

**On *Hadogenes angolensis* Lourenço, 1999 syn. n. (Scorpiones, Liochelidae), with a redescription of *H. taeniurus* (Thorell, 1876)**

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**On *Hadogenes angolensis* Lourenço, 1999 syn. n. (Scorpiones, Liochelidae), with a redescription of *H. taeniurus* (Thorell, 1876).** - The flat rock scorpion, *Hadogenes taeniurus* (Thorell, 1876), is redescribed, based on an examination of approximately 250 specimens from Angola and Namibia. *Hadogenes angolensis* Lourenço, 1999 is demonstrated to be a junior synonym. The distribution of *H. taeniurus* is mapped, and notes on its ecology and conservation status are provided. The synonymy of *Hadogenes bifossulatus* Roewer, 1943 with *Hadogenes tityrus* (Simon, 1888), rather than with *H. taeniurus*, is confirmed.

**Keywords:** Scorpiones - Liochelidae - *Hadogenes taeniurus* - *Hadogenes tityrus* - synonymy - Angola - Namibia.

## INTRODUCTION

Flat rock scorpions of the genus *Hadogenes* Kraepelin, 1894 represent an intriguing group of mostly large, extremely dorsoventrally compressed scorpions, all described species of which 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 vice-like grip on rock surfaces (Newlands, 1972a, 1972b, 1978; Newlands & 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 separated through erosion (Newlands, 1972a; Prendini, 2001b). With few exceptions, the distributional ranges of *Hadogenes* species are allopatric or parapatric as a result (Newlands, 1980; Prendini, 1995, 2001a).

The taxonomy and phylogenetic position of *Hadogenes* have been the focus of several investigations in recent years (e.g., Newlands & Prendini, 1997; Lourenço, 1999; Prendini, 2000a, 2001a). The present contribution forms part of an ongoing revision of the taxonomy of the genus, and addresses the status of *Hadogenes taeniurus* (Thorell, 1876), a flat rock scorpion endemic to southern Angola and northern Namibia (Fig. 1).

*Hadogenes taeniurus* was first described under the name *Ischnurus hahni* Peters, 1862. However, this name was apparently forgotten after its description and not listed in any subsequent revisions or catalogs until its rediscovery by V. Fet. At the time of its rediscovery, the syntypes of *I. hahni* were examined (Prendini in Fet, 2000), determined to be conspecific with *H. taeniurus*, and synonymized accordingly. Although Peters' (1862) name is the senior synonym, it has not been used since its description, whereas *H. taeniurus* has been widely accepted (Fet, 2000).

After its description, *H. taeniurus* was synonymized, first with *Hadogenes trichiurus* (Gervais, 1843) by Kraepelin (1894) and then with *Hadogenes troglodytes* (Peters, 1861) by Kraepelin (1899), but its validity was upheld by all subsequent authors, including Kraepelin (1908, 1914). *Hadogenes taeniurus* remained poorly known – aside from a few citations, mostly providing new locality records or discussing its diagnostic characters (Purcell, 1901; Kraepelin, 1908, 1914; Hewitt, 1918; Lawrence, 1928, 1955, 1959, 1961; Newlands, 1972a; Lamoral & Reynders, 1975) – until its redescription by Lamoral (1979). Lamoral (1979) examined most of the specimens of *H. taeniurus* that were available at the time, described the trichobothria and hemispermatophore of the species for the first time, and restricted its known distribution to southern Angola and northern Namibia. Meanwhile, Newlands (1980), in an unpublished thesis, independently redescribed the species, mapped its known distribution in Angola and Namibia, and refined its diagnosis in a key to the species of *Hadogenes*. Newlands' (1980) redescription and distribution map of *H. taeniurus* were never published. However, Newlands & Cantrell (1985) published Newlands' (1980) key to the species of *Hadogenes*, as well as the chromosome number of *H. taeniurus*.

