2.5	1.9	2.0	1.5	2.1
Width	1.0	0.9	0.8	1.0	0.8	0.9	0.7	0.8	0.7	0.7	0.4	0.7
Patella												
Length	4.1	4.0	3.5	4.0	3.0	3.0	3.0	3.0	2.4	2.5	1.8	2.5
Width	1.4	1.4	1.2	1.4	1.2	1.4	1.3	1.2	0.8	0.9	0.7	0.9
Chela												
Length ^e	6.1	5.5	5.5	6.6	5.1	5.2	4.7	5.1	3.8	4.0	3.0	4.2
Width	1.4	1.4	1.5	1.7	1.4	1.5	1.6	1.9	0.9	1.0	0.9	1.4
Height	1.3	1.3	1.3	1.6	1.2	1.4	1.5	1.9	0.9	0.9	0.9	1.2
Length of ventroexternal carina	2.4	2.4	2.4	3.1	2.3	2.1	2.4	2.7	1.5	1.5	1.3	2.0
Length of movable finger	4.0	3.5	3.1	3.6	3.1	3.0	2.7	2.8	2.3	2.5	1.7	2.1
Pectines												
Total length	2.2	2.4	2.6	3.3	1.9	2.1	1.9	2.9	1.5	1.4	1.3	1.9
Length along dentate margin	2.0	2.4	2.5	3.2	1.9	2.1	1.9	2.9	1.4	1.4	1.3	1.9
Tooth count (left/right)	10/10	13/13	16/15	17/17	12/11	12/11	11/11	12/13	10/10	9/9	12/11	11/11

Measurements (mm) following Stahnke (1970), Lamoral (1979), and Prendini (2000a, 2003a).

^a Sum of carapace, tergites I-VII, metasomal segments I-V, and telson.

^b Sum of tergites I-VII.

^c Sum of metasomal segments I-V and telson.

^d Pedipalps of *P. pegleri* lectotype missing; measurements taken from paralectotype ♂ (SAMC 6465).

^e Measured from base of condyle to tip of fixed finger.

1942) as *P. ochraceus*, an error repeated by Lawrence (1955) and Lamoral and Reynders (1975). Lawrence (1942) misidentified specimens of *P. pegleri* from Barberton (NMSA 744) as *P. ochraceus*, an error repeated by Lamoral and Reynders (1975). Hewitt (1918) also

misidentified specimens of *P. ochraceus* from Clearwaters, Haenertsburg (TMSA 1213) as *P. pegleri*, an error repeated by Lawrence (1955) and Lamoral and Reynders (1975). These misidentifications are attributed to the inadequacy of Hirst's (1911) description

and to the fact that neither Hewitt nor Lawrence examined the holotype deposited in BMNH.

Specimens from the Kruger National Park, referred to by Lawrence (1964, 1967), could not be traced during this investigation. However, it seems probable that the 2 ♀ from "Olifantspoort area in Msimbit forest" [Msimbitsane, 23°59'S 31°48'E] and 1 ♀ from "Ramiti pan area" [≈23°52'S 31°46'E], identified as *P. pegleri pegleri* by Lawrence (1964: 35), may be referable to *P. ochraceus*.

Distribution. On the basis of available locality records, *P. ochraceus* seems to be endemic to South Africa, where it has been recorded in the Free State, Gauteng, Limpopo, Mpumalanga, and North West provinces. However, it may also occur in eastern Botswana, western Lesotho, and southern Zimbabwe. It is locally abundant in several major South African cities (including Bloemfontein, Johannesburg, and Pretoria).

This species occurs on the interior plateau, at higher altitudes than *P. pegleri*, and mostly at lower altitudes than *P. transvaalicus* (Fig. 2). Known locality records fall within the following range of altitudes (percentage of locality records indicated in parentheses): 0–500 m (5%), 500–1,000 m (8%), 1,000–1,500 m (60%), 1,500–2,000 m (27%).

The distributional range of *P. ochraceus* falls mostly within the Grassland biome (Rutherford and Westfall 1994), where locality records occur in the Rocky Highveld Grassland (52%), Northeastern Mountain Grassland (6%), and Dry Sandy Highveld Grassland (2%) vegetation types (Bredenkamp and Van Rooyen 1998a, b, Bredenkamp et al. 1998a). Additional records fall within the following biomes and vegetation types: the Savanna biome (Rutherford and Westfall 1994), in the Mixed Bushveld (15%), Clay Thorn Bushveld (5%), Soutpansberg Arid Mountain Bushveld (5%), Sweet Lowveld Bushveld (5%), Sour Lowveld Bushveld (3%), Waterberg Moist Mountain Bushveld (3%), and Mixed Lowveld Bushveld (2%) vegetation types (Van Rooyen and Bredenkamp 1998a, b, c, d, e, f, g); the Forest biome (Rutherford and Westfall 1994), in the Afromontane Forest (2%) vegetation type (Lubke and McKenzie 1998a); the Nama Karoo biome (Rutherford and Westfall 1994) in the Eastern Mixed Nama Karoo (2%) vegetation type (Hoffman 1998). The distributional range of this species occurs in a region of moderate annual rainfall; 300–1,000 mm (mean: 677 mm) is received, mostly during the summer months.

Ecology. *Pseudolychas ochraceus* is a lapidicolous species, which can be found under stones, usually in humid habitats (e.g., forests, thickets on south-facing slopes, and in suburban gardens). In parts of its range, the species is syntopic with the buthids *Uroplectes carinatus* (Pocock, 1890) and *U. triangulifer*; the liochelids *Hadogenes bicolor* Purcell, 1899 and *H. gunningi* Purcell, 1899; and the scorpionids *Opisthophthalmus glabrifrons* Peters, 1861 and *O. pugnax* Thorell, 1876. It is allopatric with *P. pegleri* and *P. transvaalicus*.

Although specimens of this species are abundant in South African museum collections, adult males are very rare (the material examined for this study includes 5 ♂ and 110 ♀ specimens of *P. ochraceus*, compared with 41 ♂ and 60 ♀ specimens of *P. pegleri*). No males have been collected in the major cities where most of the specimens originate. It seems probable that *P. ochraceus* is parthenogenetic, as is the case in several other synanthropic buthid scorpions (Matthiesen 1962, San Martín and de Gambardella 1966, Lourenço and Cuellar 1994, 1999, Peretti 1994, Maury 1997) and that this attribute may have contributed to its successful invasion of urban habitats. Indeed, its occurrence in some cities, e.g., Bloemfontein and Bethulie, may be the result of synanthropic translocation. The absence of any records in the immediate vicinity outside of these cities, where the prevailing habitat is arid grassland or semidesert Karoo vegetation, suggests that *Pseudolychas* may not occur naturally in this region.

Conservation Status. *Pseudolychas ochraceus* is known from around 65 localities, falling within 25 QDS. The distributional range of this species occurs primarily on the South African Highveld (interior plateau), the highly urbanized and most densely populated region in southern Africa. Much of the natural savanna-grassland vegetation has been destroyed or transformed in this area, resulting in the decline or disappearance of many indigenous scorpion species, e.g., the buthids *U. carinatus* and *U. triangulifer*, the liochelid *H. gunningi*, and the scorpionid *O. pugnax*. In contrast, *P. ochraceus* seems to have benefited from the modified suburban habitat. Although typically rare in the natural savanna-grassland, where it is restricted to moist thickets on south-facing slopes, this species is fairly common in suburban gardens and may have proliferated as a result of the habitat modifications. As such, *P. ochraceus* may be assigned the Least Concern IUCN Red List Category.

Material Examined. SOUTH AFRICA: 'Transvaal', M. Stiller, 3 ♀ (SAMC C1544, C1546, C1551), 2 subad. ♀ (SAMC C1548, C1549), 1 juv. ♀ (SAMC C1556). *Free State*: Bloemfontein District: Bloemfontein [29°08'S 26°10'E], 6-XI-1986, Museum staff, in library, 1 ♀ (NMBA 1961), X-1987, Museum staff, 1 ♀ 1 subad. ♀ (NMBA 2749), 24-X-1987, J.J. Heroldt, at museum, 1 subad. ♀ (NMBA 2747), 25-I-1991, E. Irish, in museum, 1 subad. ♀ (NMBA 13116), 27-XI-1991, D. Winckworth, in swimming pool, 1 ♀ (NMBA 13140), XII-1991, Alfred, 1 subad. ♀ (NMBA 13141), 17-I-1993, Mrs Wolmarans, 3 ♀ (NMBA 13652), 8-VI-1993, J. Peyper, in drain, 1 juv. ♀ (NMBA 13656), 14-III-1994, K. Crause, in house, 1 ♀ (NMBA 13684), 11-IV-1994, T. Peyper, in museum, 1 ♀ (NMBA 13659), 3-I-1995, R. Luwes, in house, 1 ♀ (NMBA 13660), 19-II-1997, L. Lotz, in museum, 1 ♀ (NMBA 13685), 23-III-1998, L. de Villiers, in house, 1 ♀ (NMBA 9054), 5-XI-1999, L. Lotz, in house, 1 ♀ 1 juv. ♀ (NMBA 9198). *Gauteng Province*: Johannesburg District: Braamfontein, Johannesburg [26°11'S 28°02'E], XI-1997, 1 ♀ (AMNH [AH 5141]), 20-III-1975, G. Engelbrecht, 1 ♀ (AMNH [AH 189]); Ellis Park, Johannesburg [26°12'S 28°04'E], XI-

