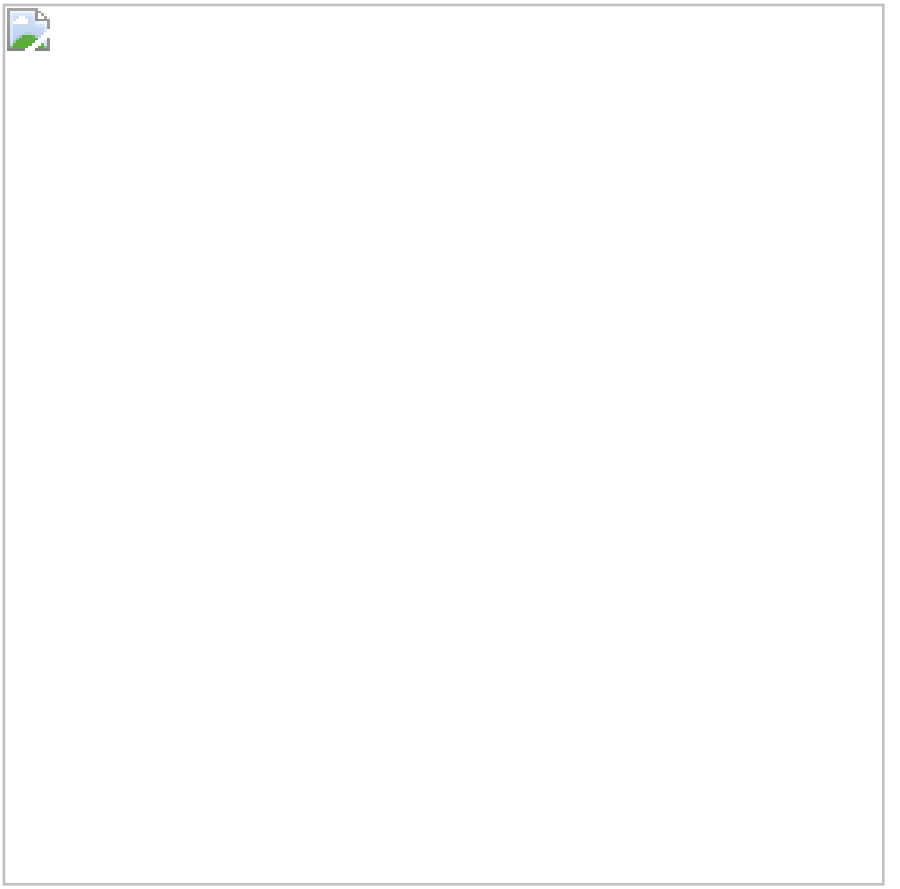

New South African Flat Rock Scorpions (Liochelidae: Hadogenes)

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New South African Flat Rock Scorpions (Liochelidae: *Hadogenes*)

LORENZO PRENDINI[1]

ABSTRACT

Two new flat rock scorpions, both endemic to South Africa, are described in the *bicolor* group of *Hadogenes* Kraepelin, 1894: *H. polytrichobothrius* n.sp.; *H. soutpansbergensis* n.sp. Both occupy discrete distributional ranges, allopatric with the other three species in the *bicolor* group: *H. bicolor* Purcell, 1899; *H. longimanus* Prendini, 2001; *H. newlandsi* Prendini, 2001. The distributions of the five species in the group are mapped, and a key provided for their identification.

INTRODUCTION

Flat rock scorpions of the genus *Hadogenes* Kraepelin, 1894 represent an intriguing group of mostly large, extremely dorsoventrally compressed scorpions. All described species are obligate lithophiles, inhabiting the narrow cracks, crevices and spaces beneath exfoliations of weathered rock outcrops from South Africa to Tanzania. Besides dorsoventral compression, other ecomorphological adaptations facilitating existence in this specialized habitat include elongation of the metasoma and pedipalps, perhaps to aid with prey capture in confined spaces; greatly enlarged lateral ocelli relative to the median ocelli, to aid in anterior light perception; pronounced superciliary carinae to protect the median ocelli from abrasion; stout, spiniform setae on the ventral surfaces of the telotarsi, and highly curved telotarsal ungues, to provide a vicelike grip on rock surfaces (Newlands, 1972a, 1972b, 1978; Newlands and Prendini, 1997; Prendini, 2001a). The tarsal adaptations of *Hadogenes* facilitate locomotion on rock but hinder locomotion across other substrata. These scorpions are thus restricted to regions of rugged, mountainous topography and subject to allopatric speciation when mountain ranges become

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separated through erosion (Newlands, 1972a; Prendini, 2001b). The distributional ranges of *Hadogenes* species are, with few exceptions, allopatric or parapatric (Newlands, 1980; Prendini, 2001a, 2005a).

Several investigations addressed the systematics of *Hadogenes* in recent years (e.g., Newlands and Prendini, 1997; Lourenço, 1999; Prendini, 2000, 2001a, 2005b). In the present contribution, two new species are described in the *bicolor* group, which is endemic to South Africa: *H. polytrichobothrius* n.sp.; *H. soutpansbergensis* n.sp. The existence of both species has been known for some time, but the paucity of material prevented their description until now. For example, Prendini (2001a: 158, 159) provisionally assigned five specimens, designated here as paratypes of *H. polytrichobothrius* n.sp., to *H. longimanus* Prendini, 2001, but suggested that they may represent an undescribed species:

> [F]our specimens from Steelpoort (Lydenburg district), ca 100 km northeast of the northernmost locality record [of *H. longimanus*] in the Groblersdal district and the ♂ specimen from Doornkop (Carolina district), described by Hewitt (1918), differ from the typical form [of *H. longimanus*] in several respects. The pedipalps, especially of ♂, are proportionally shorter and broader, the carapace, post-tergites and metasoma are slightly more granular, and the trichobothrial counts are higher (total number of trichobothria per pedipalp, 201–225). Morphometric ratios of the pedipalps of a ♂ and ♀ from Steelpoort that differ from typical specimens are as follows: femur length 57% greater than width in ♂, 55% greater in ♀; patella length 41% greater than width in ♂ and ♀; chela length along ventroexternal carina 39% greater than chela width in ♂, and 35% greater in ♀; length of movable finger 1% greater than length along ventroexternal carina in ♂, and 2% greater in ♀. Unfortunately, the absence of any specimens from the area between these localities prevented an assessment of whether this variation is continuous or discrete. Further investigation, including the collection of additional material, will be required to determine if this variation has an ecological basis, or if these specimens represent yet another cryptic species in this complex.

Recent fieldwork in the region between Steelpoort and the northernmost locality record of *H. longimanus* demonstrated that the distribution of populations of *Hadogenes* assigned to *H. longimanus* and those described here as *H. polytrichobothrius* n.sp. is discontinuous. Morphological data obtained from the five original specimens and fifteen additional adult specimens (3♂, 12♀) confirmed that the differences between these species are consistent, discrete, and diagnostic.

The collection of five additional adult specimens (1♂, 4♀) of *H. soutpansbergensis* n.sp., for which a pair of adults (collected by the author in 1990) were the only adult specimens previously available, has also facilitated its description.

Both new species occupy discrete distributional ranges, allopatric with the other three species in the *bicolor* group (fig. 1): *H. bicolor* Purcell, 1899; *H. longimanus*; *H. newlandsi* Prendini, 2001. Recognition of the two new species raises the number of currently accepted species of *Hadogenes* to 18 (table 1).

MATERIAL AND METHODS

Personally collected specimens were located at night using a portable ultraviolet (UV) lamp, comprising two mercury-vapor tubes attached to a chromium parabolic reflector and powered by a rechargeable 7 amp/hr, 12 V battery, or by inspecting rock crevices and exfoliations during the day. A portable Garmin™ GPS II Plus device was used for recording the geographical coordinates of collection localities in the field.

Material examined is deposited in the following collections: Albany Museum, Grahamstown, South Africa (AMGS); American Museum of Natural History, New York (AMNH), some bearing accession numbers from the Alexis Harington Collection (AH); California Academy of Sciences, San Francisco (CAS); Natal Museum, Pietermaritzburg, South Africa (NMSA); National Collection of Arachnida, Plant Protection Research Institute, Pretoria, South Africa (NCA); South African Museum, Cape Town (SAMC), some bearing accession numbers from the John Visser Collection (JV); Transvaal Museum, Pretoria, South Africa (TMSA); Zoologisches Museum, Humboldt-Universität, Berlin, Germany (ZMHB); Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany (ZMUH). Tissue samples of the new species have been stored (in the vapor phase of liquid nitrogen at −150°C) in the Ambrose Monell Collec-

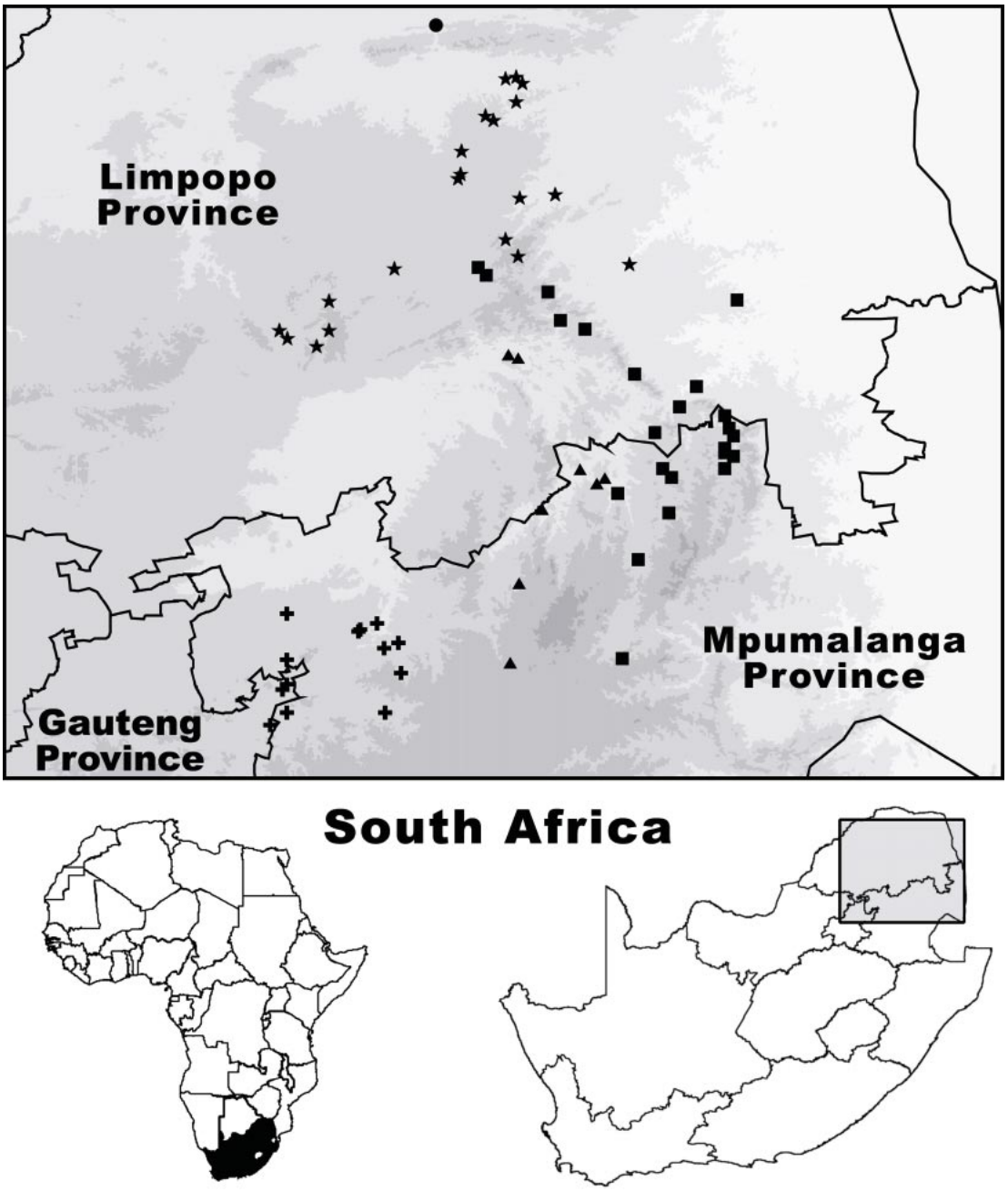


Fig. 1. Map showing the known distribution of species in the *bicolor* group of *Hadogenes*: *H. bicolor* Purcell, 1899 (square), *H. longimanus* Prendini, 2001 (cross), *H. newlandsi* Prendini, 2001 (star), *H. polytrichobothrius* n.sp. (triangle) and *H. soutpansbergensis* n.sp. (circle). Contour interval, 500 m.

TABLE 1
Currently Accepted Species of *Hadogenes* Kraepelin, 1894 (Scorpiones: Liochelidae), with Countries of Distribution Compiled from Prendini (2005a)

Hadogenes bicolor Purcell, 1899	South Africa
Hadogenes gracilis Hewitt, 1909	South Africa
Hadogenes granulatus Purcell, 1901	Botswana, Mozambique, Zambia, Zimbabwe
Hadogenes gunningi Purcell, 1899	South Africa
Hadogenes hahni (Peters, 1862)	Angola, Namibia
Hadogenes lawrencei Newlands, 1972	Namibia
Hadogenes longimanus Prendini, 2001	South Africa
Hadogenes minor Purcell, 1899	South Africa
Hadogenes newlandsi Prendini, 2001	South Africa
Hadogenes paucidens Pocock, 1896[a]	Democratic Republic of Congo, ?Tanzania
Hadogenes phyllodes Thorell, 1877[b]	Namibia, South Africa
Hadogenes polytrichobothrius n.sp.	South Africa
Hadogenes soutpansbergensis n.sp.	South Africa
Hadogenes tityrus (Simon, 1888)[b]	Namibia, South Africa
Hadogenes trichiurus (Gervais, 1843)[b]	South Africa
Hadogenes troglodytes (Peters, 1861)	Botswana, Mozambique, South Africa, Zimbabwe
Hadogenes zuluanus Lawrence, 1937	South Africa, Swaziland
Hadogenes zumpti Newlands and Cantrell, 1985	Namibia, South Africa

[a] Species of dubious validity.
[b] Species complexes.

tion for Molecular and Microbial Research (AMCC) at the AMNH.

Photographs were taken in visible light as well as under long wave UV light using a Microptics™ ML1000 digital imaging system. Measurements were recorded with Mitutoyo® digital calipers and counts taken using a Nikon® SMZ-1500 stereomicroscope. Color designation follows Smithe (1974, 1975, 1981), trichobothrial notation follows Vachon (1974), and sternum terminology follows Soleglad and Fet (2003). Morphological terminology and mensuration follows previous papers on *Hadogenes* (e.g., Newlands and Prendini, 1997; Prendini, 2000, 2001a, 2005b).