Several authors previously noted the occurrence of *H. taeniurus* in Angola (Lawrence, 1959; Newlands, 1972a, 1980; Lamoral & Reynders, 1975; Lamoral, 1979). Three of these authors cited the Angolan specimens they examined (Lawrence, 1959; Newlands, 1972a, 1980; Lamoral, 1979). Indeed, the occurrence of *H. taeniurus* in that country was not questioned until a recent paper, in which a new species, *Hadogenes angolensis* Lourenço, 1999, was described. Lourenço (1999) justified this putative new species largely on a mistaken impression that the Angolan records of *H. taeniurus*, attributed solely to Lawrence (1959), were based on misidentifications (implying that the Angolan specimens represented another species, for which the name *H. angolensis* was proposed). Lourenço (1999) neglected to mention that the type locality of *H. taeniurus* is unknown (and could, in fact, be in Angola) and failed to provide any consistent diagnostic differences by means of which this putative new species might be distinguished from *H. taeniurus*. During the present study, the type specimens of *H. angolensis* were compared and found to be conspecific with the type specimens of *H. taeniurus* and *I. hahni*, and also with 247 non-type specimens of *H. taeniurus* from Angola and Namibia, including all the material examined by Lawrence (1959), Newlands

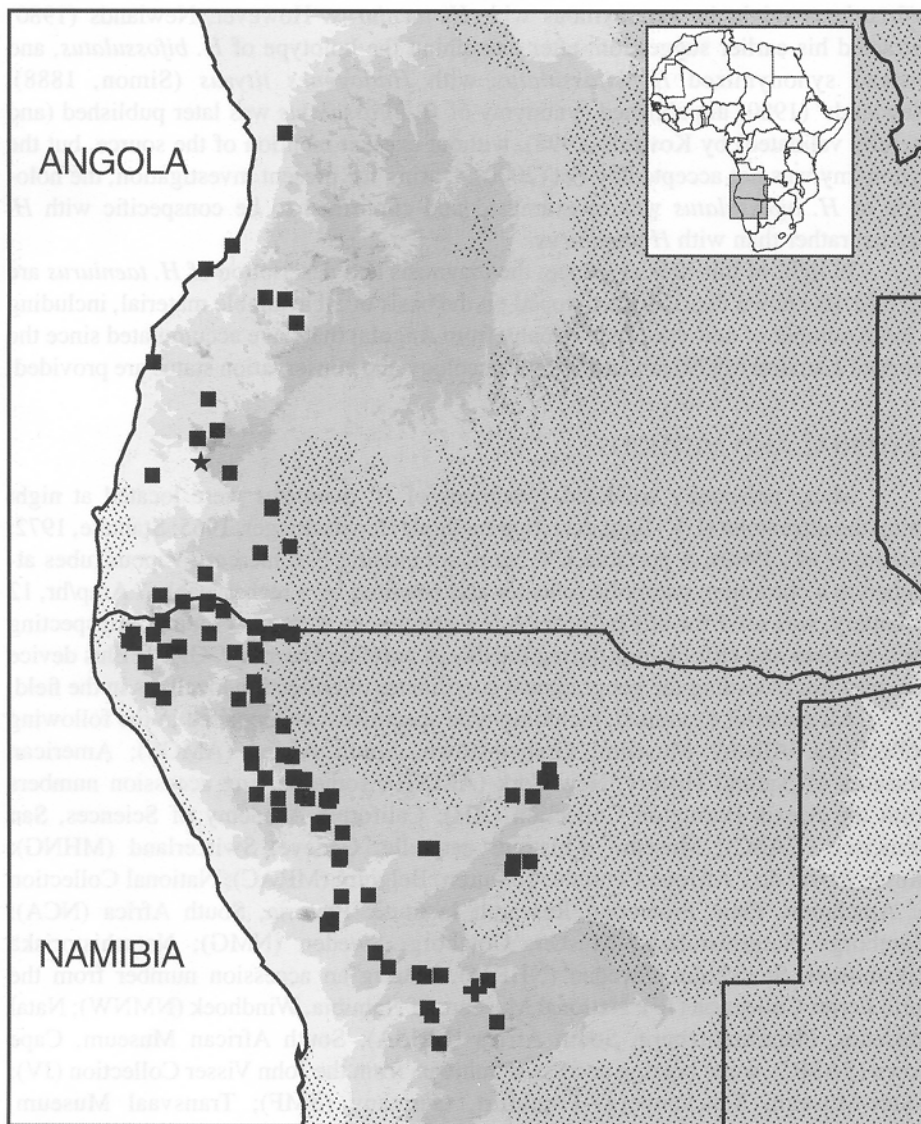


FIG. 1

Map showing the known distribution of *Hadogenes taeniurus* (Thorell, 1876) in Angola and Namibia (■), including the type localities for its synonyms: *Ischnurus hahni* Peters, 1862 (+) and *H. angolensis* Lourenço, 1999 (★).