1997, 1 ♀ (AMNH [AH 5142]); Hillbrow, Johannesburg [26°11'S 28°03'E], 1979, N. Gericke, in bath, 1 ♀ (AMNH); Johannesburg [26°12'S 28°05'E], 1 ♀ (AMGS 6650), I-1970, 1 ♀ 1 juv. ♀ (NMSA 11446), 20-VI-1966, F. Zumpt, 1 ♀ (NMSA 9125), 25-XI-1974, R.B. Burton, 1 ♀ (TMSA 18232), I-IV-1990, L. Prendini, 4 ♀ 1 juv. ♀ (ESV 2408); Melville Koppies Nature Reserve, Johannesburg [26°10'S 28°00'E], 20-V-1989, L. Prendini, under stone, 1 ♀ (ESV 2458); Northcliff, Johannesburg [26°08'S 27°57'E], 8-XI-1974, A. Harington, under rock, 1 subad. ♀ (AMNH [AH 51]), XII-1974, A. Harington, 1 ♀ (AMNH [AH 123]); Observatory, Johannesburg [26°11'S 28°03'E], 3 ♀ (AMGS 6672), 1 ♀ 1 subad. ♀ 1 juv. ♀ (AMGS 6664), 1 ♀ 1 juv. ♀ (AMGS 6656); Parktown near Johannesburg [26°10'S 28°02'E], 2-I-1980, L. Opperman, under rocks, 1 ♀ (CASC); Saxonwold, Johannesburg [26°09'S 28°03'E], I-1978, M. Levinson, 1 ♀ (TMSA 18230); Wits University Zoology Department, Johannesburg [26°11'S 28°02'E], 15-X-1999, S.A. Hanrahan, 1 ♀ (AMCC 119223). Kempton Park District: Modderfontein [26°05'S 28°10'E], 7-XI-1974, J.H. Mason, 1 ♀ (TMSA 18228). Krugersdorp District: Bekker School, Magaliesburg [25°59'S 27°33'E], 21-22-III-1978, L. Harington, 1 ♀ (AMNH [AH 507]); Farm Uitzicht, 10 mi W Pretoria [25°59'S 27°49'E], 25-VIII-1968, G. Newlands, 1 ♀ (TMSA 18223); Hekpoort, 9 km SW [25°53'S 27°37'E], 16-XII-1974, A. Harington, under rock on hillside, 1 subad. ♀ (AMNH [AH 77]). Pretoria District: Farm Vlaktefontein, near Lanseria, 30 km N Johannesburg [25°54'S 27°56'E], IV-1975, A. Harington, 1 ♀ (AMNH [AH 120]); Mooiplaat, W of Pretoria [25°51'S 28°06'E], 24-III-1967, G. Newlands, 1 ♀ (TMSA 18218); Clubview, Centurion [25°50'S 28°10'E], 7-II-2000, L. Steynberg, in house in cupboard, 1 ♀ (PPRI AcAT 2000/21); Irene [25°53'S 28°13'E], XI-1969, J. Mendelson, 1 ♀ (TMSA 9448), 9-XI-1969, J. Mendelson, 2 ♀ (TMSA 9442, 9444), 1 juv. ♀ (TMSA 9443), 4-II-2003, J. Harrison, 1 ♀ (AMNH); Brooklyn, Pretoria [25°46'S 28°15'E], XI-1969, J. Mendelson, 1 ♀ (TMSA 9445), L. Vari, 1 ♀ (TMSA 9478), N. von Jeney, 1 ♀ (TMSA 9475); Fountains [25°47'S 28°11'E], IV-1922, 1 ♀ (TMSA 14059); Gezina [25°43'S 28°13'E], 3-II-1975, P.J. Malan, 1 ♀ (TMSA 10961); Lynnwood Glen, Pretoria [25°46'S 28°16'E], 8-XI-1983, O. Nesor, in basin, 1 ♀ (PPRI AcAT 83/365); Maroelana, Pretoria [25°47'S 28°16'E], 1 ♀ (AMNH [AH 4261]); Menlo Park [25°47'S 28°15'E], 4-XII-1972, J.C. van den Berg, 1 ♀ (TMSA 10654), 17-XI-1975, J.C. du Buy, 1 ♀ (TMSA 11122); Muckleneuk Hill [25°46'S 28°13'E], 6-II-1971, C.H. Whitworth, 1 subad. ♀ (TMSA 10030), 4-III-1971, C.H. Whitworth, 1 ♀ (TMSA 10042), 24-I-1973, T. Barnes, 1 ♀ (TMSA 10658); Muckleneuk, Pretoria [25°46'S 28°14'E], 25-XI-1968, Mrs A. Roux, 1 ♀ (TMSA 18225); Pretoria [25°45'S 28°11'E], 25-IX-1971, R. Myburgh, 4 ♀ (TMSA 10197-10199, 10201), 1 juv. ♀ (TMSA 10220), 9-I-1972, F. van Niekerk, 1 ♀ (TMSA 10251), 15-I-1979, M.K.P. Meyer, in bath in house, 1 juv. ♀ (PPRI AcAT 79/9), 2-IX-1988, S. Nesor, 1 ♀ (PPRI AcAT 2002/421), 18-IV-1993, D. du Preez, in house, 1 ♀ (PPRI AcAT 93/458), 23-IV-1993, R. Hechter, in

house, one specimen [not examined] (PPRI AcAT 93/306), 15-I-1994, H. Loots, 1 ♀ (PPRI AcAT 94/275); Pretoria West [25°45'S 28°10'E], 1-X-1968, G. Newlands, 1 ♀ (TMSA 18224); Riviera [25°44'S 28°13'E], 2-XII-1974, Mrs. Shopick, 1 subad. ♀ (TMSA 10963); Strubenkop [25°45'S 28°16'E], 18-X-1969, J. Mendelson, 5 ♀ (TMSA 9425, 9427-9430), 1 subad. ♀ (TMSA 9426), 1 juv. ♀ (TMSA 9431), XI-1969, J. Mendelson, 3 ♀ (TMSA 9479-9481), 1 subad. ♀ (TMSA 9482); Waterkloof [25°47'S 28°14'E], 26-XI-1969, G. Voigt, 1 ♀ (TMSA 9521). Randburg District: Randburg [26°06'S 27°59'E], 8-XI-1969, J.E. Aldworth, 1 ♀ (TMSA 18226). Roodepoort District: Kloofendal, Roodepoort [26°10'S 27°45'E], 15-XI-1987, A. Leroy, on ground, pit traps, one specimen [not examined] (PPRI AcAT 88/779). Wonderboom District: Roo-deplaai [25°38'S 28°21'E], 5-VI-1918, G.P.F. van Dam, 1 ♀ (TMSA 2179); Wonderboom airport [25°39'S 28°13'E], 14-X-1998, T.J. Gunter, 1 ♀ (PPRI AcAT 98/1130). Limpopo Province: Letaba District: Malta forest, The Downs [24°10'S 30°13'E], 1-IV-1978, M. Picker, under stone on north-facing hill, 1 ♂ (AMNH [AH 584]), 9-X-1978, M. Picker, 1 ♀ (AMNH [AH 874]), 1 ♀ 1 juv. ♀ (AMNH [AH 875]). Mhala District: Newington [24°49'S 31°17'E], 25-IV-1976, A. Harington, 1 ♀ (TMSA 18229). Naphuno District: Trichardtsdal [24°10'S 30°24'E], 19-XII-1973, N. Jacobsen, under rock, 1 ♀ (AMNH [AH 3441]). Pietersburg District: Clearwaters, Haenertsburg [23°56'S 29°57'E], 4-II-1916, G.A. Thompson, 1 ♀ (TMSA 1213) [misidentified as *P. pegleri* by Hewitt (1918)]; Farm Loopeegte 302, Morgendal [24°05'S 29°52'E], XI-1979, N. Jacobsen, 1 ♀ (TMSA 18231). Potgietersrus District: Makapansgat [24°09'S 29°11'E], 1981, A. Harington, 1 ♂ (AMNH [AH 2263]). Percy Fife Nature Reserve [24°03'S 29°08'E], 11-V-1972, N. Jacobsen, 3 ♀ (TMSA 10478-10480). Soutpansberg District: 15 km W of Louis Trichardt [23°05'S 29°52'E], 19-VII-1984, C. Owen, 1 ♀ (AMNH [AH 3611]); 8 km W of turnoff to Bluegumspoor, Louis Trichardt [22°59'S 29°50'E], 24-XII-1984, C. Owen, 4 ♀ (AMNH [AH 3398, 3883-3885]), 1 subad. ♀ (AMNH [AH 3886]); Farm Marius 732, N of Louis Trichardt [22°55'S 29°54'E], 13-VI-1985, A. Harington, 1 ♀ (AMNH [AH 4331]), 14-VI-1985, A. Harington, steep wooded area, 1 ♀ (AMNH [AH 4378]); N end of Wylie's Poort [22°54'S 29°56'E], 29-VI-1972, E.S. Ross, 1 ♂ (CASC). Warmbad District: Farm Groothoek, 15 mi E Warmbad [24°57'S 28°32'E], 4-III-1967, G. Newlands, 1 juv. ♀ (TMSA 18217). Waterberg District: Farm Mamiaanshoek, Thabazimbi [24°24'S 27°41'E], X-1967, A. Fourie, 1 ♀ (TMSA 18222); Nylstroom, Emaweni Game Lodge [24°42'S 28°24'E], 12-15-IV-1993, J.H. Labuschagne, under stones, 1 ♀ (NMBA 13212). Mpumalanga Province: Barberton District: Louw's Creek [25°38'S 31°17'E], III-1920, G.P.F. van Dam, 1 ♂ (TMSA 2263), 1 ♀ (TMSA 2259). Pilgrim's Rest District: Blyde River Canyon Nature Reserve: Bourke's Luck Potholes [24°40'S 30°49'E], 12-VII-2000, L. Prendini and M. MacFarlane, grassland, with mixed bushveld at edge of canyon, under sandstone, 1 ♀ (AMCC 119224). North West Province: Brits District: Farm Wolhuterskop

[25°43'S 27°42'E], 31-V-1968, G. Newlands, 3 ♀ (TMSA 18219–18221). Rustenburg District: Buffelspoort, Brits area [25°48'S 27°29'E], 6-XI-1977, A.S. Dippenaar, under stone, 1 ♀ (PPRI AcAT 77/1055); Groenkloof, near Rustenburg [25°41'S 27°10'E], 29-III-1975, J.S. Harington, under rock, 1 subad. ♂ (AMNH [AH 257]); Rustenburg Kloof, Rustenburg [25°41'S 27°11'E], 3-IX-1978, A. Harington/M. Picker, 1 ♀ (AMNH [AH 585]), 1 ♀ (AMNH [AH 586]); Rustenburg Kloof Nature Reserve [25°42'S 27°12'E], 7-XI-1979, M. Stiller, under stone, 2 ♀ (PPRI AcAT 80/241, AcAT 80/242); Rustenburg Nature Reserve [25°43'S 27°11'E], VI-1970, N. Jacobsen, 1 ♀ (TMSA 9796). Dubious Record: Western Cape Province: Caledon District: Viljoenspass near Grabouw [34°06'S 19°03'E], 12-I-1979, A. Harington, 1 subad. ♀ (AMNH [AH 1137]).