A distribution map was produced using ArcView GIS Version 3.2 (Environmental Systems Research Institute, Redlands, CA), by superimposing point locality records on coverages depicting the topography (contour intervals of 500 m) 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.

All records of sufficient accuracy were isolated from the material examined to create a point locality geographical dataset for mapping distributional ranges. 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 topocadastral 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, in order to ascertain whether the distribution of the new species is related to present environmental variables, to determine the specific ecological correlates of their distributional ranges, and to calculate statistics that could be used to define their conservation status. Coverages representing the topography, mean annual rainfall, biomes, and vegetation types in South Africa

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, 1997), produced by the Computing Centre for Water Research of the South African Water Research Commission: http://www.wrc.org.za/wrcpublications/wrcreports/hydroclimatology.htm. A polygon coverage of Low and Rebelo's (1998) *Vegetation of South Africa, Lesotho and Swaziland*, incorporating the biomes defined by Rutherford and Westfall (1994), was obtained from the National Botanical Institute of South Africa.

The new species of *Hadogenes* were categorized according to their conservation priority using coverages representing national and provincial protected areas in South Africa, obtained from the Western Cape Nature Conservation Service of South Africa, superimposed on the mapped distributional ranges to determine whether any point locality records fell within the boundaries of protected areas. Both species were then assigned one of the IUCN Red List Categories (IUCN, 2001) on the basis of 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 their future survival.

SYSTEMATICS

FAMILY LIOCHELIDAE FET AND BECHLY, 2001
GENUS *HADOGENES* KRAEPELIN, 1894

Key to the identification of species in the *bicolor* group of *Hadogenes*.

1. Pedipalp chela with pronounced lobe, distal to notch in fixed finger; metasoma 51–57% of total length (♂); metasomal segment V, lateral surfaces, sparsely granular to smooth, telson smooth (♂) 2
   Pedipalp chela without pronounced lobe, distal to notch in fixed finger; metasoma 57–68% of total length (♂); metasomal segment V, lateral surfaces, and (usually) telson densely granular (♂) 4
2. Pedipalp chela with 2 trichobothria in *i* series . . . . . *Hadogenes bicolor*
   Pedipalp chela with 5–8 trichobothria in *i* series 3
3. Pedipalp chela width 46–55% of length along ventroexternal carina (♂), 59–60% (♀); lobe on chela movable finger (♂) fitting evenly into corresponding notch in fixed finger, i.e. not overlapping when fingers closed; telson same color as metasomal segments . . . . . *Hadogenes longimanus*
   Pedipalp chela width 60–73% of length along ventroexternal carina (♂, ♀); lobe on chela movable finger (♂) fitting unevenly into corresponding notch in fixed finger, i.e. displaced to external surface and overlapping when fingers closed; telson pale in comparison with metasomal segments . . . . . *Hadogenes polytrichobothrius*
4. Pedipalp chela width 60–69% of length along ventroexternal carina (♂, ♀); patella width 57–64% of length; femur width 43–48% of length; metasoma 57–58% of total length (♂), 48% (♀) . . . . *Hadogenes newlandsi*
   Pedipalp chela width 49–53% of length along ventroexternal carina (♂), 57–58% (♀); patella width 51–56% of length; femur width 33–38% of length; metasoma 62–68% of total length (♂), 52–54% (♀) . . . . . *Hadogenes soutpansbergensis*

Hadogenes bicolor Purcell, 1899

Hadogenes bicolor Purcell, 1899: 437–438.
Hadogenes bicolor: Lawrence, 1955: 251 (part); Lamoral and Reynders, 1975: 538 (part); Newlands, 1980 (unpublished): 99–105 (part), figs. 48 (part), 49–53; Newlands and Cantrell, 1985: 40, 42, 44 (part); Kovařík, 1998: 132; Fet, 2000: 387; Prendini, 2001a: 149–156, figs. 1–10, 33, 36, tab. 2; Prendini, 2001b: 137; Prendini, 2005a: 67, appendix 1.

TYPE MATERIAL: **SOUTH AFRICA: Limpopo Province:** *Pietersburg District*: Lectotype ♂ (SAMC 4062), 20 miles east of Pietersburg [23°54′S 29°47′E], 1899, J.W. Daneel. Paralectotypes: same data as lectotype, 2♀ 1 subad. ♀ 1 juv. ♂ 1 juv. ♀ (SAMC 4062).

ADDITIONAL MATERIAL: **SOUTH AFRICA: Limpopo Province:** *Letaba District*: Serala Wilderness Area, near Tzaneen [24°00′S 30°04′E], 30.viii.1980, M. Stiller, ex flat rocks, under overhang on steep mountainside, grass, rocks, 1♀ (SAMC C1602), 1 juv. ♀ (SAMC C1613). Lekgalameetse Nature Reserve: Haffenden Heights [Farm Haffenden Heights 35], The Downs, 24°07′S 30°07′E, 26.vi.1977, B.P.W. Fratscher, 6♀ (TMSA 17794, 17795, 17797–17800); Leop-

ard's Crag, 50 km W of Haffenden Heights [24°09′S 30°13′E], I.H. Davidson, 1♀ (TMSA 17449); same data, except ''9.vi.1977, I.H. Davidson'', 1♂ (TMSA 18004), 1♀ (TMSA 18005). *Phalaborwa District*: Farm Lillie, near Mica, 24°02′S 30°50′E, 1.xii.1977, I. Davidson, 1♀ (TMSA 17147 [old 1258]); Hoedspruit, 32 km W [24°23′S 30°40′E], 1♀ (AMNH [AH 4301]); Jongmansspruit, on Blyde River, near Swadini [24°30′S 30°47′E], 3–8.i.1999, I. Engelbrecht and D. Eagan, in crevices in granite rocks, 1♂ 1♀ (SAMC C4585); Peninsula trail, Blyderivierspoort Dam, Blyde River Canyon Nature Reserve, 24°33′S 30°48′E, 13.vii.2000, L. Prendini, M. MacFarlane, and K.M.A. Prendini, mixed bushveld, crevices in quartz, 1♂ 1♀ 1 subad. ♂ (AMNH), 1 juv. ♀ (AMCC 138994). *Pietersburg District*: Pietersburg, 19 mi E [23°54′S 29°47′E], 26.xii.1967, G. Newlands, 2 juv. ♂ (TMSA 17456, 17459 [old 770]), 1 juv. ♀ (TMSA 17457 [old 769]). *Sekhukhuneland District*: Burgersfort, ca. 20 km E on R555 to Ohrigstad, 24°34′S 30°30′E, 5.i.2005, I. Engelbrecht, 1255 m, ridges with valleys, broadleaf savanna, moderate N slope, 1♀ (AMCC 144144); Farm Perkoe [Perkeo] near Olifants River [24°28′S 30°36′E], xi.1927, H. Lang, 1 juv. ♂ (TMSA 6086); Penge, 24°20′S 30°25′E, 1980, N. du Toit, 1♀ (AMNH [AH 1251]). **Mpumalanga Province:** *Belfast District*: Patattanek, ca. 1.5 km E on R539 [25°29′S 30°22′E], ii–x.2003, A. Mathie, under stones and small rocks on large flat rocks, 1 juv. ♀ (AMCC 138993). *Lydenburg District*: 1879, T. Ayres, 1 dry specimen [lost, not examined] (SAMC 432); Lydenburg, 31 km N, on the road to Burgersfort [24°49′S 30°21′E], 30.xii.2002, I. Engelbrecht, 1 juv. ♀ (AMCC 138991); Ohrigstad, 1 km NE [24°45′S 30°34′E], 4.viii.1984, G. Newlands, 2 subad. ♀ (AMNH [AH 3449, 3450]), 2 juv. ♀ (AMNH [AH 3451]); same data, except ''21.viii.1984, C. Owen'', 1 juv. ♂ (AMNH [AH 3787]), 1 juv. ♀ (AMNH [AH 3788]); Ohrigstad, 4 km NE, 6 km from turnoff [24°43S 30°32′E], 6.x.1984, C. Owen, 1♂ (AMNH [AH 3577]), 1♀ (AMNH [AH 3574]); Farm Klipheuvel 549, 1 km S R533 turnoff to Pilgrim's Rest from R36 Lydenburg to Ohrigstad, on Verraaier's Nek [24°54′S 30°34′E], 14.xii.2003, A. Mathie, 1326 m, crevices, 1♀ (NCA AcAT 2005/595). *Pilgrim's Rest District*: Blyde River, Lydenburg [24°38′S 30°47E], 14.i.1971, N.H.G. Jacobsen, 1♂ (TMSA 10100); Blyde River Canyon Nature Reserve [24°35′S 30°49′E], 8.v.1974, N.H.G. Jacobsen, 1 juv. ♂ (TMSA 12515); Bourke's Luck Potholes, Blyde River Canyon Nature Reserve, 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♀ (AMNH), 2 juv. ♂ 2 juv. ♀ (AMCC 138992); Dientje G.M., Vaalhoek, near Pilgrim's Rest [24°39′S 30°47′E], Miss S. Preller, 1♂ (AMGS); Dientje P.O., Vaalhoek [24°43′S 30°47′E], S. Preller, 1 subad. ♀ (AMGS 4704).

Hadogenes longimanus Prendini, 2001

Hadogenes bicolor Purcell, 1899: Hewitt, 1918: 160, 161 (part), pl. 30, figs. 88, 89; Newlands, 1980 (unpublished): 99–105 (part), fig. 48 (part); Newlands and Cantrell, 1985: 40, 42, 44 (part).

Hadogenes longimanus Prendini, 2001a: 156–159, figs. 1, 11–21, 34, 37, table 2; Prendini, 2001b: 137.

Hadogenes longimanus: Prendini, 2005a: 67, appendix 1.

TYPE MATERIAL: **SOUTH AFRICA: Mpumalanga Province:** *Groblersdal District*: Holotype ♂ (SAMC C4602), 20 km S of Groblersdal on road to Middelburg, 25°20.30′S 29°22.85′E, 13.i.2000, L. Prendini and I. Engelbrecht, 1077 m, mixed bushveld, crevices in granite rocks. Paratypes: same data as holotype, 2♂ 2♀ 2 subad. ♀ 1 juv. ♂ (SAMC C4603). *Bronkhorstspruit District*: Bundu Inn, on road from Bronkhorstspruit to Groblersdal [25°29′S 29°01′E], 18.xii.1980, M. Stiller, on hill, under large granite rock lying on rock face, many millipede (Juliform) and beetle remains, 1♀ (NMSA 13931); same data, except ''20.xii.1980'', 1♀ (SAMC C1600); Farm Boekenhoutskloofdrift 286 [25°18′S 29°01′E], 20.ix.1982, E. Voigt, 1♂ (TMSA 12507). *Middelburg District*: 55 km S of Groblersdal on road to Middelburg, 25°32.27′S 29°28.67′E, 13.i.2000, L. Prendini and I. Engelbrecht, 1509 m, grassland and mixed bushveld, crevices in sandstone, 1♂ 5♀ 1 juv. ♂ (SAMC C4600), 1♂ 1♀

(CAS), 2 juv. ♀ (AMCC 138995, 138996); Farm Noupoort 16, Selons River [25°25′S 29°28′E], 1933, 2♂ (TMSA 17458, 17513); Fort Merensky, Botshabelo Nature Reserve, 25°41.82′S 29°24.87′E, 14.i.2000, L. Prendini and I. Engelbrecht, 1410 m, grassland, with mixed bushveld along banks of Olifants River, under flat stones and in crevices (sandstone), 2♂ 12♀ (SAMC C4601), 1♂ 1♀ (AMNH). *Witbank District*: 2-D Ranch [Loskop Dam Nature Reserve], 25°22.101′S 29°18.409′E, x.1989, L. Prendini and M.R. Filmer, 1070 m, in crevices, 2♀ (SAMC C4596); same data, except ''x.1994, I. Engelbrecht'', 1♀ 1 juv. ♀ (SAMC C4595), 1♀ (SAMC C4598); same data, except ''N. MacLean'', 1♀ (SAMC C4599); same data, except ''J. Laing'', 1 subad. ♂ (SAMC C4594); Amaphi Nature Reserve, on road from Loskop Dam to Verena [25°21.66′S 29°18.69E], 14.i.2000, L. Prendini and I. Engelbrecht, 1102 m, mixed bushveld, in crevices in granite, 1♀ 1 subad. ♂ (SAMC C4597). **Gauteng Province:** *Bronkhorstspruit District*: Farm Zusterstroom 447, 25°35′S 29°01′E, 4.xi.1977, G. Newlands, 1♂ (TMSA 17452), 2♀ (TMSA 17453, 17460).

ADDITIONAL MATERIAL: **SOUTH AFRICA: Gauteng Province:** *Bronkhorstspruit District*: Farm Zusterstroom 447, ca. 11 km E Vaalplaas turnoff on R25 from Bronkhorstspruit to Groblersdal, 25°36.290′S 28°59.875′E, 19.x.2004, I. Engelbrecht, 1235 m, ridges with valleys, broadleaf savanna on red loamy soil with grass and litter layer, moderate S slope, 1♀ 1 subad. ♂ 1 juv. ♀ (NCA AcAT 2005/504); Renosterpoort [Farm 498, 25°45′S 28°57′E], 10 km E of Bronkhorstspruit, 1.iv.1984, G. Newlands, 1♀ (AMNH [AH 3350]). **Mpumalanga Province:** *Witbank District*: Ezemvelo Nature Reserve, 25°42′S 29°01′E, 26–30.i.2004, K. Manamela, 1 subad. ♂ (TMSA 22859); Ezemvelo Nature Reserve, 25°43′S 28°57′E, 1.iii.2005, GDACE, 1 subad. ♀ (NCA AcAT 2005/513); Marulani Lodge, just S Loskop Dam, 25°26.366′S 29°24.517′E, 3.x.2004, I. Engelbrecht, 1050 m, sympatric with *Parabuthus transvaalicus* Purcell, 1899, 1 subad. ♂ (NCA AcAT 2005/506).

Hadogenes newlandsi Prendini, 2001

Hadogenes bicolor Purcell, 1899: Hewitt, 1918: 160, 161 (part); Lamoral and Reynders, 1975: 538 (part); Newlands, 1980 (unpublished): 99–105 (part), fig. 48 (part); Newlands and Cantrell, 1985: 40, 42, 44 (part).

Hadogenes newlandsi Prendini, 2001: 159, 162–169, figs. 1, 22–32, 35, 38, tab. 2; Prendini, 2001b: 137.

Hadogenes newlandsi: Prendini, 2005a: 67, appendix 1.