(1972a, 1980) and Lamoral (1979). On the basis of this evidence, *H. angolensis* is here synonymized with *H. taeniurus*.

The status of *Hadogenes bifossulatus* Roewer, 1943, long regarded as a dubious species (Lawrence, 1955; Newlands, 1972a, 1980; Lamoral & Reynders, 1975; Lamoral, 1979; Fet, 2000) was also investigated. Newlands (1972a) suggested that *H.*

*bifossulatus* might be synonymous with *H. taeniurus*. However, Newlands (1980) retracted his earlier suggestion, after examining the holotype of *H. bifossulatus*, and instead synonymized *H. bifossulatus* with *Hadogenes tityrus* (Simon, 1888). Newlands' (1980) unpublished synonymy of *H. bifossulatus* was later published (and thereby validated) by Kovařík (1998), without explicit mention of the source, but the synonymy was not accepted by Fet (2000). During the present investigation, the holotype of *H. bifossulatus* was re-examined and confirmed to be conspecific with *H. tityrus*, rather than with *H. taeniurus*.

In light of this new evidence, the diagnosis and description of *H. taeniurus* are revised, its known distribution mapped on the basis of all available material, including a large number of new specimens (many from Angola) that have accumulated since the work of Lamoral (1979), and notes on its ecology and conservation status are provided.

#### MATERIAL AND METHODS

Many personally collected specimens of *H. taeniurus* were located at night using the ultraviolet (UV) light detection method (Honetschlager, 1965; Stahnke, 1972; Sissom *et al.*, 1990). A portable UV lamp, comprising two mercury-vapour tubes attached to a chromium parabolic reflector and powered by a rechargeable 7 Amp/hr, 12 V battery, was used for this purpose. A few specimens were also found by 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.

All material examined, including type specimens, 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 (CASC); Muséum d'histoire naturelle, Genève, Switzerland (MHNG); Musée Royal de l'Afrique Centrale, Tervuren, Belgium (MRAC); National Collection of Arachnida, Plant Protection Research Institute, Pretoria, South Africa (NCA); Göteborgs Naturhistoriska Museet, Göteborg, Sweden (NMG); Naturhistoriska Riksmuseet, Stockholm, Sweden (NHRM), bearing an accession number from the Julio Ferrer Collection (JF); National Museum of Namibia, Windhoek (NMNW); Natal Museum, Pietermaritzburg, South Africa (NMSA); South African Museum, Cape Town (SAMC), some bearing accession numbers from the John Visser Collection (JV); Natur-Museum Senckenberg, Frankfurt, Germany (SMF); Transvaal Museum, Pretoria, South Africa (TMSA); Zoologisches Museum, Humboldt-Universität, Berlin, Germany (ZMHB); Zoologiska Institutionen, Lunds Universitet, Sweden (ZMLU); Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Germany (ZMUH). Tissue samples of *H. taeniurus* have been stored (in the vapour phase of liquid nitrogen at -150°C) in the Ambrose Monell Collection for Molecular and Microbial Research (AMCC) at the AMNH.

Photographs were taken in visible light as well as under long wave UV light using a Microoptics™ ML-1000 digital photomicrography system. Measurements were taken using the ocular micrometer of a Nikon® SMZ-1500 stereomicroscope. Colour designation follows Smithe (1974, 1975, 1981), trichobothrial notation follows Vachon



(1974), sternum terminology follows Soleglad & Fet (2003). Morphological terminology and mensuration follows previous papers (e.g., Newlands & Prendini, 1997; Prendini, 2000a, 2001a).

A distribution map was produced using ArcView GIS Version 3.2 (Environmental Systems Research Institute, Redlands, California), by superimposing point locality records on coverages depicting the political boundaries, topography (500 m contour interval) and major sand systems in Angola and Namibia. 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>. The coverage of sand systems was created by clipping and merging relevant polygons extracted from a coverage of the geology of Africa provided by the Department of Marine Geoscience, University of Cape Town, South Africa, with polygons extracted from a coverage of Namibian landforms from the Namibian National Biodiversity Task Force (Barnard, 1998), downloaded from their website: <http://www.dea.met.gov.na/programmes/biodiversity/countrystudy.htm>.