Pseudolychas pegleri (Purcell)

(Figs. 2, 6–8, and 23–33)

Lychas pegleri Purcell, 1901: 173–175.

Pseudolychas pegleri. Kraepelin 1911: 59, 60; Hewitt 1918: 115 (part); Hewitt 1925a: 256 (part); Hewitt 1925b: 289, 290 (part); Werner 1934: 271; Lawrence 1937: 258, 259; Lawrence 1938: fig. 1c and e; Lawrence 1942: 222, 223, 235; Lawrence 1955: 230 (part); Lawrence 1961: 123–126, fig. 2; Lamoral and Reynders 1975: 524 (part); Kovařík 1998: 117; Fet and Lowe 2000: 214, 215; Prendini 2001c: 138.

Pseudolychas pegleri nigrimanus Kraepelin, 1911: 60, New Synonym; Hewitt 1918: 115; Lawrence 1955: 230; Weidner 1959: 103; Lawrence 1964: 35; Lamoral and Reynders 1975: 525; Kovařík 1998: 117; Fet and Lowe 2000: 215.

Pseudolychas ochraceus. Hewitt 1918: 115, 116, pl. XXI, fig. 23 (misidentification: AMGS 1548, 1942); Hewitt 1925a: 256 (misidentification: AMGS 1548, 1942); Hewitt 1925b: 290 (misidentification: AMGS 1548, 1942); Lawrence 1942: 222, 235 (misidentification: NMSA 744); Lawrence 1955: 230 (misidentification: AMGS 1548, 1942); Lamoral and Reynders 1975: 524 (misidentification: AMGS 1548, 1942; NMSA 744).

Pseudolychas multicarinatus Hewitt, 1925b: 290–292, New Synonym [not synonymized by Lawrence (1942: 223) as stated in Fet and Lowe (2000: 215)]; Lawrence 1938: fig. 1f.

Pseudolychas nigrimanus. Hewitt 1925b: 291.

Pseudolychas pegleri multicarinatus. Lawrence 1942: 223; Lawrence 1955: 230; Lawrence 1964: 35; Lamoral and Reynders 1975: 524; Kovařík 1998: 117; Fet and Lowe 2000: 215.

Pseudolychas pegleri pegleri. Lawrence 1964: 35; Lawrence 1967: 85; Fet and Lowe 2000: 215.

Type Material. LECTOTYPE: 1 ♂ (SAMC 5789), Mqanduli [31°49'S 28°45'E], S of Umtata, Cape Colony [Mqanduli District, Eastern Cape Province], South Africa, 1900, A. Pegler. PARALECTOTYPES: 1 ♂ 3 ♀ 1 juv. ♀ (SAMC 6465), same data as lectotype; 2 ♀ (SAMC 6494, damaged), same data as lectotype, except '1901'. According to Purcell (1901: 175), the

syntype series comprised: "Several ♂ and ♀ specimens from near Umtata, Cape Colony, collected by Miss Pegler". Hewitt (1918: 115) later noted: "This species was recorded from Umtata, but Miss Pegler, who collected the types, informs me that the actual locality is Mqanduli." The type specimens are severely dehydrated, discolored and, in some cases, dismembered. One ♂ specimen is hereby designated as the lectotype and the remaining specimens as paralectotypes.

Syntypes of *P. pegleri nigrimanus*: 1 ♂ 2 ♀ 1 subad. ♂ 1 juv. ♂ 1 juv. ♀ (ZMUH 100), Umfuli River [28°42'S 31°39'E], Zululand [Mtonjaneni District, KwaZulu-Natal Province, South Africa], 1.vi.1907. Kraepelin's (1911: 60) Zimbabwean type locality for *P. pegleri nigrimanus*, given as "Umfuli River im Mashonaland," and adopted by subsequent authors (Hewitt 1918, 1925a, 1925b; Lawrence 1955; Lamoral and Reynders 1975; Fet and Lowe 2000) is erroneous. According to the original label, the type locality is 'Umfuli River, Zululand', which is actually the Imfuli or Mfule River in the KwaZulu-Natal Province of South Africa. There are no records of *Pseudolychas* from Zimbabwe, and Newlands and Martindale (1980) omitted *Pseudolychas* from their review of the buthid scorpion fauna of that country.

Syntypes of *P. multicarinatus*: 1 ♂ (AMGS 4480), Mfongosi [28°42'S 30°48'E], Zululand [Nkandhla District, KwaZulu-Natal Province], South Africa; 1 ♀ (AMGS 2000), 'E Zululand' [KwaZulu-Natal Province], South Africa, 1903, E. Warren. Although labeled as types, 2 ♂ from Ntambanana (AMGS 3012, 4603), were not referred to as types in Hewitt's (1925b: 290) description, which states: "This species is based on two specimens in the Albany Museum, a male from Mfongosi, Zululand, and a female from E. Zululand: we have also two males collected by Messrs. H. H. Curson and E.F.J. George at Ntambanana, N. Zululand."

Diagnosis. *Pseudolychas pegleri* is the sister species of *P. transvaalicus* (Fig. 1). Both species may be separated from *P. ochraceus* by means of the following combination of characters: pectines (♂) each with fewer than 15 teeth; pedipalp chela manus (♂) markedly incrassate, length 30–33% greater than width and 30–40% greater than height; metasoma (♂) 81–82% longer than carapace; metasomal segments, median lateral carinae distinct on segment II, distinct to obsolete on segment III.

Although superficially similar, *P. pegleri* may be separated from *P. transvaalicus* by means of the following characters: the basal pectinal tooth (♀) is enlarged (longer and wider than the other teeth) in *P. pegleri* but reduced (shorter and narrower than the other teeth) in *P. transvaalicus*; the fixed finger of the pedipalp chela (♂) is not lobate in *P. pegleri* but is lobate in *P. transvaalicus*.

Description. The following redescription supplements Purcell's (1901) original description. It is based on the lectotype and several additional ♂ and ♀ specimens (NMSA 722, 727, 3607, 3608, 3620).

Color. Carapace, tergites, sternite VII, and metasoma: Dark Brownish Olive No. 129. Chelicerae, pedipalps, legs and telson: Brownish Olive No. 29. Ster-

nites III-VI: Buff No. 124. Pectines: Cream Color No. 54.

Carapace. As for *P. ochraceus*, except as follows. Anterior margin of carapace sublinear to procurved, with small median projection; posterior margin procurved (Fig. 6).

Chelicerae. As for *P. ochraceus*.

Pedipalps. As for *P. ochraceus*, except as follows. Patella sparsely and finely granular (Figs. 31 and 32). Chela long (Figs. 27-30), slender (♀), or markedly incrassate (♂), length along ventroexternal carina 30-33% (♂) or 29-39% (♀) greater than chela width and 30-38% (♂) to 33-48% (♀) greater than chela height (Table 5); length of movable finger 4-11% (♂) to 26-30% (♀) greater than length along ventroexternal carina. Chela (♂) movable finger with a strong, rounded lobe medially; fixed finger slightly curved dorsally, with a corresponding notch, but without a smaller, rounded lobe distal to the notch; proximal dentate margin linear (i.e., no proximal "gap" is evident) when fingers are closed (Fig. 27). Dentate margins of chela fixed and movable fingers with basal row occasionally flanked medially by a single external accessory granule.

Trichobothria. As for *P. ochraceus* (Figs. 27-33).

Mesosoma. As for *P. ochraceus*, except as follows. Sternites III-V entirely smooth, but weakly granular along lateral margins in V; VI entirely sparsely and coarsely granular, except for submedian depressions; VII more densely and coarsely granular; lateral and distal margins of each sternite with a row of sparsely distributed macrosetae (Figs. 24 and 26).

Sternum. As for *P. ochraceus* (Fig. 7).

Genital operculum. As for *P. ochraceus*.

Pectines. As for *P. ochraceus*, except as follows. Pectinal teeth (Fig. 7): 12-14 (♂), 11-13 (♀).

Legs. As for *P. ochraceus*.

Metasoma and Telson. As for *P. ochraceus*, except as follows. Metasomal segments I-V width/length ratio progressively decreasing, width percentage of length 76-81% (♂) to 85-100% (♀) for I, 68-71% (♂) to 70-83% (♀) for II, 62-63% (♂) to 58-76% (♀) for III, 54-57% (♂) to 54-64% (♀) for IV, and 39-44% (♂) to 39-47% (♀) for V (Table 5). Telson oval, elongate, height 48-50% (♂) or 42-48% (♀) of length; vesicle slightly narrower than metasomal segment V, width 71-77% (♂) to 71-79% (♀) of metasomal segment V. Metasoma uniformly coarsely granular; telson uniformly coarsely granular except for dorsomedian surfaces, which are smooth (Figs. 23-26). Metasomal segments I-III each with ten carinae, but median lateral carinae often obsolete on segment III; segment IV with eight carinae (median lateral carina absent, rarely obsolete); segment V with five carinae (a single ventromedian and paired dorsolateral and ventrolateral carinae). Aculeus short, shallowly curved, 40-46% of vesicle length; subaculear tubercle varies from low and rounded to sharp and conical, and is often preceded by one or more enlarged granules.