TYPE MATERIAL: **SOUTH AFRICA: Limpopo Province:** *Soutpansberg District*: Holotype ♂ (SAMC C4589), Ben Lavin Nature Reserve, 23°07.544′S 29°56.573′E, 31.xii.1999, L. Prendini and E. Scott, 850 m, in crevices in granite rocks, mixed bushveld. Paratypes: same data as holotype, 3♂ 5♀ 1 subad. ♀ (SAMC C4593), 1♂ 1♀ (AMNH); Tabajwane Koppie, Ben Lavin Nature Reserve [23°09′S 29°58′E], xii.1990, L. Prendini and K.M.A. Prendini, 970 m, in crevices in granite rocks, 1♂ 1♀ (SAMC C4588); Bandelierkop, 23°18′S 29°51′E, iv.1988, L. Prendini, M.R. Filmer, A.M. Smith and V. Hull-Williams, in crevices in granite koppie, 2♀ (SAMC C4587); same data, except ''1995, I. Engelbrecht'', 1♂ 1♀ 1 juv. ♂ (SAMC C4586); Louis Trichardt, 10 mi S [23°08′S 29°54′E], 25.iii.1958, E.S. Ross and R.E. Leech, 1000 m, 1 subad. ♂ (CAS); same data, except ''Louis Trichardt, 18 mi S [23°17′S 29°49′E]'', 1♀ 3 juv. ♂ 1 juv. ♀ (CAS); Mailaskop, 23°13.43′S 29°56.63′S, 30.xii.1999, L. Prendini and E. Scott, 1124 m, in crevices in dolerite rocks on koppie, 1♀ 2 juv. ♀ (SAMC C4590). *Letaba District*: Letsitele, Tzaneen [23°53′S 30°24′E], 21.ix.1964, R.D. Faul, 1 subad. ♂ (TMSA 12565); Mooketsi [23°36′S 30°06′E], iv.1924, G.P.F. van Dam, 2♂ (TMSA 114, 117), 10♀ (TMSA 112, 113, 115, 116, 118–122, 125), 2 juv. ♀ (TMSA 127–128). *Pietersburg District*: Clearwaters, Haenertsburg [23°51′S 29°57′E], 4.ii.1916, G.A. Thompson, 1 subad. ♂ (TMSA 1057); Farm Munniks [23°37′S 29°57′E], 16.i.1914, Pienaar, 1 subad. ♀ (TMSA 1058); Pietersburg area [23°54′S 29°27′E], 1♀ (AMNH); Woodbush [23°47′S 29°54′E], xii.1907, D. Gough, 1♀ (TMSA 1055); The Woodbush, 1 subad. ♂ (AMGS 3990). *Potgietersrus District*: Makapan Caves [24°09′S 29°11′E], 4.ii.1911, A.

TABLE 2

Meristic Data for Adult *Hadogenes bicolor* Purcell, 1899, *H. longimanus* Prendini, 2001, and *H. newlandsi* Prendini, 2001
Measurements follow Newlands and Prendini (1997) and Prendini (2001a, 2005b).

		Hadogenes bicolor Purcell				*Hadogenes longimanus* Prendini				*Hadogenes newlandsi* Prendini			
Specimen:	Sex:	♂	♂	♀	♀	♂	♂	♀	♀	♂	♂	♀	♀
	Collection:	SAMC	TMSA	SAMC	TMSA	SAMC	AMNH	SAMC	AMNH	SAMC	SAMC	SAMC	SAMC
	Number:	4062	18004	4062	18005	C4602		C4603		C4589	C4586	C4586	C4593
	Type:	lecto		paralecto		holo	para	para	para	holo	para	para	para
Carapace:	anterior width	7.54	8.12	8.28	8.82	9.97	7.76	9.48	8.01	9.40	8.92	9.47	10.00
	posterior width	12.78	13.85	13.67	14.08	15.80	12.49	15.51	12.83	15.43	14.43	15.63	16.81
	length	12.70	13.33	13.37	14.2	15.57	12.36	15.34	12.74	16.13	14.87	15.53	16.60
Chela:	maximum width	7.59	7.78	8.55	9.90	8.62	7.63	9.76	8.03	10.22	9.25	10.46	11.26
	maximum height	3.29	3.76	4.28	4.56	5.17	3.49	5.00	4.30	5.13	4.39	4.82	5.72
	length[a]	25.86	27.99	27.30	29.18	34.49	25.94	31.63	25.00	31.25	26.66	28.42	32.89
	length of ventroexternal carina	13.61	15.28	14.14	15.77	18.71	13.82	16.30	13.50	16.95	13.59	15.26	17.69
	length of movable finger	12.84	13.29	13.65	14.72	18.15	12.77	16.28	12.34	16.03	13.52	14.50	17.60
	i trichobothria (left/right)	2/2	2/2	2/2	2/2	6/5	7/6	5/5	6/5	2/2	2/2	2/2	2/2
	E trichobothria (left/right)	39/40	35/35	36/39	34/35	37/39	39/39	40/43	39/38	30/34	30/29	33/34	32/30
	V trichobothria (left/right)	34/33	37/37	42/36	34/39	34/36	44/46	42/38	38/38	33/35	34/37	33/36	33/34
Patella:	maximum width	7.28	7.75	7.85	8.28	9.06	7.19	8.80	7.08	8.70	8.17	8.64	9.72
	maximum height	3.86	3.89	4.06	4.19	4.57	3.58	4.66	3.80	4.78	4.35	4.58	5.23
	length	13.28	13.92	13.15	14.23	17.56	12.34	15.52	12.27	15.15	13.06	13.51	15.54
	e trichobothria (left/right)	57/57	42/38	59/56	53/54	56/55	54/53	62/60	54/57	41/49	48/50	52/51	52/48
	v trichobothria (left/right)	34/31	31/30	31/30	29/29	28/32	34/33	33/33	43/39	29/28	29/31	30/32	29/31
Femur:	maximum width	5.28	5.64	5.64	5.59	6.56	5.50	6.35	5.04	6.78	6.58	6.41	7.31
	maximum height	2.99	3.28	3.39	3.27	4.15	3.13	4.04	3.18	4.24	3.50	3.72	4.38
	length	14.50	15.82	14.14	14.97	20.10	13.87	16.55	13.02	15.76	13.60	14.19	16.04
Pedipalp:	total length (incl. trochanter)	58.34	63.61	60.00	64.45	79.36	58.11	70.56	56.00	68.92	59.41	62.75	71.51
Mesosoma:	total length (tergites)	34.28	33.97	36.11	38.86	44.35	37.67	42.20	36.17	50.68	41.27	44.23	47.58
Sternite VII:	width	8.63	9.66	10.76	10.63	12.10	9.67	12.26	10.88	12.26	10.56	12.17	13.88
	length	7.87	7.37	8.11	8.51	9.90	8.40	8.61	7.75	10.83	10.08	9.48	10.38
Metasoma I:	maximum width	3.21	2.73	3.28	3.24	3.46	3.19	3.04	2.79	4.11	4.08	3.68	3.95
	maximum height	2.48	2.45	2.28	2.68	3.11	2.43	2.99	2.42	3.66	2.81	2.84	3.24
	length	7.49	7.46	6.11	6.43	8.58	6.38	6.58	5.66	12.24	10.25	7.26	7.86
Metasoma II:	maximum width	2.27	2.16	2.23	2.28	2.87	2.44	2.57	2.43	3.02	2.84	2.90	2.84
	maximum height	3.38	2.99	2.80	3.24	3.73	3.13	3.41	3.21	4.83	3.95	3.42	4.00
	length	9.52	9.56	7.27	7.10	12.24	8.54	8.44	7.16	16.22	13.88	9.32	10.1

TABLE 2
(*Continued*)

Specimen:	Sex:	*Hadogenes bicolor* Purcell				*Hadogenes longimanus* Prendini				*Hadogenes newlandsi* Prendini			
		♂	♂	♀	♀	♂	♂	♀	♀	♂	♂	♀	♀
	Collection:	SAMC	TMSA	SAMC	TMSA	SAMC	AMNH	SAMC	AMNH	SAMC	SAMC	SAMC	SAMC
	Number:	4062	18004	4062	18005	C4602		C4603		C4589	C4586	C4586	C4593
	Type:	lecto		paralecto		holo	para	para	para	holo	para	para	para
Metasoma III:	maximum width	2.09	2.10	2.10	2.14	2.69	2.37	2.44	2.15	2.92	2.71	2.63	2.69
	maximum height	3.36	2.88	2.84	3.11	3.58	3.09	3.42	3.00	4.53	3.85	3.52	4.03
	length	9.96	9.98	7.33	7.53	12.69	9.20	8.73	7.28	16.29	14.63	9.35	10.09
Metasoma IV:	maximum width	1.96	1.91	2.04	2.12	2.66	2.12	2.43	2.03	2.73	2.33	2.24	2.57
	maximum height	2.84	2.80	2.72	2.93	3.15	2.68	2.98	2.72	3.88	3.23	2.99	3.73
	length	10.55	10.57	8.02	7.57	13.41	9.95	9.27	7.59	17.43	15.46	10.38	11.05
Metasoma V:	maximum width	2.06	1.82	2.02	2.03	2.42	1.97	2.37	1.97	2.52	2.28	2.17	2.67
	maximum height	2.79	2.68	2.48	2.65	3.19	2.51	2.81	2.35	3.76	2.92	2.67	3.63
	length	11.18	11.09	8.81	8.41	14.69	10.61	10.57	7.61	17.29	15.81	10.54	11.60
Telson:	maximum width	2.31	2.18	2.20	2.13	2.89	2.30	2.50	2.01	2.95	2.47	2.23	2.9
	maximum height	2.57	2.79	2.61	2.81	3.37	2.82	2.82	2.55	3.68	3.26	2.71	3.57
	aculeus length	1.84	1.68	1.61	1.86	2.17	1.37	1.96	1.44	1.73	1.79	1.94	2.32
	total length	7.77	7.98	7.52	7.59	9.17	7.14	8.12	6.74	10.01	8.63	8.10	9.22
Metasoma:	total length[b]	56.47	56.64	45.06	44.63	70.78	51.82	51.71	42.04	89.48	78.66	54.95	59.92
Total length:	prosoma + mesosoma + metasoma	103.45	103.94	94.54	97.69	130.70	101.85	109.25	90.95	156.29	134.80	114.71	124.10
Pectines:	total length	8.29	8.72	7.20	7.36	11.10	9.38	8.49	6.84	10.77	8.48	7.62	8.62
	length along dentate margin	7.53	8.13	6.03	6.21	10.29	8.47	7.34	5.59	10.25	8.11	5.80	6.98
	tooth count (left/right)	19/18	20/20	16/15	16/16	23/23	22/22	19/19	16/15	21/22	23/21	18/16	17/16

[a] Measured from base of condyle to tip of fixed finger.
[b] Sum of metasomal segments I–V and telson.

Roberts, 1 juv. ♀ (TMSA 708); Makapansgat [24°09′S 29°11′E], I.H. Davidson, 1♀ (TMSA 17451), 1 juv. ♀ (TMSA 17450), same data, except ''31.viii.1973, R. Clark'', 1 juv. ♂ (TMSA 10781); Makapansgat World Heritage Site, iv.2000, I. Engelbrecht, 1♀ (AMCC 138997); Maribashoek [24°13′S 29°08′E], xii.1924, G.P.F. van Dam, 1 juv. ♀ (TMSA 6108); Percy Fife Nature Reserve [24°02′S 29°11′E], 11.v.1972, N.H.G. Jacobsen, 1♂ (TMSA 10484), 3♀ (TMSA 10481–10483), juv. ♂ (TMSA 10485); Potgietersrus Nature Reserve [24°09′S 28°59′S], 11.v.1972, N.H.G. Jacobsen, 1 subad. ♀ (TMSA 20393); Potgietersrus [24°11′S 29°01′E], 27.iii.1919, H.B. Pretorius, 1 juv. ♀ (TMSA 2184). *Sekgosese District*: Louis Trichardt, 35 mi S [23°31′S 29°43′E], 26.iii.1958, E.S. Ross and R.E. Leech, 1000 m, 2 juv. ♀ (CAS); Mphakane, south, granite koppies 1 km from turnoff to Munnik, 23°32.20′S 29°42.42′E, 29.xii.1999, L. Prendini and E. Scott, 1000 m, in crevices in rock, 1♀ 1 juv. ♀ (SAMC C4591); St. Brendan's Catholic School, Mission Matok, 23°25.63′S 29°43.28′E, 29.xii.1999, L. Prendini and E. Scott, 980 m, mixed bushveld, granite outcrops, in crevices, 2♂ 9♀ 1 juv. ♂ 1 juv. ♀ (SAMC C4592), 1♂ 1♀ (CAS), 1 juv. ♂ 1 juv. ♀ (AMCC 138998).

ADDITIONAL MATERIAL: **SOUTH AFRICA: Limpopo Province:** *Pietersburg District*: Mpome, 1893, Bartels, 1♀ (ZMUH [ex ZMHB]). *Potgietersrus District*: Potgietersrus [24°11′S 29°01′E], iv.1934, R.F. Lawrence, 1 specimen [lost, not examined] (SAMC B8224).

ERRONEOUS RECORD: **SOUTH AFRICA: KwaZulu-Natal Province:** *Estcourt District*: Estcourt, 5 km NE towards Weenen [29°00′S 29°53′E], 24.viii.1980, A. Harington, in rock crack on crest of very high hill, 1♂, rehydrated (AMNH [AH 3439]).

Hadogenes polytrichobothrius, new species

Hadogenes bicolor Purcell, 1899: Hewitt, 1918: 160, 161 (part), pl. 30, figs. 88, 89.
Hadogenes longimanus Prendini, 2001: 158, 159 (part), 161, fig. 1 (part), tab. 2 (part).

TYPE MATERIAL: **SOUTH AFRICA: Mpumalanga Province:** *Lydenburg District*: Holotype ♂ (AMNH), Steelpoort, 9 km SE on road to Lydenburg [Farm Olifantspoortjie 319, 24°45′S 30°18′E], i.2003, I. Engelbrecht and B. Watkins, in rock cracks. Paratypes: same data as holotype, 1♂, 6♀ (AMNH), 1 juv. (AMCC 138999); Steelpoort [24°43′S 30°12′E], J. Visser, 2♂ (SAMC C4275 [JV 1844], C4276 [JV 1850]), 1♀ (SAMC C4281 [JV 1846]), 1 juv. ♂ (SAMC C3901 [JV 1836]); same data, except ''i.2003, I. Engelbrecht and B. Watkins, in rock crack'', 1♀ (AMNH); Farm Steelpoortpark 362, turn-off to Lydenburg, koppies on left side of road 555, 24°52.510′S 30°02.812′E, 5.ii.2005, L. Prendini and K.M.A. Prendini, 840 m, in crack of granite rock in very dry, mixed bushveld, 1 juv. ♂ (AMNH); Farm Olifantspoortjie 319, entrance gate, 24°46.435′S 30°15.951′E, 5.ii.2005, L. Prendini and K.M.A. Prendini, 969 m, in crevices of granite outcrops in very dry, mixed bushveld, 1 subad. ♂ 1 juv. ♂ (AMNH), 1 juv. ♂ (AMCC 145221). *Belfast District*: Doornkop [Doringkop, on Farm Doornkop 356, 25°30′S 29°55′E], near Belfast, R. Gerhardt, 1♂ [damaged] (AMGS). *Middelburg District*: Mapoch's Grotte on Farm 500, at bottom of hill near entrance gate, 25°10.675′S 29°57.139′E, 5.ii.2005, L. Prendini and K.M.A. Prendini, 1407 m, in crevices of granite rocks at base of koppie, mixed bushveld, drier than upslope, 3♀ (AMNH). **Limpopo Province:** *Sekhukhuneland District*: Potlake Nature Reserve (Farm Jagdlust 418), 24°15.160′S 29°54.649′E, 6.ii.2005, L. Prendini and K.M.A. Prendini, 844 m, in crevices in sandstone at base of southern slope of mountains, mixed bushveld, 1 subad. ♂ (AMNH); same data, except ''Potlake Nature Reserve (Farm Wintersveld 417), 24°15.845′S 29°57.021′E, 791 m'', 1♂ 2♀ 2 subad. ♂ 1 subad. ♀ (AMNH), 1 subad. ♀, 1 juv. ♂, 10 juv., disarticulated chela (AMCC 145222).