In order to create a point locality geographical dataset for mapping the distributional range of *H. taeniurus*, all records of sufficient accuracy were isolated from the material examined. Only a small proportion of the records were accompanied by geographical coordinates or quarter-degree squares (QDS), usually entered by the collector or subsequently added by the curator or collections manager. These were checked for accuracy and an attempt was made to trace coordinates for as many of the remaining records as possible, by reference to gazetteers, the official 1:250 000, 1:500 000 and 1:1000 000 topo-cadastral maps of Namibia published by the Government Printer, and the GEOnet Names Server (GNS): [http://164.214.2.59/gns/html/cntry\\_files.html](http://164.214.2.59/gns/html/cntry_files.html). Names of provinces, regions and magisterial districts of countries listed in the material examined follow the most recent systems (post-1994).

Spatial analyses were conducted, using ArcView, in order to ascertain whether the distribution of *H. taeniurus* is related to present environmental variables, to determine the specific ecological correlates of its distributional range, and to calculate statistics that could be used to define its conservation status. Coverages representing the topography, mean annual rainfall, biomes (as defined by Irish, 1994), vegetation types and protected areas in Namibia were used for these analyses. The GTOPO30 raster grid coverage was used for spatial analysis of topography. Polygon coverages representing the mean annual rainfall and vegetation types (as defined by Giess, 1971) of Namibia, were obtained from the website of the Namibian National Biodiversity Task Force (Barnard, 1998).

The conservation status of *H. taeniurus* was assessed using a coverage of the protected area network in Namibia, also obtained from the Namibian National Biodiversity Task Force (Barnard, 1998). This was superimposed on the mapped distributional range of *H. taeniurus* to determine whether any point locality records fall within the boundaries of protected areas. Number of known locality records, extent of the distributional range, occurrence inside and outside of protected areas, and prevailing land uses that might be construed as threats to the future survival of the species were then used as criteria for assigning *H. taeniurus* to one of the IUCN Red List Categories (IUCN, 2001).

## SYSTEMATICS

*Hadogenes taeniurus* (Thorell, 1876)

*Ischnurus hahni* Peters, 1862: 27 (synonymized by Prendini in Fet, 2000: 389); Moritz & Fischer, 1980: 315.

*Ischnurus taeniurus* Thorell, 1876: 254-258.

*Hadogenes trichiurus*: Kraepelin, 1894: 115 (part).

*Hadogenes troglodytes*: Kraepelin, 1899: 145 (part).

*Hadogenes taeniurus*: Purcell, 1901: 206; Kraepelin, 1908: 267, 268 (part); Kraepelin, 1914: 117 (part); Hewitt, 1918: 163; Lawrence, 1928: 277, 278, tab.; Lawrence, 1955: 223, 252; Lawrence, 1959: 386; Lawrence, 1961: 154; Newlands, 1972a: 135 (part); Lamoral & Reynders, 1975: 540; Lamoral, 1979: 654-656, 657 (part), fig. 304, 305, 307-309; Newlands & Cantrell, 1985: 42, 44, tab. 2; Sissom, 1990: 125, fig. 3.24H; Kovařík, 1998: 133; Lourenço, 1999: 932, 934, 935, fig. 18, 21, 22; Fet, 2000: 389; Prendini, 2001a: 148, tab. 1; Prendini, 2001b: 137.

*Hadogenes* sp.?: Lawrence, 1927: 73.

*Hadogenes angolensis* Lourenço, 1999: 932-936, fig. 1-17, 19, 20, 23, 25, tab. I (syn. n.); Kovařík, 2001: 83; Prendini, 2001a: 148, tab. 1; Prendini, 2001b: 136.