Hemispermaphore. As for *P. ochraceus* (Fig. 8).

Geographic Variation. Across its distributional range, *P. pegleri* exhibits limited variation in color,

granulation, and development of the metasomal carinae. Specimens from the Lebombo Mountain range (extending from northern KwaZulu-Natal, through Swaziland, into Mpumalanga) tend to be light brownish-orange in color, rather than the more typical dark brownish-olive. Occasionally, specimens from various localities (e.g., the syntypes of *P. pegleri nigrimanus*) display infuscated pedipalp chelae. Specimens from the northeastern part of the distributional range (Swaziland and Zululand), formerly assigned to *P. pegleri nigrimanus* and *P. multicarinatus*, are characterized by increased granulation and development of the metasomal carinae. In these specimens, median lateral carinae are present on segment III, and less often, segment IV, and the subaculear tubercle is preceded by one or more enlarged granules. A further character subject to geographic variation is the presence or absence of a single external accessory granule medially flanking the basal granular row of the pedipalp chela movable finger. The presence of this granule was proposed as a diagnostic character for *P. pegleri pegleri* by Lawrence (1938, 1942), but it was found to vary among and within populations in the current study.

Ontogenetic Variation. As for *P. ochraceus*.

Sexual Dimorphism. As for *P. ochraceus*, except as follows. The pedipalp chela manus of adult ♂ is markedly incrassate (bulbous or swollen) compared with that of adult ♀, which is more slender (Figs. 27 and 28). In addition, the chela of adult ♂ presents a strong, rounded lobe on the movable finger and a corresponding notch in the fixed finger, which are absent in adult ♀.

Remarks. Because of confusion regarding the identity of *P. ochraceus*, specimens of *P. pegleri* have frequently been misidentified as *P. ochraceus* and vice versa (discussed in remarks under *P. ochraceus*). Further confusion surrounds delimitation of the subspecies of *P. pegleri*. As with *P. ochraceus*, the ambiguous status of these taxa can be attributed to the failure of past workers to compare the type specimens and consider the extent of geographical variation in putative diagnostic characters. During the course of this investigation, the type specimens of *P. pegleri*, *P. pegleri nigrimanus* and *P. multicarinatus* were compared and found to be conspecific. The diagnostic characters for separating them provided by Kraepelin (1911), Hewitt (1918, 1925b), and Lawrence (1938, 1942, 1955) were found to be unreliable when additional specimens from multiple localities were examined. Consequently, *P. pegleri nigrimanus* and *P. multicarinatus* are synonymized with *P. pegleri*. A brief discussion of the diagnostic characters proposed for these taxa by previous authors shall justify the decision to synonymize these taxa.

Kraepelin (1911) distinguished *P. pegleri nigrimanus* from *P. pegleri* on the following grounds: (1) geographical distribution (he alleged that the type specimens of *P. pegleri nigrimanus* originated from Mashonaland, near 18°S, whereas Umtata, the type locality of *P. pegleri*, is near 32°S); (2) the median lateral carinae of metasomal segment III are well de-

veloped, those of segment IV weak but distinguishable in *P. pegleri nigrimanus* (the carinae of segment III are obsolete, those of segment IV absent in *P. pegleri*); (3) 13 pectinal teeth in the ♂ of *P. pegleri nigrimanus* (12 pectinal teeth in *P. pegleri*); (4) pedipalp chela movable finger with six anterior flanking granules in *P. pegleri nigrimanus* (seven granules in *P. pegleri*); and (5) coloration (chelae infuscated in *P. pegleri nigrimanus* compared with *P. pegleri*, in which the chelae are not infuscated). These differences were repeated by Hewitt (1918, 1925b) and Lawrence (1955), although neither of those workers examined the type specimens of *P. pegleri nigrimanus*.

Hewitt (1925b) differentiated *P. multicoloratus* from *P. pegleri* on the following basis: (1) median lateral carinae of metasomal segment III well developed in *P. multicoloratus* (carinae weakly developed in *P. pegleri*); (2) subaculear tubercle subconical and strong, preceded by one or more enlarged granules in *P. multicoloratus* (weak, not preceded by granules in *P. pegleri*); and (3) tergal carinae stronger in *P. multicoloratus* than in *P. pegleri*. Hewitt (1925b) further distinguished *P. multicoloratus* from *P. pegleri nigrimanus* on the presence of seven anterior flanking granules on the pedipalp chela movable finger and the weaker median lateral carina of metasomal segment IV. Lawrence (1938, 1942, 1955) repeated these differences but relegated *P. multicoloratus* to a subspecies of *P. pegleri* (Lawrence 1942: 223): "The differences which Dr. Hewitt described between this and the typical form, though well marked, seem hardly sufficient to warrant specific recognition for it."

Kraepelin's putative distributional difference can be dismissed because the type specimens of *P. pegleri nigrimanus* originated from Zululand—well within the distributional range of *P. pegleri*—and not from Mashonaland as he stated. The remaining morphological differences proposed for *P. pegleri nigrimanus* and *P. multicoloratus* are all subject to geographical variation across the range of *P. pegleri*. Development of the tergal carinae, metasomal median lateral carinae, and subaculear tubercle are all contingent on the degree of granulation, which is inevitably subject to geographical variation in *Pseudolychas*, as in most other scorpions. In *P. pegleri*, the median lateral carinae vary from distinct to obsolete on metasomal segment III and from obsolete to absent on segment IV, whereas the subaculear tubercle varies from low and rounded to sharp and conical, and may or may not be preceded by one or more enlarged granules. Pectinal tooth counts and coloration are likewise subject to geographic variation in most scorpions, including *Pseudolychas*. In *P. pegleri*, the pectinal tooth count of the ♂ varies from 12 to 14, and the chelae may or may not be infuscated.

None of the abovementioned characters, considered separately or in combination, justify the continued recognition of *P. pegleri nigrimanus* and *P. multicoloratus*. The only potentially legitimate diagnostic character among those proposed by previous authors is that described as the number of "anterior flanking granules" of the pedipalp chela movable finger. This

character, translated as the presence or absence of a single external accessory granule medially flanking the basal granular row of the movable finger, is diagnostic at the species level in other buthid genera, e.g., *Babycurus* (see Prendini 2003c). In *Pseudolychas*, all seven granular rows of the movable finger, except the basal row, are usually flanked proximally by two external accessory granules, leading to a count of "six anterior flanking granules." However, when a single external accessory granule, flanking the basal granular row medially, is present, this is added to the count, resulting in "seven anterior flanking granules."

Kraepelin (1911), followed by Hewitt (1918), used the absence of this granule (i.e., six instead of seven anterior flanking granules) to separate *P. pegleri nigrimanus* from *P. pegleri*. Hewitt (1925b) subsequently used the same character to separate *P. pegleri nigrimanus* from *P. multicoloratus*. Thus, according to Hewitt (1918, 1925b), the granule is present in *P. pegleri* and *P. multicoloratus*. Lawrence (1938: 291, fig. 1c) illustrated the presence of the granule (seven anterior flanking granules) in *P. pegleri*. Later, Lawrence (1942: 222) proposed this as a diagnostic character, unique to *P. pegleri*: "In the female of *pegleri* there is along the outer side of the cutting edge of the movable finger an enlarged granule at the middle of the basal row of granules, in addition to the double granules at the base of the remaining six rows . . . This extra granule is absent in *ochraceus* and *multicoloratus*." However, in the key by Lawrence (1955: 230), *P. pegleri multicoloratus* is again separated from *P. pegleri nigrimanus* by the presence of seven, as opposed to six anterior flanking granules, implying that the granule is present in *P. pegleri multicoloratus*. Therefore, on the basis of the literature, *P. pegleri* and its putative subspecies cannot be separated consistently according to the presence or absence of this granule. Furthermore, when this character was surveyed in actual specimens during the current study, it was found to be unreliable, varying both among and within populations identified by Lawrence as *P. pegleri* and *P. pegleri multicoloratus*.

Specimens identified by Lawrence (1942) as *P. pegleri multicoloratus* (NMSA 738, 1369, 3532, 3536, 3539, 3545, 3546, 3565; CASC [ex NMSA]) are thus referable to *P. pegleri*. Specimens from the Kruger National Park, referred to by Lawrence (1964, 1967), could not be traced during this investigation. However, it seems probable that the 3 ♀ from "Ships mountain" [Ship Mountain, 25°12'S 31°21'E], identified as *P. pegleri nigrimanus* by Lawrence (1964: 35), and another specimen from "Skabekop" [25°10'S 31°16'E], identified as *P. pegleri pegleri* by Lawrence (1967: 85), may be referable to *P. pegleri*.

Distribution. On the basis of available locality records, *P. pegleri* seems to be endemic to Mozambique, Swaziland, and South Africa. South African records occur in the Eastern Cape, KwaZulu-Natal, and Mpumalanga provinces.

This species is distributed mainly along the eastern coastal plain and generally occurs at lower altitudes than the other species of *Pseudolychas* (Fig. 2). Known locality records fall within the following range of al-

titudes (percentage of locality records indicated in parentheses): 0–500 m (43%), 500–1,000 m (39%), and 1,000–1,500 m (17%).