DIAGNOSIS: *Hadogenes polytrichobothrius* is placed in the *bicolor* group on account of the shape of metasomal segment I, which is wider than it is high posteriorly. It appears to be the sister species of *H. longimanus*: both are characterized by the presence of five or more trichobothria on the internal surface of the pedipalp chela, a pronounced lobe, distal to the notch in the fixed finger of the pedipalp chela of adult males and females, and

a relatively short metasoma in the adult male (ca. 53–57% of the total length), compared with most other *Hadogenes* species (including *H. newlandsi* and *H. soutpansbergensis*). The latter two characters are shared with *H. bicolor*, suggesting that the three species collectively form a monophyletic group, to the exclusion of *H. newlandsi* and *H. soutpansbergensis*.

Hadogenes polytrichobothrius is distinguished from *H. bicolor*, *H. newlandsi*, and *H. soutpansbergensis* by the presence of five or more internal trichobothria on the pedipalp chela; in the other species, there are only two internal trichobothria. It is distinguished from *H. longimanus* by its shorter, broader pedipalps (especially the chelae), displaced lobe on the movable finger of the pedipalp chela of the adult male, and higher trichobothrial counts. This species has the greatest number of trichobothria thus far recorded in *Hadogenes* (Newlands, 1980; L. Prendini, unpublished data): up to 237 trichobothria per pedipalp.

ETYMOLOGY: The species name refers to the high trichobothrial counts of this species, which are the highest recorded in the genus.

DESCRIPTION: The following description, based on the holotype male (AMNH; figs. 2, 3) and a paratype female from 9 km SE of Steelpoort (AMNH; figs. 4, 5), complements previous descriptions (Hewitt, 1918; Prendini, 2001a) of the first specimen collected, from Doornkop, near Belfast (AMGS), and four specimens from Steelpoort (SAMC C3901, C4275, C4276, C4281). Measurements and counts are recorded from 4♂ (table 4) and 13♀ (table 3).

Color: Chelicerae, pedipalp chelae, legs, and distal third of tergites slightly paler, and contrasting with carapace, rest of pedipalps, tergites, and metasoma. Telson (♂) distinctly paler than metasomal segments I–V. Sternites distinctly paler than tergites and metasoma. Chelicerae, pedipalp chelae, legs, and telson (♀), Clay Color 26; carapace, pedipalp patellae and femora, Raw Sienna 136; tergites I–VI, proximal two-thirds, sternite VII, metasoma, Brownish Olive 29; tergites I–VI, distal third, pectines, genital operculum, and sternites, Raw Umber 123; telson (♂), Buff 124.

Carapace: Three pairs of lateral ocelli, slightly smaller than median ocelli (figs. 6, 7). Median ocular tubercle with superciliary carinae well developed, protruding above ocelli, and interocular sulcus distinct. Anterior margin of carapace with median notch well developed, triangular inset situated far back, with frontal lobes protruding anteriorly. Anteromedian sulcus deep, suturiform, furcating anteriorly around triangular inset. Median longitudinal suture distinct, continuous from anterior furcated sutures, through ocular tubercle to posterior furcated sutures, which converge on ocular tubercle from posterior carapace margin. Posterior furcated sutures obsolete, discontinuous. Posteromedian and posteromarginal sulci distinct, shallow. Paired median lateral and posterolateral sulci also distinct, shallow. Carapace entirely granular, except for surfaces of frontal lobes, median lateral, posterolateral and posteromarginal sulci, which are smooth. Granulation almost uniformly fine, becoming coarser on anterocular and anterolateral surfaces.

Chelicerae: Movable finger with distal internal tooth slightly smaller than distal external tooth, and opposed. Ventral aspect of fingers and manus with long, dense macrosetae.

Pedipalps: Femur with four distinct carinae (fig. 12); ventroexternal carina obsolete, reduced to a few granules proximally; dorsoexternal carina, dorsointernal and ventrointernal carinae costate granular, composed of large, heavily sclerotized granules; externomedian carina comprised of spiniform granules; dorsal, dorsoexternal and ventral intercarinal surfaces finely and uniformly granular; internal intercarinal surfaces smooth, except for a few scattered spiniform granules. Femur width 39.5% (33–46%) of length (tables 3, 4).

Patella with six distinct carinae (figs. 13–15); dorsoexternal carina obsolete; dorsointernal and ventrointernal carinae costate to costate granular; internal carinae costate granular, composed of very large, heavily sclerotized spiniform granules, converging at apex of anterior process; externomedian and ventroexternal carinae granular; dorsoexternal and ventral intercarinal surfaces finely and uniformly granular, becoming granuloreticulate on ventral surfaces; internal intercarinal surfaces smooth, except for a few

Figs. 2–5. *Hadogenes polytrichobothrius* n.sp., habitus of holotype ♂ and paratype ♀ (AMNH). **2.** Dorsal aspect, ♂. **3.** Ventral aspect, ♂. **4.** Dorsal aspect, ♀. **5.** Ventral aspect, ♀. Scale bars = 10 mm.

scattered granules; anterior process strongly developed. Patella width 61.5% (56–67%) of length.

Chela with three distinct carinae; dorsal secondary and digital carinae obsolete (figs. 16, 17); external secondary carina strongly developed, costate granular; ventroexternal carina strongly developed, crenulate, aligned parallel to longitudinal axis of chela, with distal edge disconnected from external movable finger condyle and directed toward a point between external and internal movable

finger condyles, but closer to external condyle (fig. 19); ventromedian carina obsolete, reduced to a vestigial granule proximally; ventrointernal carina also obsolete; internomedian and dorsointernal carinae weakly developed, each comprised of a series of isolated spiniform granules; dorsomedian carina strongly developed, composed of a continuous double row of spiniform granules; dorsal intercarinal surfaces smooth to weakly reticulate, becoming finely granular externally (♂), smooth to uniformly finely granular (♀); external intercarinal surfaces coarsely granular (fig. 18); dorsointernal intercarinal surfaces with scattered spiniform granules, becoming finely granular on internal surface of fixed finger; ventrointernal intercarinal surfaces smooth. Chela with pronounced, conical lobe on movable finger, fitting unevenly into corresponding notch in fixed finger of adult ♂, i.e. displaced to external surface and overlapping, when fingers closed; fixed finger additionally with pronounced, conical lobe distal to notch, and smaller, rounded lobe proximally. Dentate margins of chela fingers with double row of denticles, fused proximally at lobe/notch and also distally. Chela height 47% (38–56%) of width; chela width 66.5% (60–73%) of length along ventroexternal carina; length movable finger 104% (97–111%) of length along ventroexternal carina.

Trichobothria: Neobothriotaxic major, type C (figs. 12–19; tables 3, 4), with the following segment totals: femur, 3 (1 *d*; 1 *i*; 1 *e*), patella, 82–121 (2 *d*; 1 *i*; 28–43 *v*; 51–75 *e*) and chela, 75–113 (66–101 manus; 13–16 fixed finger, including 5–8 *i*). Total number of trichobothria per pedipalp, 160–237. Only femoral trichobothria, trichobothria in the *d* and *i* series of the patella, and trichobothria in the *D, d,* and *e* series of the chela are stable in number and distribution. External and ventral trichobothria of the chela and patella are numerically and distributionally too variable for diagnostic purposes. This species is characterized by the presence of 5–8 accessory trichobothria in the *i* series of the chela.

Mesosoma: Tergites each with paired submedian depressions and obsolete median carina. Pre-tergites of ♂ and ♀ smooth and shiny. Post-tergites I–VI smooth and shiny in ♂, except for very fine and even granulation on anteromedial surfaces (excluding median carina and submedian depressions, which are smooth) and lateral surfaces; VII sparsely and coarsely granular anteriorly, becoming smooth posteriorly in ♂; post-tergites of ♀ smooth and shiny. Sternites smooth and shiny, each with paired longitudinal depressions internal to spiracles; VII with pair of shallow posterolateral oval depressions in ♂, and pair of obsolete carinae, converging distally towards shallow notch in distal apex (figs. 10, 11). Sternite VII length 92.5% (85–100%) of width in ♂, 76.5% (66–87%) in ♀ (tables 3, 4).

Pectines: Mesial margin of first proximal median lamella of each pecten angular, with pectinal teeth present along entire posterior margin in ♂ (fig. 8); mesial margin of first proximal median lamella shallowly curved, with proximal fifth of posterior margin devoid of teeth in ♀ (fig. 9). Pectinal teeth (left/right): 21–24/20–23 (♂), 16–21/16–20 (♀).

Sternum: Subpentagonal, type 2. Median longitudinal furrow deep and narrow along entire length (figs. 8, 9).

Genital operculum: Suboval, completely divided longitudinally, with genital papillae present (♂). Subcordate, partially connected by a membrane in anterior two-thirds, with distinct distal lobes in posterior third, and with genital papillae absent (♀).

Legs: Femora each with paired granular carinae on ventral surface, becoming less developed on posterior legs. Basitarsi each with few spiniform setae on prolateral and retrolateral margins, decreasing in number from anterior to posterior legs. Telotarsi each with two rows of three ventrosubmedian spiniform setae and basal row of ventromedian spinules. Telotarsal laterodistal lobes truncated; median dorsal lobes extending to ungues. Telotarsal ungues short, distinctly curved, and equal in length. Retrolateral pedal spurs absent.

Metasoma and telson: Metasomal segment I posterior height 88.5% (78–99%) of width (tables 3, 4). Metasomal segments I–V progressively increasing in length, and decreasing in width, segment V width 68.5% (57–78%) of segment I width. Metasoma slender, width percentage of length for segment I, 30% (23–37%) in ♂, 42% (32–52%) in ♀;

TABLE 3

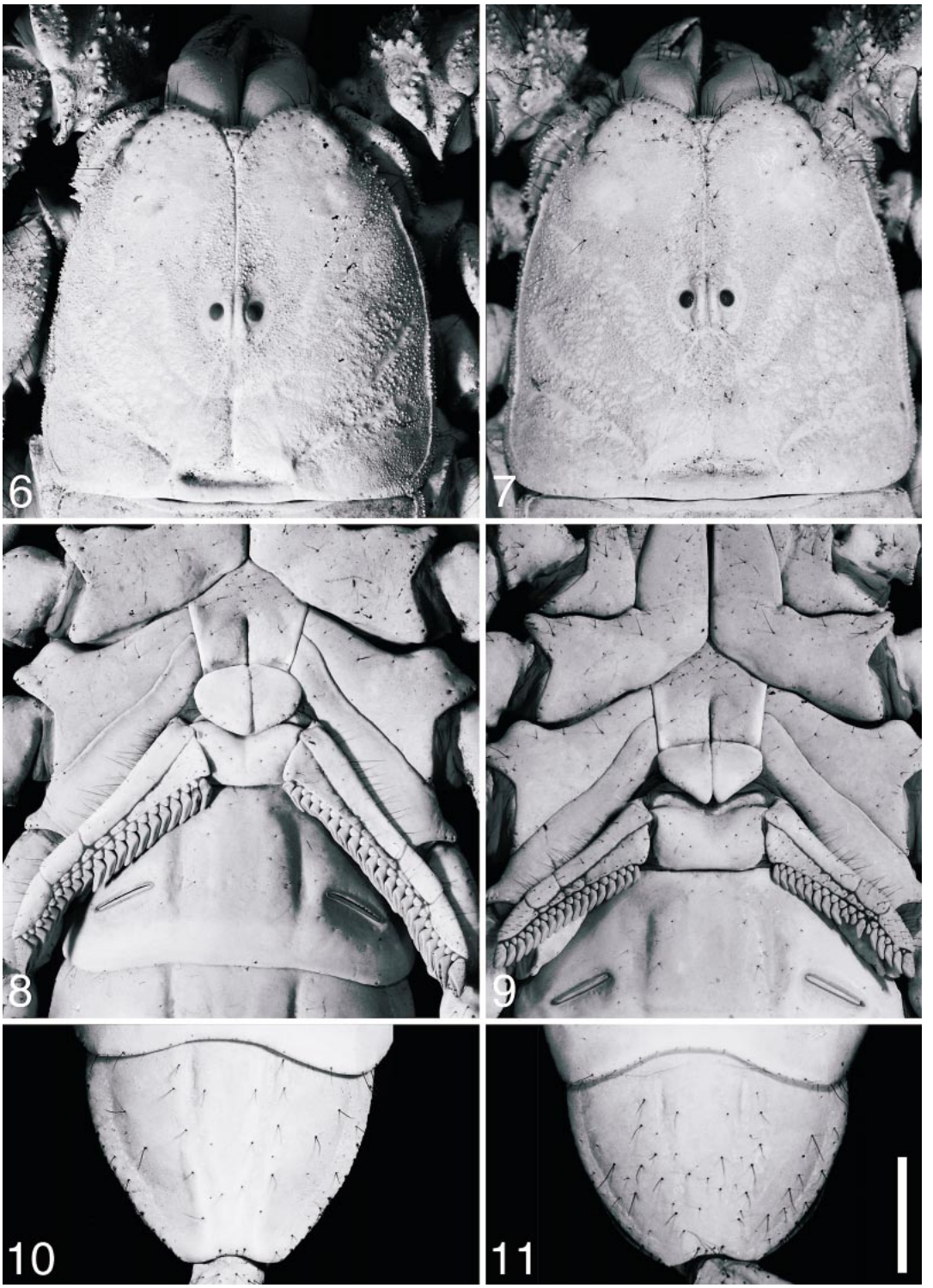
Meristic Data for Adult *Hadogenes polytrichobothrius* n.sp.
Measurements follow Newlands and Prendini (1997) and Prendini (2001a, 2005b).