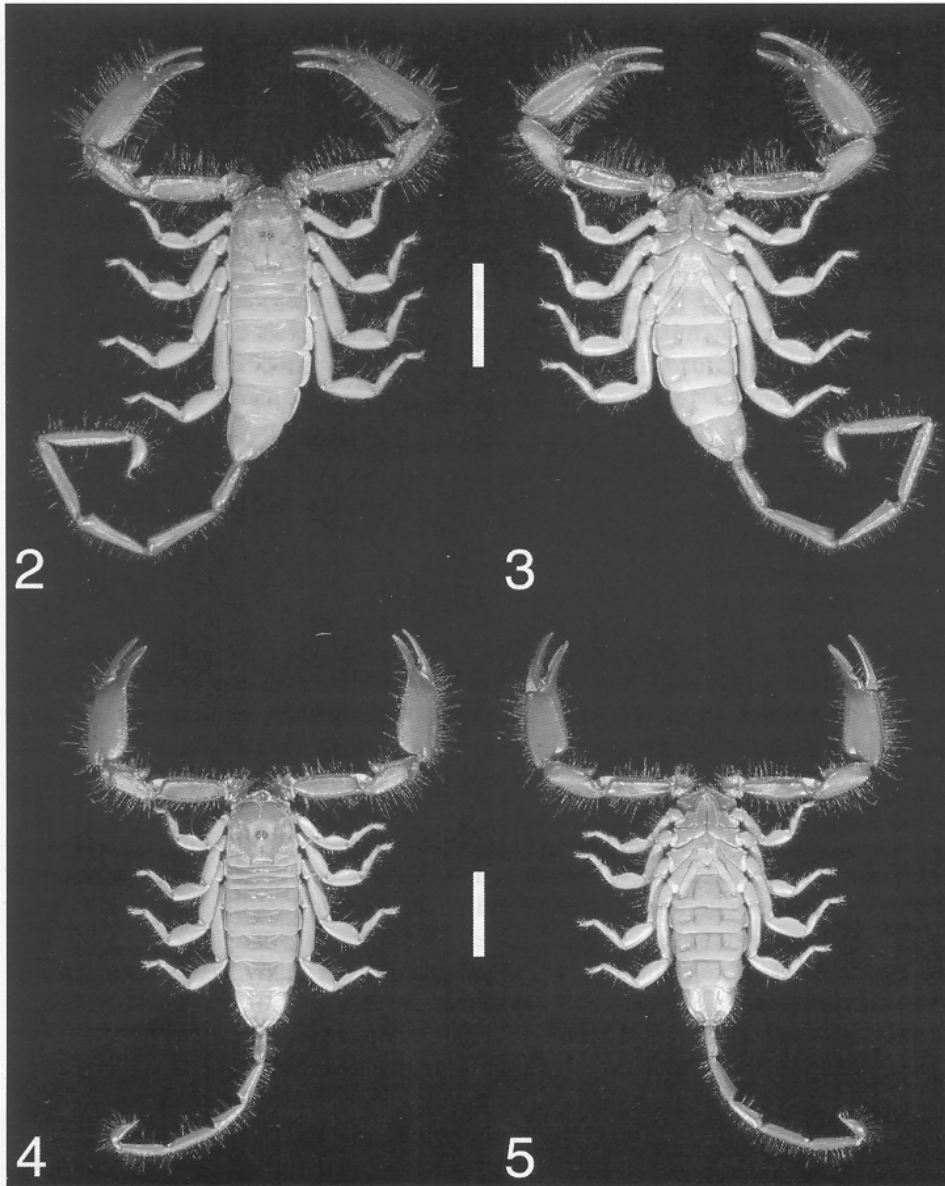
*Hadogenes taeniurus* (?): Lourenço, 1999: 937, fig. 25.

*Type material* (examined). *Ischnurus taeniurus*: holotype ♀ [two legs broken, opisthosoma damaged] (NMG 121 [type no. 90]), 'S. Africa' [probably northern NAMIBIA (Purcell, 1901; Hewitt, 1918)], 28.xi.1864, C.J. Andersson. *Ischnurus hahni*: 1 ♂, 1 ♀ syntypes (ZMHB 2317/18), Neu-Barmen [Gross Barmen, 22°06'S 16°45'E], Otjimbingue [21°21'S 16°08'E], South West Africa [NAMIBIA: Otjozondjupa Region: Okahandja District], Hahn. *Hadogenes angolensis*: holotype ♂ [hemispermaphore dissected], paratype ♀, 1 juv. ♂ paratype (MHNG), ANGOLA: Huíla District: Fazenda Bumbo, near Capangombe, 15°10'S 13°09'E, 21-26.vi.1954, W. Kisker & H. Barmann.

*Diagnosis.* *Hadogenes taeniurus* appears most closely related to *H. granulatus* Purcell, 1901 and *H. troglodytes*, based on their large size (113-160 mm in ♂, 108-154 mm in ♀) and similarity in habitus. All three species share the presence of posterolateral oval depressions in sternite VII (Figs 10, 11), although these are most pronounced in *H. taeniurus* (Lawrence, 1928; Newlands, 1972a, 1980; Lamoral, 1979). They also share the presence of granulation on the telson of the adult male, which is more pronounced in *H. granulatus* (Purcell, 1901; Newlands, 1980).