The distributional range of *P. ochraceus* falls within four biomes: the Savanna biome (Rutherford and Westfall 1994), where locality records occur in the Coast-Hinterland Bushveld (11%), Natal Lowveld Bushveld (9%), Coastal Bushveld-Grassland (7%), Lebombo Arid Mountain Bushveld (7%), Sour Lowveld Bushveld (7%), Sweet Lowveld Bushveld (7%), Eastern Thorn Bushveld (2%), and Mixed Lowveld Bushveld (2%) vegetation types (Granger 1998a, b, Granger et al. 1998, Van Rooyen and Bredenkamp 1998d, e, g, h, i); the Grassland biome (Rutherford and Westfall 1994), where records occur in the Northeastern Mountain Grassland (11%), Moist Upland Grassland (2%), and Short Mistbelt Grassland (2%) vegetation types (Bredenkamp et al. 1998a, b, Granger and Bredenkamp 1998); the Thicket biome (Lubke 1998a), where records occur in the Valley Thicket (18%) and Mesic Succulent Thicket (2%) vegetation types (Lubke 1998b, c); and the Forest biome (Rutherford and Westfall 1994), where records occur in the Coastal Forest (13%) vegetation type (Lubke and McKenzie 1998b). The distributional range of this species occurs in a region of moderate to high annual rainfall; 350–1,500 mm (mean: 877 mm) is received, mostly during the summer months.

Ecology. *Pseudolychas pegleri* is a lapidicolous species, which can be found under stones or tree bark and in or under rotten logs, usually in humid habitats (e.g., forests, thickets on south-facing slopes, moist grassland). In parts of its range, the species is syntopic with the buthids *Uroplectes formosus* Pocock, 1890 and *U. triangulifer* and the liochelids *Opisthacanthus asper* (Peters, 1861), *O. laevipes* (Pocock, 1893), and *O. validus* Thorell, 1876. It is allopatric with *P. ochraceus* and *P. transvaalicus*.

Conservation Status. *Pseudolychas pegleri* is known from around 50 localities, falling within 41 QDS. The distributional range of this species occurs predominantly along the eastern coast of southern Africa, a region of moderate to high rainfall that is both densely populated and subject to extensive agriculture. Much of the natural savanna-grassland vegetation has been afforested, replaced with sugar cane plantations, or urbanized. Fortunately, many patches of indigenous forest remain intact because they are situated against inaccessible cliffs or in deep gorges. Most of the known localities for *P. pegleri* fall outside of protected areas. However, South African populations are protected in the Kruger National Park, the Hluhluwe and Umfolozi Game Reserves, and the Ngoye Forest Reserve (populations may also exist in the Mkuze Game Reserve, the Pongolapoort Nature Reserve, and the Entumeni Forest Reserve). Swazi populations are protected in the Malolotja and Mlawula-Mbuluzi Nature Reserves. In view of this situation, the survival of *P. pegleri* is assured, and it is assigned the Least Concern IUCN Red List Category.

Material Examined. MOZAMBIQUE: Maxixe, Inhambane [23°52'S 35°23'E], I-1924, R.F. Lawrence, 1

♀ (SAMC B6055). SOUTH AFRICA: *Eastern Cape Province*: Mqanduli District: Mqanduli [31°49'S 28°45'E], 11-VII-1927, L.E.G. Crow [?], 1 ♀ (AMGS 5606); Qingqolo [31°45'S 28°49'E], 1 ♀ (AMGS 6976). Port Elizabeth District: Redhouse [33°50'S 25°34'E], Mrs T.V. Paterson, 2 ♀ (AMGS 1548, 1942) [misidentified as *P. ochraceus* by Hewitt (1918, 1925a, 1925b)]. Tsolo District: Somerville, Tsolo [31°19'S 28°45'E], 26-VI-1919, R. Godfrey, 1 ♀ (AMGS). Umzimvubu District: Port St. Johns [31°38'S 29°32'E], VIII-1937, W.G. Rump, 3 ♀ (NMSA 727); Port St. Johns [31°37'S 29°33'E], 14-VIII-1974, B. Kensley, under stone, 3 ♀ (SAMC C8). *KwaZulu-Natal Province*: 'Natal', 1 ♀ (AMNH); 'Zululand', 1905, F. Toppin, 2 ♂ 5 ♀ 1 subad. ♂ 2 subad. ♀ (NMSA 3545); 'E Zululand', 1903, E. Warren, 1 ♂ 2 ♀ (NMSA 3532). Camperdown District: Drummond, Valley of 1,000 Hills [29°45'S 30°42'E], XII-1959, R.F. Lawrence, 1 ♂ 1 subad. ♂ (NMSA 7289); Richmond, Pateni Tea Estate [29°56'S 30°09'E], 18-XI-1971, 1100 m, 2 ♀ (NMSA 19695). Durban District: Burman Bush, on Durban Bluff [29°53'S 31°03'E], 14-III-1973, G. Setaro, under bark of trees, 5 ♀ (NMSA 19700). Eshowe District: Windy Ridge Game Reserve [28°53'S 31°23'E], 20-IX-1981, P. Reavell, under log in mixed bush, 1 ♀ (AMNH [AH 4289]). Hlabisa District: Hluhluwe Game Reserve [28°05'S 32°05'E], 1 ♂ 2 subad. ♂ 1 subad. ♀ (NMSA 696). Ingwavuma District: Gwaliweni [27°17'S 31°59'E], VIII-1954, 1 ♂ (NMSA 3614), II-1957, R.F. Lawrence, 1 ♂ 1 ♀ (NMSA 3621), 2 ♀ (NMSA 3620); Ingwavuma [27°07'S 31°58'E], VII-1938, R.F. Lawrence, 5 ♀ (NMSA 738), under stones, 1 ♂ 1 ♀ (CASC [ex NMSA]), VII-1951, R.F. Lawrence, 3 ♀ (MRAC 70932 [NMSA 3603]). Kranskop District: Gcotoli, 15 km N of Kranskop [28°51'S 30°51'E], 9-I-1996, A. Harington, under partly embedded rock on very steep (>45°) grassy hillside, volcanic rock, dark soil, 1 ♀ (AMNH [AH 2940]); Middeldrift, Tugela River [28°53'S 31°02'E], X-1940, R.F. Lawrence, 1 ♀ (NMSA 3565). Lower Umfolozi District: Empangeni [28°45'S 31°54'E], 28-IX-1982, 1 ♀ (AMNH [AH 3182]); Nazana Camp, White Umfolozi [28°21'S 31°58'E], VI-1922, A. Roberts, 1 ♂ (TMSA 1216), 1 ♀ (TMSA 1214), 1 subad. ♂ (TMSA 1215); Nta[m]banana, N Zululand [28°43'S 31°45'E], H.H. Curson, 1 ♂ (AMGS 4603), 20-XII-1921, E.F.J. George, 1 ♂ (AMGS 3012); Richards Bay [28°48'S 32°06'E], 16-VIII-1975, J.P.J., 1 ♀ (NMSA 11051); Umfolozi Game Reserve [28°17'S 31°45'E], 9-10-XII-1983, A.E. Bowland, under log in open *Acacia* woodland, prey of genets, 1 ♀ (NMSA 14234). Mapumulo District: Mapumulo [29°09'S 31°04'E], between Kranskop and Stanger, 9-I-1996, A. Harington, under rock on inclined area before very steep incline, dark soil, volcanic rocks, 1 ♂ (AMNH AH 2945). Mtonjaneni District: Melmoth [28°35'S 31°23'E], XII-1906, Miss Hickley, 1 ♀ (NMSA 3546). Mtunzini District: Ngoye Forest [28°50'S 31°40'E], II-1953, 1 ♂ (NMSA 3608), 6 ♀ (NMSA 3607). Nkandhla District: Mfongosi [28°42'S 30°48'E], II-1917, W.E. Jones, 2 ♂ 1 juv. ♂ (NMSA 3536), III-1917, W.E. Jones, 1 ♂ 2 ♀ 1 subad. ♀ 4 juv. [sex indet.] (NMSA 3539), II-1918, W.E. Jones, 1 ♂ 3 ♀ 2 subad.

♀ (SAMC B3911). Piet Retief District: Pongola [27°23'S 31°37'E], 21-VIII-1975, A. Harington, under rock, 1 ♂ (TMSA 18227), 1 ♀ (AMNH [AH 256]). Pietermaritzburg District: Otto's Bluff, near Pietermaritzburg [29°31'S 30°22'E], XII-1937, R.F. Lawrence, 1 ♂ (NMSA 722); Edendale, Pietermaritzburg [29°39'S 30°17'E], III-1937, W.G. Rump, 1 ♀ (NMSA 730); Pietermaritzburg [29°37'S 30°23'E], X-1942, R.F. Lawrence, 1 ♀ (NMSA 3586); Town Bush, Pietermaritzburg [29°34'S 30°21'E], 1928, W.G. Rump, 1 ♂ (NMSA 1156). Port Shepstone District: Margate [30°51'S 30°22'E], W.G. Rump, 1 ♂ (NMSA) [not examined]; Port Shepstone [30°45'S 30°27'E], II-1957, N.H.L. Krauss, 1 ♀ (AMNH); Port Shepstone, Beach Terminus [30°45'S 30°27'E], X-1936, R.F. Lawrence, 1 ♂ 3 ♀ 1 subad. ♂ 1 juv. ♂ 2 juv. ♀ (NMSA 718). Ubombo District: NE of Ubombo [27°37'S 32°08'E], 11-14-V-1973, B. Lamoral, under stone, 2 ♀ (NMSA 19730). Umvoti District: Tugela [28°44'S 30°27'E], 1929, W.G. Rump, 1 ♂ (NMSA 1369). Mpumalanga Province: Barberton District: Barberton [25°47'S 31°03'E], I-1939, 2 ♂ 1 ♀ 2 subad. ♀ (NMSA 744), 1 ♂ (MRAC 70907 [ex NMSA 744]), III-1960, R.F. Lawrence, 1 ♀ (NMSA 7298) [all misidentified as *P. ochraceus* by Lawrence (1942)]. Carolina District: Doornkop Private Reserve [25°56.342'S 30°14.199'E], 28-III-2001, E.S. Volschenk, L. Prendini, L. Monod and J. Leeming, under stone in vine forest patch, 1 ♀ (ESV); Ndubazi Forest, near Badplaas [25°50'S 30°28'E], 2-V-1992, M.R. Filmer, under rock in forest, 1 ♀ [fragments] (AMNH). Eerstehoek District: Arnheimburg [26°03'S 30°50'E], 8-IX-1915, A. Roberts, 1 ♀ (TMSA 1212). Nelspruit District: Nelspruit, 5 km SSE [25°28'S 30°58'E], 16-XII-1970, D. Onderstall, 1 ♀ (TMSA 10020). Pilgrim's Rest District: Bergvliet, Sabie [25°10'S 30°48'E], 17-VII-1984, A.M. van den Berg, on ground, pit traps, 2 ♀ (PPRI AcAT 87/383). SWAZILAND: Mananga Mountain, near Mhlume, 26°00'E 31°51'S, 18-VII-1982, P. Reavell, under rocks, *Combretum-Pterocarpus* woodland, 1 ♂ (AMNH AH 3479). Malolotja Nature Reserve: Mgwayiza Forest and nearby grassland [25°59'49"S 31°06'59"E], 1-IV-2001, L. Prendini, G. Giribet and R. Boycott, 1138 m, Afromontane forest, under stones in leaf litter, 1 ♂ 1 ♀ 2 juv. [sex indet.] (AMCC 119226); Nkomati Viewpoint road, 26°04'47"S 31°07'56"E, 30-VIII-1997, R. Boycott, under rock on soil, grassland with scattered bush clumps, 1 ♀ (AMNH); road to Nkomati Viewpoint, 26°06'44"S 31°07'36"E, 1-IV-2001, L. Prendini and G. Giribet, 1362 m, grassland, under stone, 1 ♂ (AMCC 119228). Mlawula Nature Reserve: Croc Pool, 26°17.327'S 31°57.771'E, 3-IV-2001, L. Prendini, G. Giribet and R. Boycott, mixed bushveld at base of western slope of Lebombo mountains, under stone, 1 ♂ (AMCC 119227); Sara Camp, 26°11'44"S 31°59'24"E, 2-IV-2001, L. Prendini, G. Giribet and R. Boycott, 188 m, mixed bushveld on rocky hill, UV collecting at night, resting on leaf litter on the ground, one specimen under stone, 5 ♂ 2 ♀ (AMCC 119225).