		Hadogenes polytrichobothrius n.sp.												
Specimen:	Sex:	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀
	Collection:	SAMC	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH
	Number:	C4281												
	Type:	para	para	para	para	para	para	para	para	para	para	para	para	para
Carapace:	anterior width	11.64	10.69	9.64	9.79	9.49	10.04	9.88	10.92	9.58	10.01	10.01	9.80	8.81
	posterior width	18.58	17.46	16.77	17.33	15.56	16.89	16.65	17.73	15.82	16.28	15.42	15.70	13.97
	length	19.11	16.59	16.66	16.92	16.08	16.59	16.14	18.08	15.49	17.06	16.45	16.48	15.00
Chela:	maximum width	12.11	11.64	11.69	11.34	10.97	12.08	11.26	12.00	10.19	11.14	10.49	10.64	10.05
	maximum height	6.47	5.69	6.08	5.87	5.22	5.54	4.95	6.77	4.55	5.28	4.93	4.01	4.60
	length[a]	36.52	32.71	32.24	31.85	30.40	31.85	31.27	33.91	30.38	31.22	31.00	17.31	31.13
	length of ventroexternal carina	18.68	16.93	16.76	16.02	16.02	17.08	15.52	18.25	16.53	16.03	16.67	16.72	16.86
	length of movable finger	19.01	17.33	17.32	16.90	16.34	16.86	16.09	17.69	15.36	16.19	16.31	16.75	15.67
	i trichobothria (left/right)	7/8	7/7	2/7	6/7	6/7	7/7	5/6	7/6	8/8	7/7	8/7	7/7	7/7
	E trichobothria (left/right)	41/44	42/35	38/42	40/29	39/38	43/40	44/43	41/45	44/43	36/37	38/38	40/42	41/37
	V trichobothria (left/right)	46/49	37/39	37/42	47/35	37/41	44/49	41/43	37/40	42/46	50/51	42/46	47/48	52/50
Patella:	maximum width	10.36	10.34	9.82	9.88	9.54	9.75	9.60	10.58	10.01	9.96	9.93	9.60	8.88
	maximum height	5.79	5.46	5.45	5.13	4.98	5.26	4.83	5.44	4.73	5.12	5.00	5.28	4.20
	length	17.64	15.46	14.97	15.37	15.30	15.45	14.63	15.97	14.96	15.08	15.00	16.13	15.32
	e trichobothria (left/right)	69/70	52/54	57/62	55/67	58/60	62/56	63/55	56/55	62/64	56/55	60/61	70/70	70/75
	v trichobothria (left/right)	33/31	31/29	37/34	29/31	33/34	33/28	34/35	35/36	34/34	34/31	39/38	36/36	39/38
Femur:	maximum width	8.03	7.00	7.18	6.83	6.61	7.14	6.80	7.23	6.75	6.98	6.51	6.62	5.62
	maximum height	5.19	4.55	4.60	4.21	4.17	4.23	4.03	4.61	3.56	4.16	3.92	4.09	3.49
	length	18.00	15.96	16.04	15.98	15.39	15.56	16.00	16.47	15.50	15.90	17.48	17.16	16.87
Pedipalp:	total length (incl. trochanter)	80.76	71.05	70.82	70.11	67.10	69.86	68.61	74.02	67.46	69.05	69.35	58.08	69.45
Mesosoma:	total length (tergites)	55.17	47.66	48.45	44.53	46.92	48.30	42.76	49.52	44.64	46.26	47.72	48.45	45.19
Sternite VII:	Width	13.86	11.99	12.16	12.31	11.74	12.37	11.45	12.93	12.63	12.77	11.64	12.40	10.67
	length	11.05	9.09	10.54	8.84	9.88	9.35	7.61	10.84	8.99	9.97	8.61	8.43	8.66
Metasoma I:	maximum width	3.96	3.44	3.60	3.32	3.17	3.00	2.91	4.13	3.27	3.68	3.18	2.78	2.44
	maximum height	3.30	2.87	2.88	3.18	2.73	2.98	2.56	3.22	2.85	3.15	2.90	2.57	2.35
	length	8.58	7.22	6.89	7.09	7.45	7.00	7.48	8.27	7.48	7.97	8.01	7.81	7.53
Metasoma II:	maximum width	2.84	2.77	2.65	2.59	2.39	2.75	2.36	2.85	2.58	2.70	2.47	2.45	2.08
	maximum height	4.06	3.73	3.66	3.57	3.12	3.53	3.19	4.20	3.36	3.80	3.37	8.47	2.65
	length	10.85	8.70	8.67	8.88	9.43	8.52	9.18	10.03	9.31	9.93	9.47	7.94	8.92

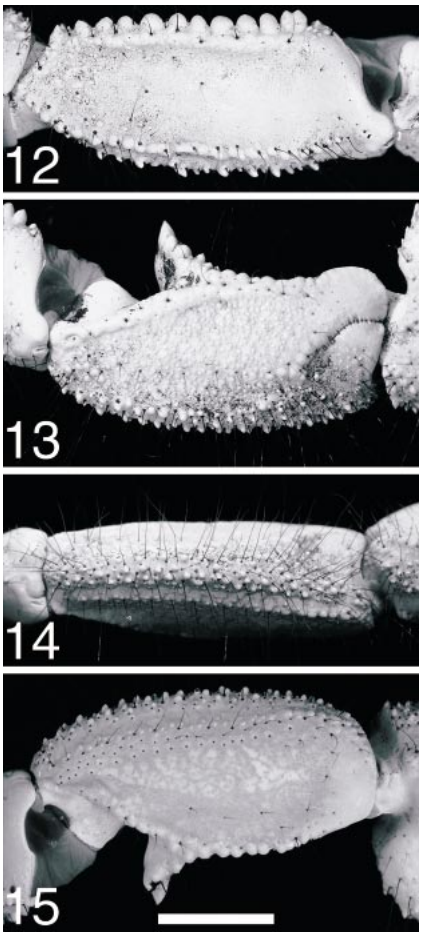
TABLE 3
(*Continued*)

		Hadogenes polytrichobothrius n.sp.												
Specimen:	Sex:	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀	♀
	Collection:	SAMC	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH
	Number:	C4281												
	Type:	para	para	para	para	para	para	para	para	para	para	para	para	para
Metasoma III:	maximum width	2.88	2.42	2.61	2.36	2.27	2.43	2.41	2.75	2.49	2.37	2.54	2.23	1.92
	maximum height	4.16	3.62	3.78	3.48	3.15	3.49	3.21	3.95	3.18	3.55	3.21	3.04	2.46
	length	11.17	8.90	8.82	9.41	9.20	8.91	9.40	10.27	9.46	9.92	9.34	8.24	8.90
Metasoma IV:	maximum width	2.69	2.25	2.11	2.52	2.07	2.26	1.94	2.69	2.31	2.20	2.19	1.96	1.77
	maximum height	3.54	3.15	3.06	2.85	2.72	3.05	2.61	3.45	2.77	3.06	2.98	2.58	2.37
	length	12.08	9.29	10.49	9.36	9.76	9.05	9.87	10.81	9.66	10.27	9.66	8.85	9.07
Metasoma V:	maximum width	2.63	2.49	2.19	2.44	2.00	2.34	2.02	2.72	2.31	2.08	1.94	2.12	1.81
	maximum height	3.38	2.97	3.16	2.75	2.63	3.00	2.62	3.46	2.63	2.78	2.99	2.14	2.00
	length	12.53	9.93	9.65	10.54	10.14	11.24	11.18	12.30	11.05	11.73	11.60	9.54	9.08
Telson:	maximum width	3.16	2.83	2.64	2.66	2.22	2.63	2.27	3.06	2.45	2.46	2.36	2.21	1.89
	maximum height	3.48	3.26	3.10	3.11	2.52	2.82	2.41	3.43	2.52	2.66	3.12	2.31	2.17
	aculeus length	2.92	2.41	2.47	1.85	1.93	1.84	1.54	2.46	1.47	1.86	2.23	1.64	2.03
	total length	10.33	7.97	7.88	8.51	7.98	8.03	8.10	8.32	7.68	8.26	8.45	8.14	8.16
Metasoma:	total length[b]	65.54	52.01	52.40	53.79	53.96	52.75	55.21	60.00	54.64	58.08	56.53	50.52	51.66
Total length:	prosoma + mesosoma + metasoma	139.82	110.36	110.49	108.11	110.37	111.09	107.85	120.44	108.86	114.35	114.26	108.77	105.66
Pectines:	total length	9.50	9.83	9.36	9.02	9.30	8.95	8.45	9.89	9.76	9.11	9.37	9.01	7.72
	length along dentate margin	7.84	7.95	6.83	6.80	7.59	7.24	6.97	7.59	8.31	8.04	7.81	7.78	5.45
	tooth count (left/right)	18/18	16/17	17/17	17/17	18/17	16/18	18/17	16/16	19/19	19/20	21/19	19/19	16/17

[a] Measured from base of condyle to tip of fixed finger.
[b] Sum of metasomal segments I–V and telson.



Figs. 6–11. *Hadogenes polytrichobothrius* n.sp., carapace, pectines and sternites of ♂ and ♀ paratypes (AMNH). **6.** Carapace, ♂. **7.** Carapace, ♀. **8.** Pectines and basal piece, ♂. **9.** Pectines and basal piece, ♀. **10.** Sternite VII, ♂. **11.** Sternite VII, ♀. Scale bars = 5 mm.



Figs. 12–15. *Hadogenes polytrichobothrius* n.sp., carinae, trichobothria and macrosetae on dextral pedipalpal segments of paratype ♀ (AMNH). **12.** Femur, dorsal aspect. **13.** Patella, dorsal aspect. **14.** Patella, external aspect. **15.** Patella, ventral aspect. Scale bar = 5 mm.

for II, 19.5% (17–22%) in ♂, 27.5% (23–32%) in ♀; for III, 18% (15–21%) in ♂, 26% (22–30%) in ♀; for IV, 16.5% (14–19%) in ♂, 23.5% (20–27%) in ♀; and for V, 15.5% (12–19%) in ♂, 21% (17–25%) in ♀. Telson vesicle width 112.5% (103–122%) of metasomal segment V width; globose in ♂, oval in ♀, with flattened dorsal surface and rounded ventral surface (fig. 33), height 33% (25–41%) of length. Aculeus short, 25% (19–31%) of vesicle length, and sharply curved. Total length of metasoma 115.5% (111–120%) of combined length of prosoma and mesosoma in ♂, but 85% (78–92%) in ♀.

Eight carinae on segment I, six carinae on segments II–IV, and five carinae on segment V (figs. 20, 21). Dorsosubmedian carinae of segment I becoming obsolete distally, but distinct throughout length of segments II–V. Median lateral carinae fully developed on segment I, but absent from segments II–V. Segments I–IV with closely paired ventrosubmedian carinae, fused into a single ventromedian carina on segment V. Median lateral and dorsosubmedian carinae costate on segment I, dorsosubmedian carinae costate to costate granular on segments II–V (♀), composed of spiniform granules on segments II–V (♂). Dorsosubmedian carinae of metasomal segments II and III each terminating distally with enlarged, spiniform granule; dorsosubmedian carinae of other metasomal segments without spiniform granules distally. Ventrosubmedian and ventrolateral carinae costate on segment I, costate to costate granular on segments II–IV. Ventrolateral and ventromedian carinae of segment V composed of spiniform granules. Intercarinal surfaces smooth, except for lateral surfaces of segments III–V in ♂. Telson smooth, sparsely covered in long macrosetae.

Hemispermatophore: Doubled hook near base of distal lamella; distal crest truncate (figs. 22, 23).

Geographic variation: Specimens collected at the northernmost locality record, Potlake Nature Reserve, display longer, narrower pedipalps and a more slender metasoma than specimens collected further south in the distributional range (tables 3, 4).

Ontogenetic variation: The presence of a lobe on the movable finger of the pedipalp chela and a corresponding notch in the fixed finger (figs. 16, 17) are indicative of sexual maturity in most species of *Hadogenes* (Lawrence, 1966; Newlands and Prendini, 1997; Prendini, 2001a). The lobe and corresponding notch are absent from the fingers of the pedipalp chela in subadults and juveniles, developing in the final instar of species, such as *H. polytrichobothrius*, in which these characters are present in adults.

In the specimens of *Hadogenes* examined for this study, sexual maturity was assessed by the presence of a lobe and notch in males and females, and by the presence of fully developed paraxial organs in males, and ovari-

TABLE 4

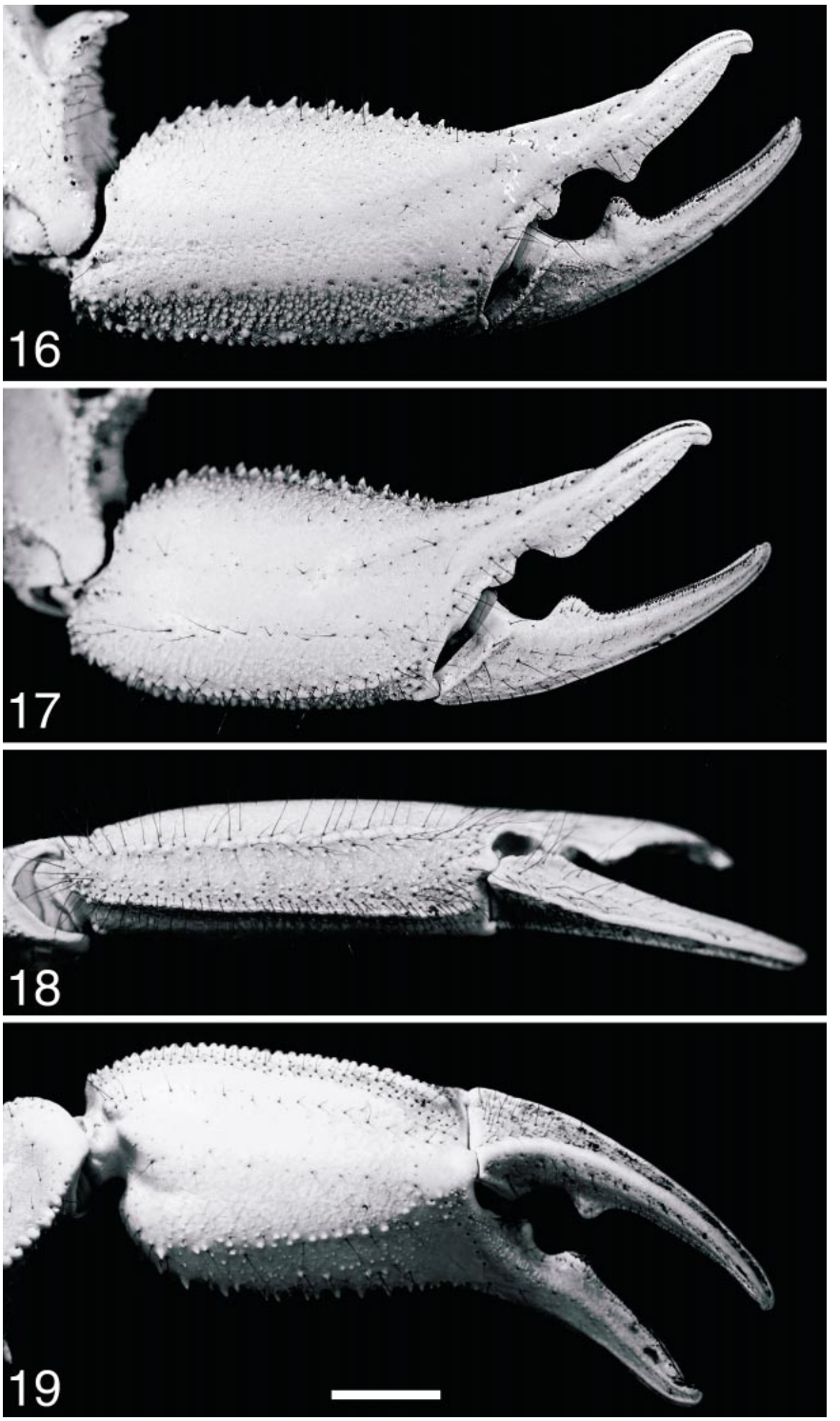
Meristic Data for Adult *Hadogenes polytrichobothrius* n.sp. and *H. soutpansbergensis* n.sp. Measurements follow Newlands and Prendini (1997) and Prendini (2001a, 2005b).