*Hadogenes troglodytes* differs from *H. granulatus* and *H. taeniurus* in the shape of metasomal segment I, which is higher than wide posteriorly, rather than wider than high posteriorly (Newlands, 1972a, 1980; Lamoral, 1979; Newlands & Cantrell, 1985). *Hadogenes granulatus* differs from *H. taeniurus* and *H. troglodytes* in two secondary sexual characters of the adult male. The lobe on the movable finger and corresponding notch in the fixed finger of the pedipalp chela are weakly developed to absent in *H. granulatus*, whereas the lobe and notch are more pronounced in *H. taeniurus* (Fig. 12) and *H. troglodytes*. The telson of *H. granulatus* is elongated and coarsely granular (Purcell, 1901; Newlands, 1980), compared with that of *H. taeniurus* and *H. troglodytes*, which is oval and finely granular (Fig. 21).

*Hadogenes taeniurus* is readily separated from *H. granulatus* and *H. troglodytes* by the presence of a deep oval depression in the basal piece, between the pectines (Figs 8, 9), which is absent in the other species. This character has not been noted previously. These species are further separated by the relatively shorter metasoma of the adult male *H. taeniurus* (usually 30-40% greater than the combined length of prosoma and mesosoma, compared with 50% and 45% greater in *H. granulatus* and *H. troglodytes*, respectively).



FIGS 2-5

*Hadogenes taeniurus* (Thorell, 1876), habitus of ♂ and ♀ (Farm Uisib 427 [AMNH]). 2. Dorsal aspect, ♂. 3. Ventral aspect, ♂. 4. Dorsal aspect, ♀. 5. Ventral aspect, ♀. Scale bars = 10 mm.

*Description.* The following description is based on the holotype ♀ of *I. taeniurus*, the ♂ and ♀ syntypes of *I. hahni*, the holotype ♂ and paratype ♀ of *H. angolensis*, and another ♂ specimen in the AMNH [AH 4132]. Colour is described from a ♂ and ♀ recently collected at Farm Uisib 427 (AMNH).

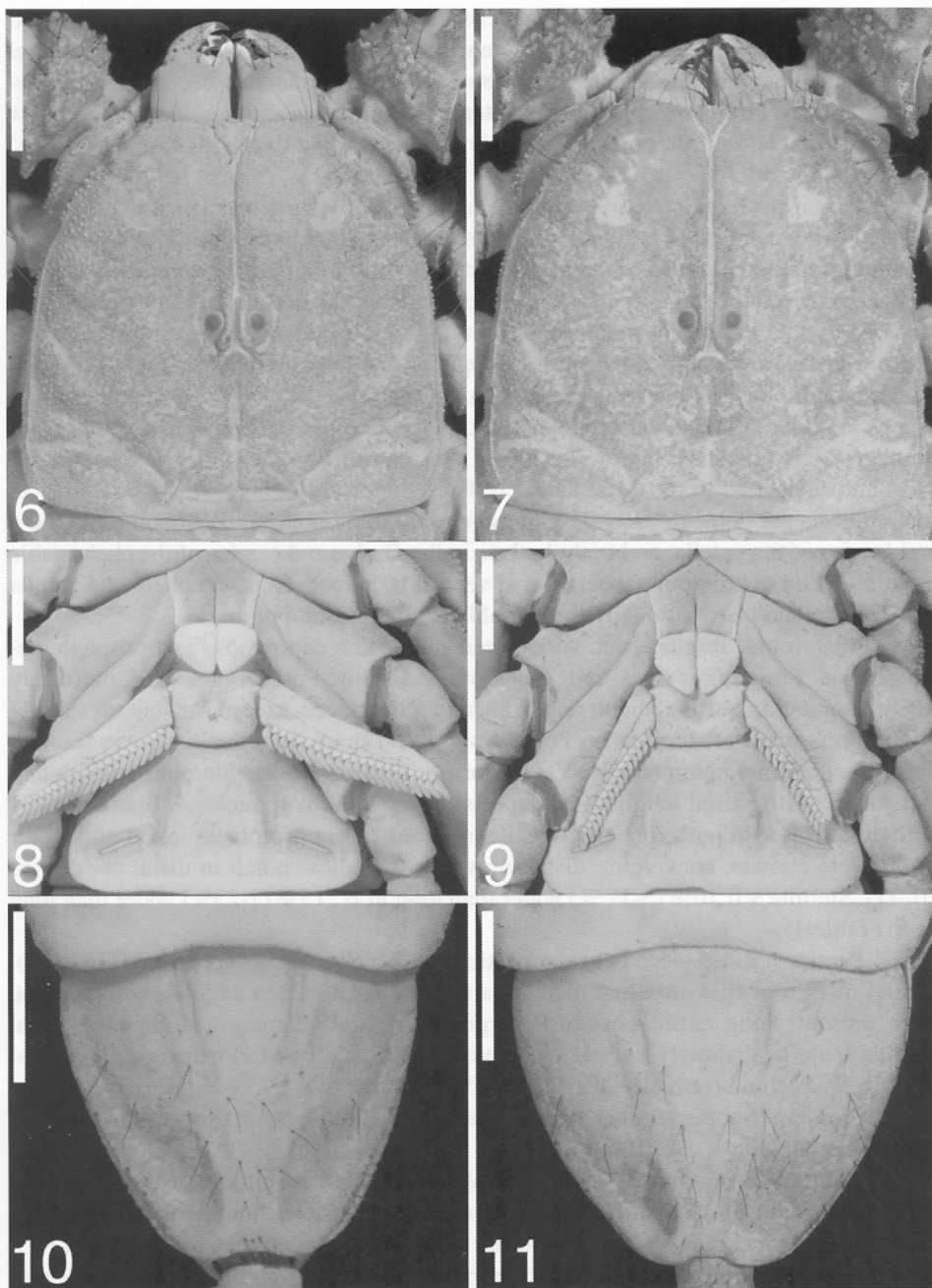
Colour. Pale legs and tergites contrasting with darker chelicerae, carapace, pedipalps, metasoma and telson (Figs 2-5). Posterior third of carapace, tergites, and sternites paler than anterior two-thirds of carapace, pedipalps, metasoma and telson. Telson often slightly paler than metasoma but darker than tergites. Chelicerae, pedipalp carinae, chela fingers, and ventral surfaces of leg femora sepia 119; carapace (anterior two-thirds), pedipalp chela manus, and intercarinal surfaces of patella and femur chestnut 32; carapace (posterior third), tergites and sternites olive-yellow 52; pectines and genital operculum straw yellow 36; legs (except ventral surfaces of femora) cinnamon 123A; metasomal segments I-V dusky brown 19; telson raw umber 123.