Pseudolychas transvaalicus Lawrence

(Figs. 2, 9-11, and 34-44)

Pseudolychas transvaalicus Lawrence, 1961: 123-126, fig. 1.

Pseudolychas transvaalicus. Lamoral and Reynders 1975: 525; Kovářik 1998: 118; Fet and Lowe 2000: 215; Prendini 2001c: 138.

Type Material. HOLOTYPE: ♀ (NMSA 7290), Mariepskop [24°32'S 30°52'E], eastern Transvaal [Pilgrim's Rest District, Mpumalanga Province], South Africa, 6.iii.1960, R.F. and E.P. Lawrence, 6,000 feet, under stones in indigenous forest. PARATYPES: 1 ♂ (NMSA 7290), 6 ♀ 50 first instars [sex indet.] (NMSA 18678), same data as holotype. Lawrence (1961: 123) listed 1 ♀ and 1 ♂ "holotypes" and a further 7 ♀ paratypes. Following Fet and Lowe (2000), the ♀ (NMSA 7290) is regarded as the holotype, the ♂ (NMSA 7290) and remaining 6 ♀ (NMSA 18678) as paratypes. One ♀ paratype is missing.

Diagnosis. *Pseudolychas transvaalicus* is the sister species of *P. pegleri* (Fig. 1). It may be separated from other species of *Pseudolychas* on the basis of a reduced basal pectinal tooth (♀) and a medial lobe on the fixed finger of the pedipalp chela (♂). In *P. ochraceus* and *P. pegleri*, the basal pectinal tooth (♀) is enlarged, and the fixed finger of the pedipalp chela (♂) is not lobate.

Description. The following redescription supplements Lawrence's (1961) original description. It is based on the holotype, paratypes and several additional ♂ and ♀ specimens (AMGS [NMSA 7295]; AMNH [AH 2252]).

Color. Carapace, pedipalps, tergites, sternite VII, and metasoma: Dark Brownish Olive No. 129. Telson: Dark Drab No. 119B. Chelicerae and legs: Brownish Olive No. 29. Sternites III-VI: Buff No. 124. Pectines: Cream Color No. 54.

Carapace. As for *P. ochraceus*, except as follows. Anterior margin of carapace sublinear to procurved, with small median projection; posterior margin procurved (Fig. 9).

Chelicerae. As for *P. ochraceus*.

Pedipalps. As for *P. ochraceus*, except as follows. Patella sparsely and finely granular (Figs. 42 and 43). Chela long (Figs. 38-41), slender (♀), or markedly incrassate (♂), length along ventroexternal carina 30-31% (♂) to 33-40% (♀) greater than chela width and 31-40% (♂) to 40-41% (♀) greater than chela height (Table 5); length of movable finger 5-24% (♂) to 35-40% (♀) greater than length along ventroexternal carina. Chela (♂) movable finger with a strong, rounded lobe medially; fixed finger slightly curved dorsally, with a corresponding notch and a smaller, rounded lobe distal to notch; proximal dentate margin emarginate (i.e., a proximal "gap" is evident) when fingers are closed (Fig. 38).

Trichobothria. As for *P. ochraceus* (Figs. 38-44).

Mesosoma. As for *P. ochraceus*, except as follows. Sternites III-V entirely smooth, but weakly granular along lateral margins in V; VI entirely sparsely and coarsely granular, except for submedian depressions;

VII more densely and coarsely granular; lateral and distal margins of each sternite with a row of sparsely distributed macrosetae (Figs. 35 and 37).

Sternum. As for *P. ochraceus* (Fig. 10).

Genital operculum. As for *P. ochraceus*.

Pectines. Basal tooth of each pecten reduced (shorter and narrower than other teeth), triangular in ♀, unmodified in ♂ (Fig. 10). Pectinal teeth: 11–12 (♂), 9–11 (♀).

Legs. As for *P. ochraceus*.

Metasoma and Telson. As for *P. ochraceus*, except as follows. Metasomal segments I–V width/length ratio progressively decreasing, width percentage of length 92–94% (♂) to 88–94% (♀) for I, 85–86% (♂) to 83–88% (♀) for II, 77–79% (♂) to 75–83% (♀) for III, 65–68% (♂) to 68–79% (♀) for IV, and 43–50% (♂) to 45–47% (♀) for V (Table 5). Telson oval, elongate, height 40–48% (♂) to 45–48% (♀) of length; vesicle considerably narrower than metasomal segment V, width 60–62% (♂) to 64–71% (♀) of metasomal segment V. Metasoma uniformly coarsely granular; telson uniformly coarsely granular except for dorsomedian surfaces, which are smooth (Figs. 34–37). Metasomal segments I–III each with ten carinae, but median lateral carinae often obsolete on segment III; segment IV with eight carinae (median lateral carina absent, rarely obsolete); segment V with five carinae (a single ventromedian and paired dorsolateral and ventrolateral carinae). Aculeus short, shallowly curved, 43–50% of vesicle length; with a low, rounded subaculear tubercle.

Hemispermaphore. As for *P. ochraceus*, except as follows. *Pars reflecta* coiled distally; *pars recta* S-shaped, not parallel to axis of distal lamina (Fig. 11).

Geographic Variation. No distinctive variation.

Ontogenetic Variation. As for *P. ochraceus*.

Sexual Dimorphism. As for *P. ochraceus*, except as follows. The pedipalp chela manus of adult ♂ is markedly incrassate (bulbous or swollen), compared with that of adult ♀, which is more slender (Figs. 38 and 39). In addition, the chela of adult ♂ presents a strong, rounded lobe on the movable finger, a corresponding notch in the fixed finger, and a smaller, rounded lobe distal to the notch, which are absent in adult ♀. The pale color of the ♂ paratype, mentioned by Lawrence (1961) can be attributed to the fact that this specimen ecdysed shortly before capture.

Remarks. This species is range-restricted and rarely collected. It is presently known from only 15 adult or subadult specimens (3 ♂ and 12 ♀).

Distribution. *Pseudolychas transvaalicus* is endemic to the Pilgrim's Rest District in the Mpumalanga Province of South Africa, where it is known from only three localities along the Drakensberg escarpment.

This species occurs at higher altitudes than the other species of *Pseudolychas* (Fig. 2). Known locality records fall within the following range of altitudes (percentage of locality records indicated in parentheses): 500–1,000 m (33%), 1,000–1,500 m (33%), and 1,500–2,000 m (33%).

The distributional range of *P. transvaalicus* falls in the Afromontane Forest (67%) vegetation type

(Lubke and McKenzie 1998a) of the Forest biome (Rutherford and Westfall 1994), and the Northeastern Mountain Grassland (33%) vegetation type (Bredenkamp et al. 1998a) of the Grassland biome (Rutherford and Westfall 1994). This region experiences a very high annual rainfall; 800–2,000 mm (mean: 1243 mm) is received, mostly during the summer months.

Ecology. *Pseudolychas transvaalicus* is a lapidicolous species that has been collected under stones and in or under rotten logs (Lawrence 1961), in moist montane grassland and Afromontane forest. The species is allopatric with *P. ochraceus* and its sister species, *P. pegleri*.

Conservation Status. *Pseudolychas transvaalicus* is presently known from only three localities, falling within two QDS. The distributional range of this species occurs at high altitude along the Drakensberg escarpment, a high rainfall region in which much of the natural forest habitat has been, and continues to be destroyed by afforestation. Afforestation, especially with conifers, alters the vegetation composition (and hence also the chemical composition of the substratum) sufficiently to lead to the eradication of most scorpions (personal observation). This threat, together with its restricted distributional range, which falls entirely outside of existing protected areas (although it is likely that populations of the species exist in Afromontane forest patches in the Blyde River Canyon Nature Reserve and the Pilgrim's Rest Nature Reserve, this remains to be verified), suggests that *P. transvaalicus* is more vulnerable than the other species of *Pseudolychas*. It is therefore assigned the Vulnerable IUCN Red List Category. The species is characterized by an acute restriction in both its area of occupancy and number of known localities. It would thus be prone to the effects of human activities (or stochastic events, the impact of which is increased by human activities) within a very short period of time in an unforeseeable future and is capable of becoming Critically Endangered or even Extinct in a very short period.