		Hadogenes polytrichobothrius n.sp.				*Hadogenes soutpansbergensis* n.sp.						
Specimen:	Sex:	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀
	Collection:	AMNH	AMNH	AMNH	SAMC	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH
	Number:				C4275							
	Type:	holo	para	para	para	holo	para	para	para	para	para	para
Carapace:	anterior width	10.02	10.04	10.27	9.89	11.50	10.17	12.02	11.53	11.48	10.97	10.84
	posterior width	16.96	16.91	16.34	16.04	18.30	14.90	18.63	18.32	17.78	16.60	16.72
	length	17.38	16.40	17.25	16.07	17.95	15.72	18.86	18.33	17.95	17.27	16.62
Chela:	maximum width	11.61	12.62	11.48	10.13	9.44	8.17	10.69	10.61	10.75	9.91	9.82
	maximum height	5.53	5.65	5.61	5.35	4.87	3.94	5.37	5.12	5.38	4.70	4.93
	length[a]	34.75	33.37	37.82	32.07	36.39	28.05	36.56	35.53	33.83	32.64	31.34
	length of ventroexternal carina	17.84	18.95	16.60	16.57	19.16	15.41	18.84	18.31	18.38	17.40	16.90
	length of movable finger	17.56	18.40	18.45	16.75	18.53	14.90	18.08	17.97	17.45	16.98	16.78
	i trichobothria (left/right)	7/8	7/6	7/6	6/6	2/2	2/2	2/2	2/2	2/2	2/2	2/2
	E trichobothria (left/right)	40/40	39/38	46/44	39/36	40/42	37/42	39/37	38/36	42/38	43/43	37/37
	V trichobothria (left/right)	42/37	42/35	48/53	47/45	32/32	36/32	31/32	32/34	30/33	40/40	32/32
Patella:	maximum width	9.89	10.18	10.94	8.96	8.88	7.48	8.62	8.53	8.69	8.72	8.37
	maximum height	5.73	5.80	5.79	5.37	4.63	4.05	4.97	4.88	4.91	4.46	4.63
	length	16.00	15.64	19.49	15.12	17.43	14.07	16.52	16.63	15.70	15.66	15.14
	e trichobothria (left/right)	56/51	65/65	70/70	73/70	58/56	62/62	51/55	58/58	67/62	67/63	59/63
	v trichobothria (left/right)	35/35	30/34	43/40	37/36	32/32	31/32	26/30	30/31	34/36	34/33	30/30
Femur:	maximum width	7.09	7.13	7.14	6.68	6.19	5.56	6.30	6.21	6.09	5.78	6.12
	maximum height	4.49	4.53	4.02	4.02	3.25	3.59	3.86	3.96	4.20	3.82	3.92
	length	17.17	17.47	21.12	15.64	18.87	15.41	18.18	17.88	17.48	16.54	16.09
Pedipalp:	total length (incl. trochanter)	75.12	74.41	85.20	68.83	81.20	62.33	77.20	76.02	73.02	70.66	69.20
Mesosoma:	total length (tergites)	47.06	45.68	54.13	46.84	49.46	43.22	48.98	46.40	48.41	48.48	47.77
Sternite VII:	width	12.08	12.25	12.03	11.77	12.86	10.71	13.76	12.90	13.05	11.82	11.34
	length	10.77	12.29	10.59	10.00	12.88	10.76	11.14	9.75	10.82	9.38	10.19
Metasoma I:	maximum width	3.74	3.80	3.07	3.43	3.69	2.84	3.49	3.53	3.03	3.03	3.07
	maximum height	3.41	3.27	3.02	3.14	3.21	2.72	3.18	3.10	2.96	2.94	2.97
	length	10.24	10.36	13.08	9.77	16.14	11.10	8.87	9.08	9.03	8.53	8.70
Metasoma II:	maximum width	2.74	2.91	2.51	2.73	2.78	2.09	2.68	2.60	2.73	2.18	2.41
	maximum height	4.03	4.09	3.52	3.75	3.90	3.38	3.89	3.69	3.57	3.47	3.50
	length	13.74	13.34	14.43	12.34	24.88	15.63	12.19	10.68	12.41	11.33	11.43

TABLE 4
(*Continued*)

Specimen:		*Hadogenes polytrichobothrius* n.sp.				*Hadogenes soutpansbergensis* n.sp.						
	Sex:	♂	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀
	Collection:	AMNH	AMNH	AMNH	SAMC	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH
	Number:				C4275							
	Type:	holo	para	para	para	holo	para	para	para	para	para	para
Metasoma III:	maximum width	2.64	2.76	2.31	2.48	2.55	1.89	2.63	2.30	2.37	2.08	2.36
	maximum height	3.92	4.06	2.95	3.72	3.89	3.42	3.92	3.96	4.04	3.52	3.52
	length	13.87	13.29	15.17	12.64	25.01	16.76	10.97	11.32	12.34	11.36	11.24
Metasoma IV:	maximum width	2.35	2.67	2.20	2.48	2.46	1.76	2.56	2.02	2.37	2.13	1.95
	maximum height	3.35	3.39	3.00	3.10	3.08	2.79	3.28	3.06	3.04	2.52	2.94
	length	13.99	13.99	16.17	13.15	27.61	18.82	13.38	13.68	12.70	11.57	12.33
Metasoma V:	maximum width	2.87	2.78	2.00	2.31	2.25	1.84	1.96	1.98	2.31	2.17	1.85
	maximum height	3.41	2.87	2.60	3.03	2.83	2.68	3.20	3.10	2.50	2.56	2.75
	length	16.28	14.49	16.38	13.49	24.16	16.50	13.26	13.08	12.71	11.82	12.01
Telson:	maximum width	2.97	2.89	2.44	2.47	2.67	2.37	2.61	2.61	2.56	2.40	2.16
	maximum height	3.51	3.48	2.58	3.08	3.25	3.18	3.50	3.23	3.13	2.94	3.10
	aculeus length	2.33	2.50	2.10	2.12	1.53	1.24	0.96	1.37	1.48	1.68	1.73
	total length	8.82	8.92	10.29	8.71	10.29	8.52	9.49	9.26	9.89	8.93	8.98
Metasoma:	total length[b]	76.94	74.39	85.52	70.10	128.09	87.33	68.16	67.10	69.08	63.54	64.69
Total length:	prosoma + mesosoma + metasoma	134.02	130.11	149.92	133.01	189.05	140.72	129.16	125.03	128.97	122.99	123.30
Pectines:	total length	12.65	12.86	13.09	12.23	12.38	10.42	9.10	9.51	8.94	9.03	8.80
	length along dentate margin	10.62	11.11	11.63	11.84	11.33	10.25	8.61	9.04	7.68	8.21	7.22
	tooth count (left/right)	21/20	21/22	22/20	24/23	20/21	20/20	17/17	16/17	16/17	17/16	17/16

[a] Measured from base of condyle to tip of fixed finger.
[b] Sum of metasomal segments I–V and telson.



Figs. 16–19. *Hadogenes polytrichobothrius* n.sp., carinae, trichobothria and macrosetae on dextral pedipalpal segments of ♂ and ♀ paratypes (AMNH). **16.** Chela, dorsal aspect, ♂. **17.** Chela, dorsal aspect, ♀. **18.** Chela, external aspect, ♀. **19.** Chela, ventrointernal aspect, ♀. Scale bar = 5 mm.

Figs. 20–21. *Hadogenes polytrichobothrius* n.sp., metasoma and telson of holotype ♂ and paratype ♀ (AMNH). **20.** Lateral aspect, ♀. **21.** Lateral aspect, ♂. Scale bar = 10 mm.

uterus or the gravid condition in females. The elongated metasoma (longer than the combined length of prosoma and metasoma), a secondary sexual characteristic only acquired in the final instar male (Lamoral, 1979; Newlands, 1980; Prendini, 2001a), is a further indication that male specimens are adult (fig. 21, cf. female, fig. 20). In all species of *Hadogenes*, juvenile males and females resemble each other, and adult females, very closely in general morphological features (besides the absence of a lobe and notch on the pedipalp chela fingers) until the final instar. The metasoma of the juvenile male is also shorter than the combined length of the prosoma and mesosoma.

Sexual dimorphism: The characters of primary external sexual dimorphism are the undivided genital operculum, which opens in a single flap, in the female (fig. 9), compared with the two unconnected sclerites, which open independently and cover a pair of genital papillae, in the male (fig. 8). Secondary sexual characters observed in adult males, compared with adult females and juveniles of both sexes, are as follows (tables 3, 4): more pronounced lobes on the fixed and movable fingers of the chela, and a more pronounced notch in the fixed finger; slightly flatter pedipalp chelae; metasoma elongated, longer than the combined length of the prosoma and mesosoma (fig. 21); increased granulation of the carapace (fig. 6), tergites and metasoma; reduced granulation on the pedipalp chelae; greater number of pectinal teeth (fig. 8).

Remarks: The male specimen from Doornkop near Belfast (AMGS), described as *H. bicolor* by Hewitt (1918), and provisionally

Figs. 22–23. *Hadogenes polytrichobothrius* n.sp., hemispermatophore of paratype ♂ (AMNH). **22.** Ectal aspect. **23.** Ental aspect. Scale bar = 1 mm.

assigned to *H. longimanus* by Prendini (2001a), is conspecific with *H. polytrichobothrius*, as are the four specimens from Steelpoort (SAMC C3901, C4275, C4276, C4281), also provisionally assigned to *H. longimanus* by Prendini (2001a). The correct georeference for Doornkop [Doringkop, on Farm Doornkop 356], in the Belfast District, has been established as 25°30′S 29°55′E. The georeference assigned by Prendini (2001a: 159), i.e. 25°55′S 30°16′E, refers to another Doornkop, in the Carolina District. That particular locality was visited during 2001 and no *Hadogenes* were found there.

DISTRIBUTION: *Hadogenes polytrichobothrius* is endemic to rocky outcrops and ridges in the Steelpoort River valley and the middle Olifants River valley, of the Limpopo Province (Sekhukhuneland District) and Mpumalanga Province (Belfast, Lydenburg, Middelburg districts), South Africa (fig. 1). The southernmost locality record, Doornkop [25°30′S 29°55′E], is approximately 150 km southwest of the northernmost record in the Potlake Nature Reserve [24°15.160′S 29°54.649′E].

The known locality records of *H. polytrichobothrius* fall within the following range of altitudes (percentage of locality records indicated in parentheses): 500–1000 m (62.5%), 1000–1500 m (25%), 1500–2000 m (12.5%).

The distributional range falls mostly (87.5%) within the Mixed Bushveld vegetation zone (Van Rooyen and Bredenkamp, 1998a) of the Savanna biome (Rutherford and Westfall, 1994; Low and Rebelo, 1998). However, the record from Doornkop falls close to the boundary of the Moist Sandy Highveld Grassland vegetation zone (Bredenkamp and Van Rooyen, 1998) in the Grassland biome (Rutherford and Westfall, 1994; Low and Rebelo, 1998).

The annual rainfall in the region inhabited by this species varies from less than 650 mm in the north of the distributional range, to 950 mm in the south, and is received mostly in the summer (December to May). Temperatures range from −10°C to 40°C (Bredenkamp and Van Rooyen, 1998; Van Rooyen and Bredenkamp, 1998a).

ECOLOGY: In common with all other species of *Hadogenes*, *H. polytrichobothrius* is an obligate lithophile (Prendini, 2001b). This species inhabits the narrow cracks and crevices of weathered granite and sandstone out-

crops on gently sloping hillsides at moderate altitudes in the Steelpoort River valley and the middle Olifants River valley. Its distributional range is allopatric with that of its closest relative, *H. longimanus*, which inhabits rocky outcrops along the upper reaches of the Olifants River valley, running parallel, further to the south and west (Prendini, 2001a). It is also allopatric with *H. bicolor*, which occurs at higher altitudes along the Drakensberg escarpment, further north and east.

Another liochelid, *Opisthacanthus validus* Thorell, 1876, was collected in sympatry with *H. polytrichobothrius* at Mapoch's Grotte but the two species were not syntopic. *Opisthacanthus validus* occupied humid habitats in the shade of dense vegetation upslope, whereas *H. polytrichobothrius* occupied drier, unshaded habitats at the base of the slope. A scorpionid, *Opistophthalmus glabrifrons* Peters, 1861, is the only other scorpion species thus far recorded in sympatry with *H. polytrichobothrius* (I. Engelbrecht, personal commun.).

CONSERVATION STATUS: *Hadogenes polytrichobothrius* is presently known from eight localities, falling within seven QDS. As with many other species of *Hadogenes* in southern Africa, this species is threatened by habitat destruction. Steelpoort, the type locality of the species, is an open-cast vanadium mine. At least six other large mines and several granite quarries are situated in the Steelpoort River valley, between Doornkop and Steelpoort. Most of the remaining land is privately owned and cattle farming (rangeland) is the dominant land-use. Much of the rangeland in the northern part of this species' range (part of the former ''Independent Homeland'' of Lebowa) is severely degraded by overgrazing and soil erosion. Although one population of *H. polytrichobothrius* is protected in the Potlake Nature Reserve, the threat of mining, quarrying, and other forms of habitat degradation, together with the restricted distributional range of this species, which otherwise falls entirely outside of existing protected areas, warrants its assignment to the Vulnerable IUCN Red List Category. This 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.