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 absent, triangular inset protruding slightly 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, but shallow. Paired median lateral and posterolateral sulci also distinct, shallow. Carapace almost entirely granular, except for surfaces behind lateral ocelli, and median lateral, posterolateral and posteromarginal sulci, which are smooth. Granulation almost uniformly fine, becoming coarse on antero-ocular and anterolateral surfaces.

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

Pedipalps. Chela pentacarinata, with three distinct carinae; dorsal secondary and digital carinae obsolete (Figs 12, 13); external secondary carina strongly developed, costate granular (Figs 13, 14); 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. 15); ventromedian carina obsolete, reduced to a vestigial granule proximally; ventrointernal carina also obsolete; internomedian and dorsointernal carinae weakly developed, each comprising a series of isolated spiniform granules; dorsomedian carina strongly developed, composed of a continuous row of spiniform granules; dorsal and ventrointernal intercarinal surfaces smooth, reticulate, becoming granulo-reticulate dorsally; dorsointernal intercarinal surfaces with scattered spiniform granules, becoming finely granular on internal surface of fixed finger; external intercarinal surfaces coarsely granular. Chela with a rounded lobe on movable finger and corresponding notch in fixed finger. Dentate margins of chela fingers with double row of denticles, fused at the lobe/notch. Chela width 49.5% (45-54%) greater than chela height; length along ventroexternal carina 46% (43-49%) greater than width in ♂, and 39.5% (32-47%) greater in ♀; length of movable finger 15.5% (10-21%) less than length along ventroexternal carina in ♂, and 10.5% (3-18%) less in ♀.

Patella with seven carinae, six of them distinct (Figs 16-18); dorsoexternal carina obsolete; dorsointernal and ventrointernal carinae costate to costate granular;



FIGS 6-11

*Hadogenes taeniurus* (Thorell, 1876), carapace, pectines and sternites of ♂ and ♀ (Farm Uisib 427 [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.



internomedian carina costate granular, composed of very large heavily sclerotized spiniform granules; externomedian and ventroexternal carinae granular; dorsoexternal and ventral intercarinal surfaces finely and uniformly granular, becoming granulo-reticulate on ventral surfaces; internal intercarinal surfaces smooth, except for a few scattered granules; anterior process strongly developed. Patella length 38.5% (32-46%) greater than width.