Material Examined. SOUTH AFRICA: [locality illegible], IV-1909, 1 ♀ (ZMUH). *Mpumalanga Province*: Pilgrim's Rest District: Farm Ponieskrans 543 [24°52'S 30°46'E], 4-III-1972, G. Newlands, 1 ♀ (TMSA 10451); Graskop [24°57'S 30°48'E], III-1960, R.F. Lawrence, 5,000 feet, under decayed tree fern trunks, 1 ♂ 1 ♀ 1 subad. ♂ [not 2 ♀, 1 juv. ♂] (AMGS [NMSA 7295]), 15-VII-1981, L. Harington, under stone on stone at cliff base, damp grassy area, 1 ♀ (AMNH [AH 2252]).

Acknowledgments

I appreciate the assistance rendered by the following people in loaning types and additional specimens of *Pseudolychas* and outgroup taxa from their institutions: S. Gess (AMGS); J. Beccaloni (BMNH); C. Griswold and D. Ubick (CASC); R. Jocqué (MRAC); L. Lotz (NMBA); D. Jennings (NMSA); A. Dippenaar-Schoeman and A. van den Berg (PPRI); M. Cochrane (SAMC); K. Manamela (TMSA); and H. Dastyh (ZMUH). Erich Volschenk (ESV) kindly loaned several

specimens from his private collection. This is the fifth paper that includes material from the Alexis Harington Scorpion Collection, and I thank J. Harington, L. Harington, and E. de Wet for transferring the collection to the AMNH; the Scott family for accommodation, assistance, and congenial company during the sorting and packing of the collection in Johannesburg; and R. T. Schuh for expediting the financial aspects of bringing the collection to New York. I thank the Swaziland National Trust Commission for permission to collect and export scorpions from Swaziland (permit application process kindly facilitated by R. Boycott; permits issued by M. Mtsambiwa) and the Mpumalanga Parks Board for permission to collect scorpions in Mpumalanga Province, South Africa (permit issued by K. de Wet). I thank R. Boycott, G. Giribet, M. MacFarlane, L. Monod, K. Prendini, and E. Volshchenk for congenial company on the field trips during which *Pseudolychas* scorpions were collected. Additional thanks are extended to R. Boycott for hospitality and logistical assistance while visiting the Malolotja and Mlawula Nature Reserves in Swaziland. Further specimens were generously provided by R. Boycott, I. Engelbrecht, M. Filmer, S. Hanrahan, and J. Harrison. For providing GIS coverages and/or permission to use them in the spatial analyses, I thank the following people and institutions: the National Botanical Institute of South Africa; the Water Research Commission (Department of Water Affairs and Forestry); D. Marais (Department of Environmental Affairs and Tourism, South Africa); A. Armstrong (KwaZulu-Natal Nature Conservation Service); M. Horan, S. Lynch, and R. Schulze (Computing Centre for Water Research, University of Natal); H. de Klerk (Western Cape Nature Conservation). Finally, I thank S. Thurston for preparing the photographic plates in this paper, and J. Carpenter, D. Grimaldi, and two anonymous reviewers for commenting on earlier drafts of the manuscript.

References Cited

- Birula, A. A. 1917a.** Arachnoidea Arthrogastra Caucasia. Pars I. Scorpiones. Zapiski Kavkazskogo Muzeya (Mémoires du Musée du Caucase), Tiflis, Imprimerie de la Chancellerie du Comité pour la Transcaucasie. Ser. A, 5: 1–253.
- Birula, A. A. 1917b.** Faune de la Russie et des pays limitrophes fondée principalement sur les collections du Musée zoologique de l'Académie des sciences de Russie. Arachnides (Arachnoidea). 1: 1–227.
- Bredenkamp, G. J., and N. van Rooyen. 1998a.** Rocky Highveld Grassland, p. 39. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Bredenkamp, G. J., and N. van Rooyen. 1998b.** Dry Sandy Highveld Grassland, pp. 41–42. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Bredenkamp, G. J., E. Granger, and N. van Rooyen. 1998a.** North-eastern Mountain Grassland, pp. 46–47. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Bredenkamp, G. J., E. Granger, R. Lubke, and N. van Rooyen. 1998b.** Moist Upland Grassland, pp. 45–46. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Bremer, K. 1988.** The limits of amino acid sequence data in angiosperm phylogenetic reconstruction. *Evolution*. 42: 795–803.
- Bremer, K. 1994.** Branch support and tree stability. *Cladistics*. 10: 295–304.
- Bryant, H. N. 1995.** Why autapomorphies should be removed: a reply to Yeates. *Cladistics*. 11: 381–384.
- Donoghue, M. J., R. G. Olmstead, J. F. Smith, and J. D. Palmer. 1992.** Phylogenetic relationships of Dipsacales based on *rbcl* sequence data. *Ann. Missouri Bot. Gard.* 79: 333–345.
- Farris, J. S. 1969.** A successive approximations approach to character weighting. *Syst. Zool.* 18: 374–385.
- Farris, J. S. 1970.** Methods for computing Wagner trees. *Syst. Zool.* 19: 83–92.
- Farris, J. S. 1982.** Outgroups and parsimony. *Syst. Zool.* 31: 328–334.
- Fet, V., and G. Lowe. 2000.** Family Buthidae C. L. Koch, 1837, pp. 54–286. In V. Fet, W. D. Sissom, G. Lowe, and M. E. Braunwalder, *Catalog of the scorpions of the world (1758–1998)*. New York Entomological Society, New York.
- Fitch, W. M. 1971.** Toward defining the course of evolution: minimum change for a specific tree topology. *Syst. Zool.* 20: 406–416.
- Francke, O. F. 1985.** Conspectus genericus scorpionorum 1758–1982 (Arachnida: Scorpiones). *Occasion. Papers Museum, Texas Tech. Univ.* 98: 1–32.
- Goloboff, P. A. 1993.** Estimating character weights during tree search. *Cladistics*. 9: 83–91.
- Goloboff, P. A. 1995.** Parsimony and weighting: a reply to Turner and Zandee. *Cladistics*. 11: 91–104.
- Goloboff, P. A. 1997a.** NONA, version 2.0. American Museum of Natural History, New York.
- Goloboff, P. A. 1997b.** Pee-Wee, version 2.6. American Museum of Natural History, New York.
- Granger, E. 1998a.** Coast-Hinterland Bushveld, p. 31. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Granger, E. 1998b.** Natal Lowveld Bushveld, p. 32. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Granger, E., and G. J. Bredenkamp. 1998.** Short Mistbelt Grassland, p. 50. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Granger, E., G. J. Bredenkamp, and N. van Rooyen. 1998.** Coastal Bushveld-Grassland, p. 30. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Griswold, C. E., J. A. Coddington, G. Hormiga, and N. Scharff. 1998.** Phylogeny of the orb-web building spiders (Araneae, Orbicularia: Deinopoidea, Araneoidea). *Zool. J. Linn. Soc.* 123: 1–99.
- Hewitt, J. 1918.** A survey of the scorpion fauna of South Africa. *Trans. R. Soc. South Afr.* 6: 89–192.
- Hewitt, J. 1925a.** Facts and theories on the distribution of scorpions in South Africa. *Trans. R. Soc. South Afr.* 12: 249–276.
- Hewitt, J. 1925b.** Descriptions of some African Arachnida. *Rec. Albany Mus.* 3: 277–299.
- Hirst, S. 1911.** Descriptions of new scorpions. *Ann. Mag. Nat. Hist.* 8: 462–473.