Hadogenes soutpansbergensis, new species

TYPE MATERIAL: **SOUTH AFRICA: Limpopo Province:** *Soutpansberg District*: Holotype ♂ (AMNH), Vancoller's Pass, Soutpansberg [Farm Waterpoort 695, 22°55′S 29°37′E], xii.1990–i.1991, L. Prendini and K.M.A. Prendini, in deep rock crevice. Paratypes: same data as holotype, 1♀ (AMNH); same data, except ''i.1996, L. Prendini and J. Laing'', 1 juv. ♂ (AMNH); same data, except ''iii.2003, I. Engelbrecht and B. Watkins, removed from rock crevices at night, located with UV detection'', 1♂ 4♀ 1 subad. ♂ 2 subad. ♀ (AMNH), 1 subad. ♀ (AMCC 139000).

DIAGNOSIS: *Hadogenes soutpansbergensis* is placed in the *bicolor* group on account of the shape of metasomal segment I, which is wider than it is high posteriorly. It appears to be more closely related to *H. newlandsi* than to the other three species in the *bicolor* group. Adult males of both species exhibit dense granulation on the telson and lateral surfaces of metasomal segment V. This character occurs in only a few other *Hadogenes* species (e.g., *H. granulatus* Purcell, 1901 and *H. minor* Purcell, 1899), and is potentially synapomorphic for *H. newlandsi*, *H. soutpansbergensis* and *H. granulatus*. *Hadogenes minor* does not appear to be closely related to these species and is presumed to have acquired this state independently.

Unlike the other the three species in the *bicolor* group, the pedipalp chela of *H. soutpansbergensis* and *H. newlandsi* lacks a pronounced lobe, distal to the notch in fixed finger, and the metasoma of the adult male is relatively longer (more than 55% of the total length). *Hadogenes soutpansbergensis* and *H. newlandsi* are further distinguished from *H. longimanus* and *H. polytrichobothrius* by the presence of only two trichobothria on the internal surface of the pedipalp chela. Both *H. longimanus* and *H. polytrichobothrius* ex-

hibit five or more internal trichobothria on the chela.

Hadogenes soutpansbergensis is distinguished from *H. newlandsi* by its longer metasoma in the adult male, longer, narrower, flatter pedipalps, and higher trichobothrial counts.

ETYMOLOGY: The species name refers to the Soutpansberg mountain range, where the species is probably endemic.

DESCRIPTION: Measurements and counts in the following description are recorded from 2♂ and 5♀ (table 4).

Color: Uniformly dark in color, with pedipalps, legs, sternites, and telson only slightly paler than the rest (figs. 24–27). Carapace, chelicerae, tergites, and metasoma, Sepia 219; pedipalps and legs (dorsal surface), Maroon 31; legs (ventral surface), pectines, genital operculum, sternites, and telson, Warm Sepia 221A.

Carapace: As for *H. polytrichobothrius*, except median notch in anterior margin weakly developed, and frontal lobes almost entirely granular (figs. 28, 29).

Chelicerae: As for *H. polytrichobothrius*.

Pedipalps: As for *H. polytrichobothrius*, but differing in the following respects. Femur width 35.5% (33–38%) of length (table 5). Patella ventroexternal carina granular to costate granular (fig. 37). Patella width 53.5% (51–56%) of length. Chela with weak, rounded lobe on movable finger and correspondingly shallow notch in fixed finger; fixed finger additionally with small, rounded lobe proximal to notch, but without pronounced, conical lobe distally (figs. 38, 39); dorsal and ventrointernal intercarinal surfaces finely granular, reticulate in ♂, becoming smooth, reticulate in ♀. Chela height 49.5% (47–52%) of width; chela width 51% (49–53%) of length along ventroexternal carina in ♂, and 57.5% (57–58%) in ♀; length movable finger 97% (95–99%) of length along ventroexternal carina.

Trichobothria: Neobothriotaxic major, type C (figs. 34–41; table 5), with the following segment totals: femur, 3 (1 *d*; 1 *i*; 1 *e*), patella, 80–106 (2 *d*; 1 *i*; 26–36 *v*; 51–67 *e*) and chela, 79–95 (69–85 manus; 10 fixed finger, including 2 *i*). Total number of trichobothria per pedipalp, 162–204. Only femoral trichobothria, trichobothria in the *d* and *i* series of the patella, and trichobothria in the *D, d, e* and *i* series of the chela are stable in number and distribution. External and ventral trichobothria of the chela and patella are numerically and distributionally too variable for diagnostic purposes.

Mesosoma: As for *H. polytrichobothrius*, except as follows. Post-tergites of ♂ covered with very fine and even granulation, imparting matt appearance to all surfaces, except median carina and submedian depressions, which are smooth; post-tergites of ♀ smooth and shiny, becoming finely granular laterally. Sternite VII length equal (100%) to width in ♂, 83% (76–90%) in ♀ (table 5; figs. 32, 33).

Pectines: As for *H. polytrichobothrius* (figs. 30, 31), except pectinal teeth (left/right): 20/20–21 (♂), 16–17/16–17 (♀).

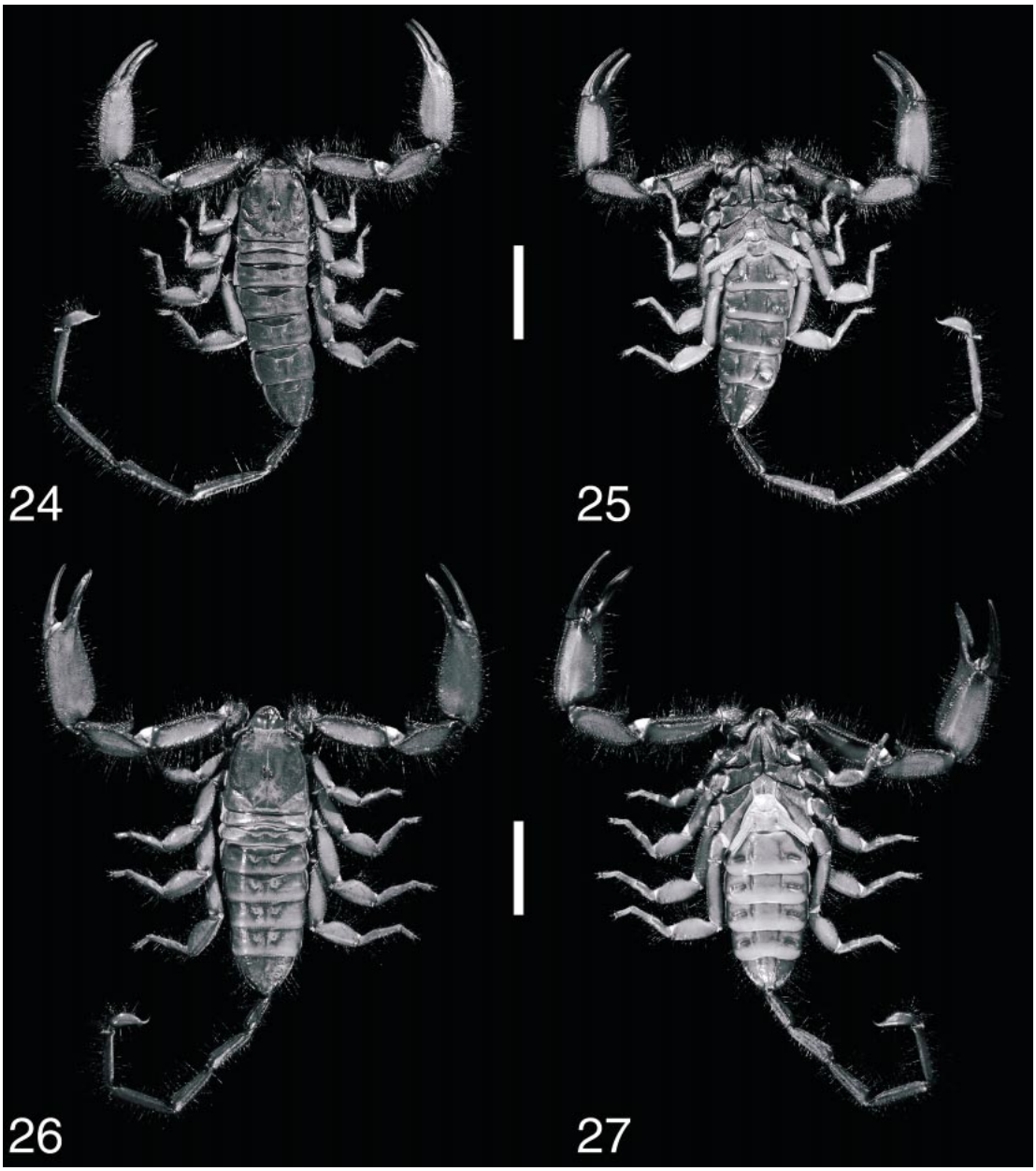
Sternum: As for *H. polytrichobothrius*.

Genital operculum: As for *H. polytrichobothrius*.

Legs: As for *H. polytrichobothrius*.

Metasoma and telson: As for *H. polytrichobothrius*, except as follows. Dorsosubmedian carinae costate to costate granular on segments II–V (♀), costate granular on segments II–IV, becoming granular on V (♂), II–IV each terminating distally with small spiniform granule. Metasomal segment V, lateral surfaces, and telson densely granular in ♂, smooth to sparsely granular in ♀ (figs. 42, 43).

In addition, metasomal segments of adult ♂ longer than in *H. polytrichobothrius*, with morphometric differences as follows. Metasomal segment I posterior height 92.5% (87–98%) of width (table 5). Metasomal segments I–V progressively increasing in length, and decreasing in width, segment V width 66% (56–76%) of segment I width. Metasoma slender, width percentage of length for segment I, 24.5% (23–26%) in ♂, 36.5% (34–39%) in ♀; for II, 12% (11–13%) in ♂, 21.5% (19–24%) in ♀; for III, 10.5% (10–11%) in ♂, 21% (18–24%) in ♀; for IV, 9% in ♂, 17% (15–19%) in ♀; and for V, 10% (9–11%) in ♂, 16.5% (15–18%) in ♀. Telson vesicle width 122% (111–133%) of metasomal segment V width; distinctly elongated in ♂, oval in ♀, with flattened dorsal surface and rounded ventral surface, height 34.5% (32–37%) of length. Aculeus short, 14.5% (10–19%) of vesicle length, and sharply



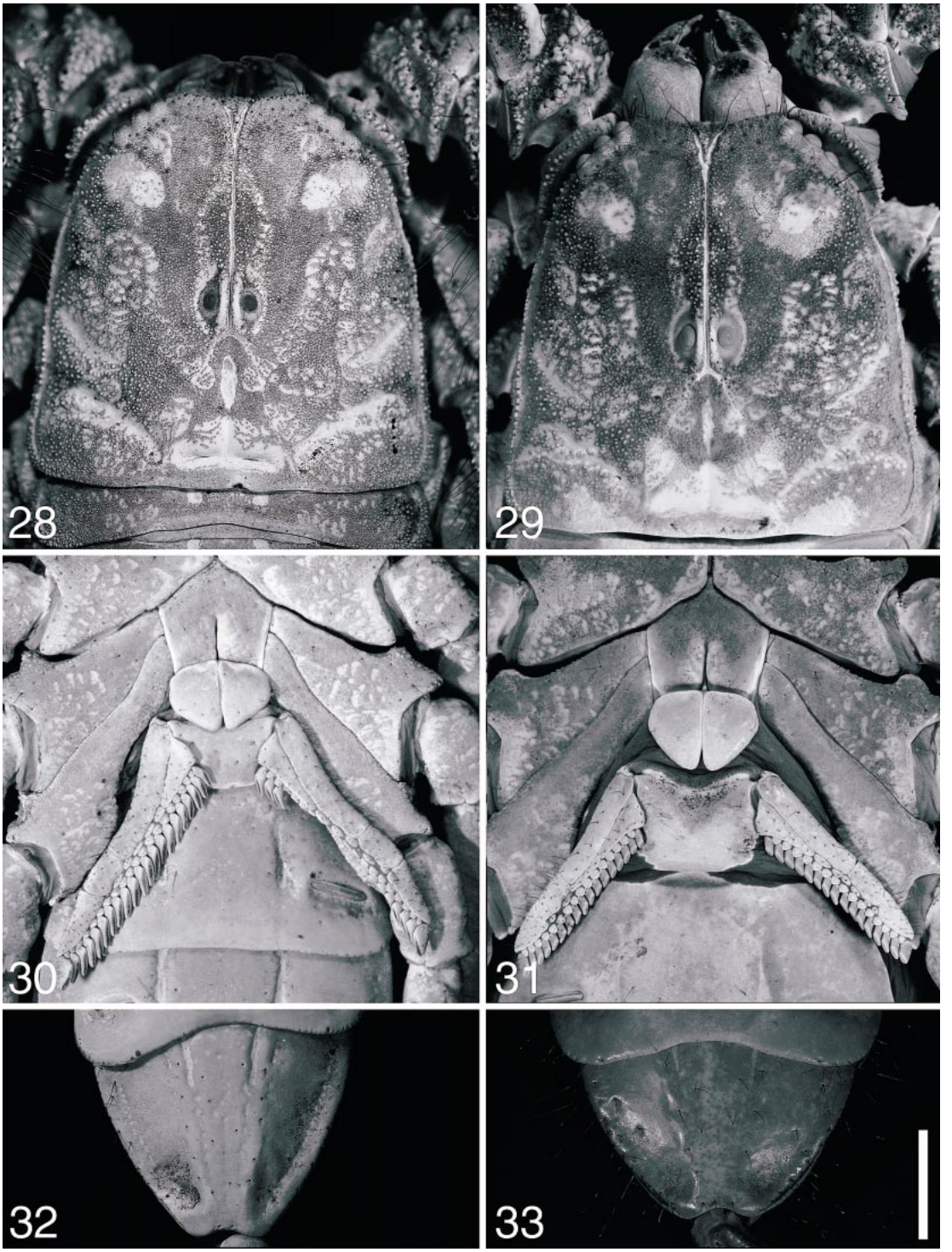
Figs. 24–27. *Hadogenes soutpansbergensis* n.sp., habitus of ♂ and ♀ paratypes (AMNH). **24.** Dorsal aspect, ♂. **25.** Ventral aspect, ♂. **26.** Dorsal aspect, ♀. **27.** Ventral aspect, ♀. Scale bars = 10 mm.

curved. Total length of metasoma 168.5% (148–190%) of combined length of prosoma and mesosoma in ♂, but approximately equal (97–104%) to combined length of prosoma and mesosoma in ♀.

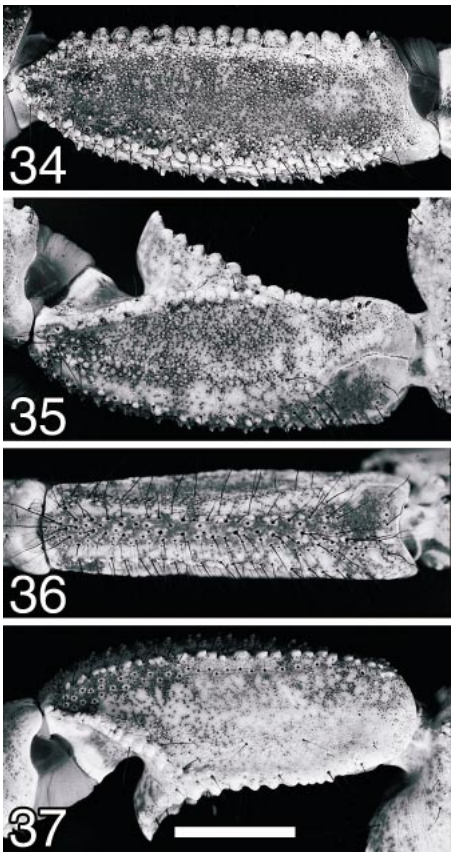
Hemispermatophore: Doubled hook near base of distal lamella; distal crest truncate (figs. 44, 45).

Geographic variation: No significant variation.

Ontogenetic variation: As for *H. polytrichobothrius*.



Figs. 28–33. *Hadogenes soutpansbergensis* n.sp., carapace, pectines, and sternites of ♂ and ♀ paratypes (AMNH). **28.** Carapace, ♂. **29.** Carapace, ♀. **30.** Pectines and basal piece, ♂. **31.** Pectines and basal piece, ♀. **32.** Sternite VII, ♂. **33.** Sternite VII, ♀. Scale bars = 5 mm.



Figs. 34–37. *Hadogenes soutpansbergensis* n.sp., carinae, trichobothria, and macrosetae on dextral pedipalpal segments of paratype ♀ (AMNH). **34.** Femur, dorsal aspect. **35.** Patella, dorsal aspect. **36.** Patella, external aspect. **37.** Patella, ventral aspect. Scale bar = 5 mm.

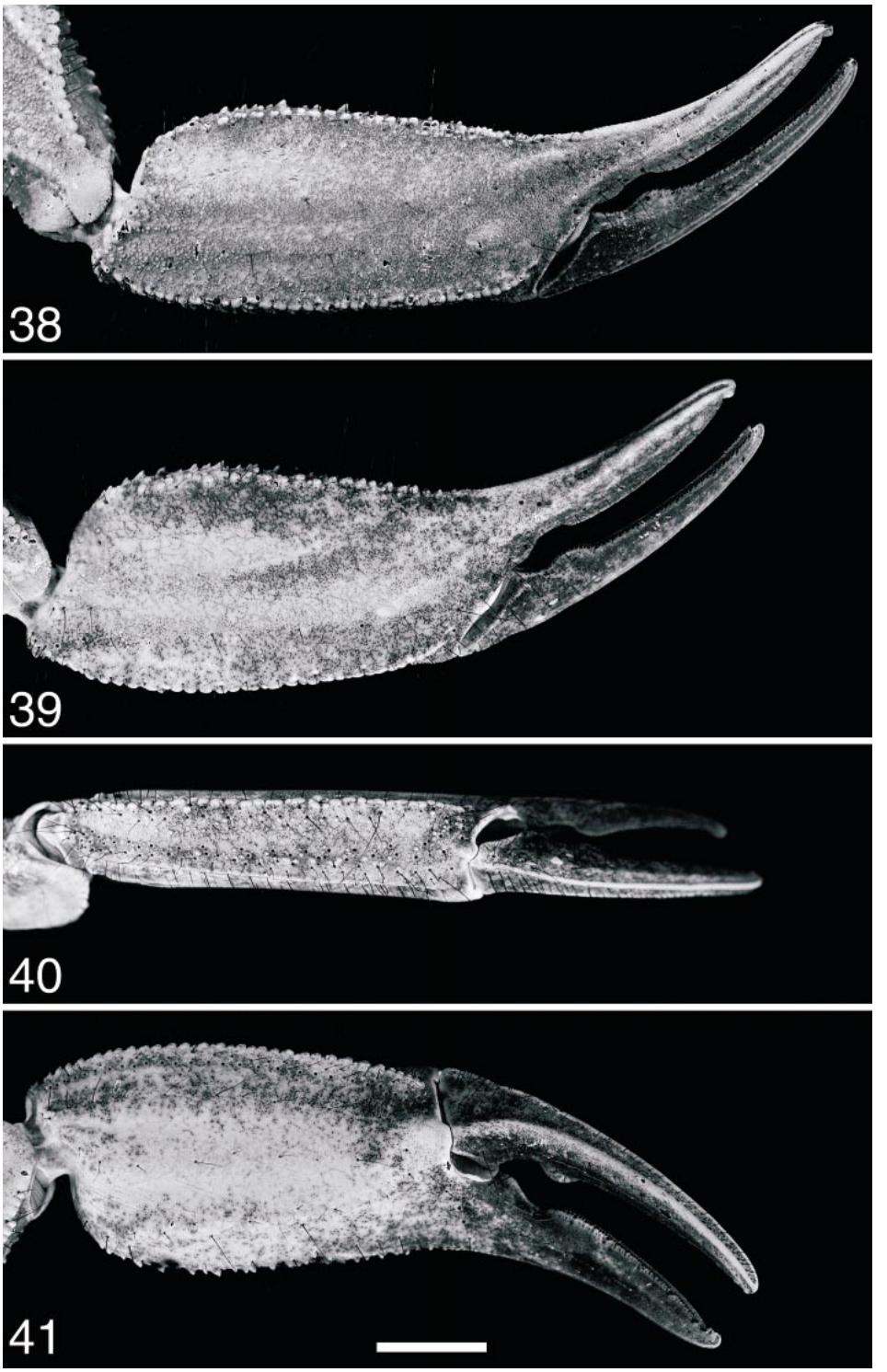
Sexual dimorphism: As for *H. polytrichobothrius*, except in this species no lobe is present distal to the notch in the fixed finger of the pedipalp chela, and the lobe on the movable finger and notch in the fixed finger are slightly less developed in the adult male and than in the adult female (figs. 38, 39). In addition, the pedipalp chelae are more granular in the adult male, and the metasoma is considerably more elongated, with segment V and telson granular (fig. 43).

DISTRIBUTION: *Hadogenes soutpansbergensis* is probably endemic to the Soutpansberg mountain range in the Soutpansberg District, Limpopo Province, South Africa (fig. 1). It is currently known only from a single locality, Vancoller's Pass, a deep gorge incised in the northern slopes of the Soutpansberg by the Sand River, a tributary of the Limpopo River. The species is expected to be more widespread in the Soutpansberg, however, particularly on the mesic southern slopes of the mountain range. The xeric northern slopes, which have been better surveyed for scorpions, are dominated by the larger *Hadogenes troglodytes* (Peters, 1861) and the two species are unlikely to occur in sympatry. The occurrence of *H. soutpansbergensis* at Vancoller's Pass is presumed to be an extension through the mountain range associated with the Sand River. *Uroplectes flavoviridis* Peters, 1861, otherwise observed only on the southern side of the Soutpansberg, is also found there.

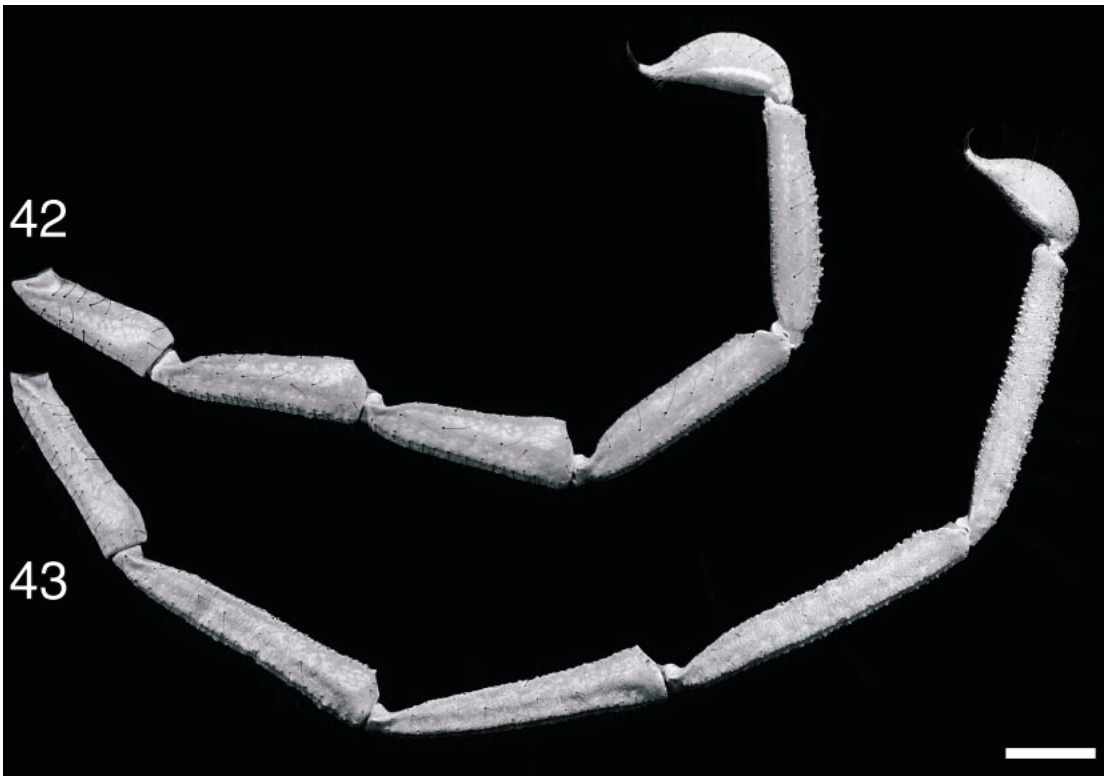
The only known locality record of *H. soutpansbergensis* occurs at an altitude between 700–800 m, in the Soutpansberg Arid Mountain Bushveld vegetation zone (Van Rooyen and Bredenkamp, 1998b) of the Savanna biome (Rutherford and Westfall, 1994; Low and Rebelo, 1998).

This species inhabits a moderately arid region, where annual rainfall varies from 300 mm on the hot, dry northern slopes of the Soutpansberg, to more than 500 mm on the higher plateaux. Most rainfall is received in the summer (December to May). Temperatures vary between 3°C and 44°C, with an average of 23°C (Van Rooyen and Bredenkamp, 1998b).

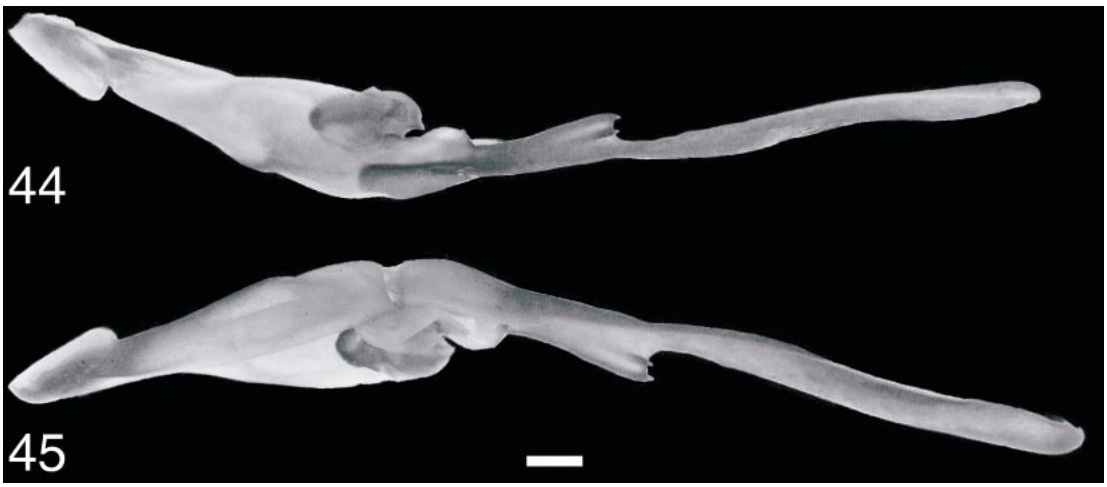
ECOLOGY: *Hadogenes soutpansbergensis* is an obligate lithophile (Prendini, 2001b). This species inhabits very deep cracks and crevices in weathered sandstone outcrops, often on sheer cliff faces. One specimen was collected about 2 m above ground level in a crack in a tree trunk (I. Engelbrecht, personal commun.). The distributional range of *H. soutpansbergensis* is allopatric with that of its closest relatives, *H. newlandsi*, which inhabits scattered inselbergs south of the Soutpansberg, and *H. bicolor*, which occurs along the Drakensberg escarpment, southeast of the Soutpansberg (Prendini, 2001a). *Hadogenes soutpansbergensis* has not been collected in sympatry with *H. troglodytes*, which is very common in drier habitats along the northern slopes of the Soutpansberg (e.g., at Farm



Figs. 38–41. *Hadogenes soutpansbergensis* n.sp., carinae, trichobothria, and macrosetae on dextral pedipalpal segments of holotype ♂ and paratype ♀ (AMNH). **38.** Chela, dorsal aspect, ♂. **39.** Chela, dorsal aspect, ♀. **40.** Chela, external aspect, ♀. **41.** Chela, ventrointernal aspect, ♀. Scale bar = 5 mm.



Figs. 42–43. *Hadogenes soutpansbergensis* n.sp., metasoma and telson of ♂ and ♀ paratypes (AMNH). **42.** Lateral aspect, ♀. **43.** Lateral aspect, ♂. Scale bar = 10 mm.



Figs. 44–45. *Hadogenes soutpansbergensis* n.sp., hemispermatophore of paratype ♂ (AMNH). **44.** Ectal aspect. **45.** Ental aspect. Scale bar = 1 mm.

Rochdale 700), and north of the mountain range.

At Vancoller's Pass, *H. soutpansbergensis* has been collected in sympatry with several other scorpion species: the buthids, *Hottentotta trilineatus* (Peters, 1861), *Parabuthus transvaalicus*, *Uroplectes planimanus* (Karsch, 1879), *U. flavoviridis*, and *U. vittatus* (Thorell, 1876); the liochelid, *Opisthacanthus asper* (Peters, 1861); and the scorpionid, *Opistophthalmus lawrencei* Newlands, 1969. *Uroplectes vittatus* and *O. asper* are strictly corticolous, whereas *H. trilineatus*, *U. planimanus*, and *O. lawrencei* prefer flatter rocky areas.

CONSERVATION STATUS: Unlike many other species of *Hadogenes*, *H. soutpansbergensis* does not appear to be threatened by habitat destruction. This species is presently known from only a single locality, but may be widespread on the southern slopes of the Soutpansberg, a region of low agricultural potential where there are several provincial and private nature reserves. The following protected areas should be surveyed for the presence of *H. soutpansbergensis*, which is suspected to occur there: Happy Rest Nature Reserve, Lesheba Wilderness Area, Medike Private Nature Reserve. Until more data become available on the distribution, ecology and abundance of *Hadogenes soutpansbergensis*, this species is assigned to the Data Deficient category of the IUCN Red List.

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