- Hoffman, M. T. 1998. Eastern Mixed Nama Karoo, p. 55. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- International Union for the Conservation of Nature. 2001. IUCN Red List Categories and Criteria: version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. Available online at <http://www.iucn.org/themes/ssc/redlists/RLcats2001booklet.html>. Accessed on 10 September 2002.
- Kästner, A. 1941. Ordnung der Arachnida: Scorpiones, pp. 117–240. In T. Krumbach (ed.), *Handbuch der Zoologie*, vol. 3. Walter de Gruyter Verlag, Berlin, Germany.
- Kovařík, F. 1998. Štíři (Scorpions). Madagaskar, Jihlava, Czech Republic.
- Kraepelin, K. 1908. Die sekundären Geschlechtscharaktere der Skorpione, Pedipalpen und Solifugen. *Jahrb. Hamburg Wiss. Anst.* 25: 181–225.
- Kraepelin, K. 1911. Neue Beiträge zur Systematik der Gliederspinnen. *Jahrb. Hamburg Wiss. Anst.* 28: 59–107.
- Lamoral, B. H. 1979. The scorpions of Namibia (Arachnida: Scorpionida). *Ann. Natal Mus.* 23: 498–783.
- Lamoral, B. H., and S. C. Reynders. 1975. A catalogue of the scorpions described from the Ethiopian faunal region up to December 1973. *Ann. Natal Mus.* 22: 489–576.
- Lawrence, R. F. 1937. A collection of Arachnida from Zululand. *Ann. Natal Mus.* 8: 211–273.
- Lawrence, R. F. 1938. The Arachnida of the Transvaal Museum expedition to South Rhodesia, November–December, 1937. Scorpions and Solifugae. *Ann. Transv. Mus.* 19: 289–296.
- Lawrence, R. F. 1942. The scorpions of Natal and Zululand. *Ann. Natal Mus.* 10: 221–235.
- Lawrence, R. F. 1952. The unequal distribution of some invertebrate animals in South Africa. *South Afr. J. Sci.* 48: 308–310.
- Lawrence, R. F. 1953. The biology of the cryptic fauna of forests. A. A. Balkema, Cape Town, South Africa.
- Lawrence, R. F. 1955. Solifugae, scorpions and Pedipalpi, with checklists and keys to South African families, genera and species. Results of the Lund University Expedition in 1950–1951, pp. 152–262. In B. Hanström, P. Brinck, and G. Rudebeck (eds.), *South African animal life*, vol. 1. Almqvist and Wiksells, Uppsala, Sweden.
- Lawrence, R. F. 1961. A new forest-living scorpion from the Transvaal. *Ann. Mag. Nat. Hist.* 4: 123–126.
- Lawrence, R. F. 1964. The Solifugae, scorpions and Pedipalpi of the Kruger National Park. *Koedoe*. 7: 30–39.
- Lawrence, R. F. 1967. Supplementary list of the Solifugae, scorpions and Pedipalpi of the Kruger National Park. *Koedoe*. 10: 82–86.
- Lourenço, W. R., and O. Cuellar. 1994. Notes on the geography of parthenogenetic scorpions. *Biogeographica*. 70: 19–23.
- Lourenço, W. R., and O. Cuellar. 1999. A new all-female scorpion and the first probable case of arrhenotoky in scorpions. *J. Arachnol.* 27: 149–153.
- Low, A. B., and A. G. Rebelo. 1998. *Vegetation of South Africa, Lesotho and Swaziland*, 2nd ed. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Lubke, R. 1998a. Thicket Biome, p. 14. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Lubke, R. 1998b. Valley Thicket, p. 16. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Lubke, R. 1998c. Mesic Succulent Thicket, p. 17. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Lubke, R., and B. McKenzie. 1998a. Afromontane Forest, p. 12. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Lubke, R., and B. McKenzie. 1998b. Coastal Forest, p. 11. In A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Maddison, D. 1991. The discovery and importance of multiple islands of most parsimonious trees. *Syst. Zool.* 40: 315–328.
- Matthiesen, F. A. 1962. Parthenogenesis in scorpions. *Evolution*. 16: 255–256.
- Maurry, E. A. 1997. *Tityus trivittatus* en la Argentina. Nuevos datos sobre distribución, partenogénesis, sinantropía y peligrosidad (Scorpiones, Buthidae). *Rev. Mus. Argentino Cienc. Nat.* 24: 1–24.
- Nenilin, A. B., and V. Fet. 1992. Zoogeographical analysis of the world scorpion fauna (Arachnida: Scorpiones). *Arthropoda Selecta*, Moscow. 1: 3–31.
- Newlands, G. 1978. Arachnida (except Acari), pp. 687–702. In M.J.A. Werger (ed.), *Biogeography and ecology of southern Africa*, vol. 2. W. Junk, The Hague, The Netherlands.
- Newlands, G., and C. B. Martindale. 1980. The buthid scorpion fauna of Zimbabwe-Rhodesia with checklists and keys to the genera and species, distribution and medical importance (Arachnida: Scorpiones). *Zeit. Ang. Zool.* 67: 51–77.
- Nixon, K. C. 1999. WinClada, version 0.9.9+. Computer software and documentation. Available online at <http://www.cladistics.com>. Accessed on 21 June 2001.
- Nixon, K. C., and J. M. Carpenter. 1993. On outgroups. *Cladistics*. 9: 413–426.
- Peretti, A. V. 1994. Comportamiento de relación madre-cría de *Tityus trivittatus* Kraepelin, 1898 (Scorpiones, Buthidae). *Bol. Soc. Biol. Concepción*. 65: 9–21.
- Pocock, R. I. 1890. A revision of the genera of scorpions of the family Buthidae, with descriptions of some South-African species. *Proc. Zool. Soc. London* 1890: 114–141.
- Prendini, L. 2000a. A new species of *Parabuthus* Pocock (Scorpiones: Buthidae), and new records of *Parabuthus capensis* (Ehrenberg), from Namibia and South Africa. *Cimbebasia*. 16: 31–45.
- Prendini, L. 2000b. Phylogeny and classification of the Superfamily Scorpionioidea Latreille 1802 (Chelicerata, Scorpiones): an exemplar approach. *Cladistics*. 16: 1–78.
- Prendini, L. 2001a. A review of synonyms and subspecies in the genus *Opisthophthalmus* C. L. Koch (Scorpiones: Scorpionidae). *Afr. Entomol.* 9: 17–48.
- Prendini, L. 2001b. Phylogeny of *Parabuthus* (Scorpiones, Buthidae). *Zool. Scripta*. 30: 13–35.
- Prendini, L. 2001c. Substratum specialization and speciation in southern African scorpions: the Effect Hypothesis revisited, pp. 113–138. In V. Fet and P. A. Selden (eds.), *Scorpions 2001*. British Arachnological Society, Burnham Beeches, Buckinghamshire, United Kingdom.
- Prendini, L. 2003a. Discovery of the male of *Parabuthus muelleri*, and implications for the phylogeny of *Parabuthus* (Scorpiones: Buthidae). *Amer. Mus. Novit.* 3408: 1–24.

- Prendini, L. 2003b. The systematics of southern African *Parabuthus* Pocock (Scorpiones, Buthidae): Revisions to the taxonomy and key to the species. *J. Arachnol.* (in press).
- Prendini, L. 2003c. On the scorpions of Gabon and neighbouring countries, with a reassessment of the synonyms attributed to *Babycurus buetneri* Karsch and a redescription of *Babycurus melanicus* Kovařík. *Proc. Calif. Acad. Sci.* (in press).
- Purcell, W. F. 1901. On some South African Arachnida belonging to the orders Scorpiones, Pedipalpi, and Solifugae. *Ann. South Afr. Mus.* 2: 137–225.
- Rutherford, M. C., and R. H. Westfall. 1994. Biomes of southern Africa: an objective categorization. *Mem. Bot. Surv. South Afr.* 63: 1–94.
- San Martín, P. R., and L. A. de Gambardella. 1966. Nueva comprobación de la partenogénesis en *Tityus serrulatus* (Lutz y Mello-Campos, 1922, Scorpionida, Buthidae). *Rev. Soc. Entomol. Argentina.* 28: 79–84.
- Schulze, R. E., M. Maharaj, S. D. Lynch, B. J. Howe, and B. Melvil-Thomson. 1997. South African atlas of agrohydrology and climatology. Water Research Commission, Pretoria, South Africa.
- Sissom, W. D. 1990. Systematics, biogeography and paleontology, pp. 64–160. *In* G. A. Polis (ed.), *The biology of scorpions*. Stanford University Press, Stanford, CA.
- Smithe, F. B. 1974. Naturalist's color guide supplement. The American Museum of Natural History, New York.
- Smithe, F. B. 1975. Naturalist's color guide. The American Museum of Natural History, New York.
- Smithe, F. B. 1981. Naturalist's color guide. Part III. The American Museum of Natural History, New York.
- Soleglad, M. E., and V. Fet. 2003. The scorpion sternum: structure and phylogeny (Scorpiones: Orthosterni). *Euscorpius.* 5: 1–34.
- Stahnke, H. L. 1970. Scorpion nomenclature and mensuration. *Entomol. News.* 81: 297–316.
- Stahnke, H. L. 1972. A key to the genera of Buthidae (Scorpionida). *Entomol. News.* 83: 121–133.
- Swofford, D. L., and W. P. Maddison. 1987. Reconstructing ancestral character states under Wagner parsimony. *Math. Biosci.* 87: 199–229.
- Swofford, D. L., and W. P. Maddison. 1992. Parsimony, character-state reconstructions, and evolutionary inferences, pp. 186–283. *In* R. L. Mayden (ed.), *Systematics, historical ecology, and North American freshwater fishes*. Stanford University Press, Palo Alto, CA.
- Vachon, M. 1974. Étude des caractères utilisés pour classer les familles et les genres de scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les scorpions. *Bull. Mus. Natl. Hist. Nat. Paris.* 140: 857–958.
- Van Rooyen, N., and G. J. Bredenkamp. 1998a. Mixed Bushveld, p. 26. *In* A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Van Rooyen, N., and G. J. Bredenkamp. 1998b. Clay Thorn Bushveld, p. 23. *In* A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Van Rooyen, N., and G. J. Bredenkamp. 1998c. Soutpansberg Arid Mountain Bushveld, p. 21. *In* A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Van Rooyen, N., and G. J. Bredenkamp. 1998d. Sweet Lowveld Bushveld, pp. 27–28. *In* A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Van Rooyen, N., and G. J. Bredenkamp. 1998e. Sour Lowveld Bushveld, pp. 28–29. *In* A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Van Rooyen, N., and G. J. Bredenkamp. 1998f. Waterberg Moist Mountain Bushveld, p. 22. *In* A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Van Rooyen, N., and G. J. Bredenkamp. 1998g. Mixed Lowveld Bushveld, p. 27. *In* A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Van Rooyen, N., and G. J. Bredenkamp. 1998h. Lebombo Arid Mountain Bushveld, pp. 22–23. *In* A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Van Rooyen, N., and G. J. Bredenkamp. 1998i. Eastern Thorn Bushveld, pp. 24–25. *In* A. B. Low and A. G. Rebelo (eds.), *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria, South Africa.
- Watrous, L. E., and Q. D. Wheeler. 1981. The out-group comparison method of character analysis. *Syst. Zool.* 30: 1–11.
- Weidner, H. 1959. Die Entomologischen Sammlungen des Zoologischen Staatsinstitut und Zoologischen Museums Hamburg. I. Teil. Pararthropoda und Chelicerata. *Mitt. Zool. Mus. Hamburg.* 57: 89–142.
- Werner, F. 1934. Scorpiones, Pedipalpi, pp. 1–316 [Scorpiones]. *In* H. G. Bronn (ed.), *Klassen und Ordnungen des Tierreichs*, 5, IV, 8, Lief. 1–2. Akademische Verlagsgesellschaft, Leipzig, Germany.

Received for publication 14 January 2003; accepted 3 September 2003.