Femur pentacarinata, with four distinct carinae; ventroexternal carina obsolete, reduced to a weak row of scattered granules; dorsoexternal and externomedian carinae granular, dorsointernal and ventrointernal carinae costate granular, composed of very large heavily sclerotized granules (Fig. 19); dorsoexternal and ventral intercarinal surfaces finely and uniformly granular, becoming granulo-reticulate on ventral surfaces; internal intercarinal surfaces smooth, except for a few scattered spiniform granules. Femur length 62.5% (58-66%) greater than width (Table 1).

Trichobothria. Neobothriotaxia major, type C (Figs 12-19), with the following segment totals (Table 1): femur 3 (1 *d*; 1 *i*; 1 *e*), patella 86-127 (2 *d*; 1 *i*; 28-49 *v*; 55-75 *e*) and chela 90-126 (80-116 manus; 10 fixed finger, including 2 *i*). Total number of trichobothria per pedipalp, 179-256. 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 stable in number and distribution. External and ventral trichobothria of the chela and patella numerically and distributionally too variable for diagnostic purposes.

Mesosoma. Tergites each with paired submedian depressions and obsolete median carina. Pre-tergites of ♂ and ♀ smooth and shiny. Post-tergites of ♂ uniformly finely granular, imparting a matt appearance to all surfaces, except for smooth submedian depressions; post-tergites I-VI of ♀ smooth and shiny, but often with very fine and even granulation anteromedially, VII uniformly finely granular. Sternites smooth and shiny, each with paired longitudinal depressions internal to spiracles; VII additionally with a pair of deep posterolateral oval depressions (more prominent in ♂) and a pair of obsolete carinae, converging distally towards a shallow notch in distal apex (Figs 10, 11). Sternite VII 10% (3-17%) wider than long in ♂, 15% (7-23%) wider than long in ♀ (Table 1).

Pectines. Basal piece between pectines with a deep oval depression (Figs 8, 9). Mesial margin of first proximal median lamella of each pecten angular, with pectinal teeth present along entire posterior margin in ♂; mesial margin of first proximal median lamella shallowly curved, with proximal fifth of posterior margin devoid of teeth in ♀. Pectinal teeth: 18-24 (♂), 14-20 (♀).

Sternum. Subpentagonal, type 2. Median longitudinal furrow deep and narrow along entire length.

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 a 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 a basal row of ventromedian spinules. Telotarsal laterodistal lobes truncated; median dorsal lobes

extending to unguis. Telotarsal unguis short, distinctly curved, and equal in length. Retrolateral pedal spurs absent.

Metasoma and telson. Metasomal segment I 13.5% (2-25 %) wider than high posteriorly (Table 1). Metasomal segments I-V progressively increasing in length, and decreasing in width, with segment V 36.5% (27-46%) narrower than segment I in ♂, 40% (32-43%) narrower in ♀. Metasoma slender, width percentage of length for segment I, 34% (29-39%) in ♂, 45.5% (38-53%) in ♀; for II, 15% (12-18%) in ♂, 23.5% (22-25%) in ♀; for III, 17% (15-19%) in ♂, 25% (24-26%) in ♀; for IV, 12.5% (10-15 %) in ♂, 19.5% (14-22%) in ♀; and for V, 12.5% (11-14%) in ♂, 17.5% (16-19%) in ♀. Telson vesicle 16.5% (3-30%) wider than metasomal segment V in ♂, 15% (4-26%) wider in ♀; oval in shape, with flattened dorsal surface and rounded ventral surface (Figs 20, 21), height 36.5% (33-40%) of length. Aculeus short, 20% (14-26%) of vesicle length, and sharply curved. Total length of metasoma 45.5% (31-60%) greater than combined length of prosoma and mesosoma in ♂, but 5% (0-10%) less than combined length of prosoma and mesosoma in ♀.

Eight carinae on segment I, six carinae on segments II-IV, and five carinae on segment V. Dorsosubmedian carinae of segment I becoming obsolete posteriorly, 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 ventro-submedian carinae, fused into a single ventromedian carina on segment V. 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. Median lateral and dorsosubmedian carinae costate on segment I, dorsosubmedian carinae costate to costate granular (♀) or granular (♂) on segments II-V. Dorsosubmedian carinae of metasomal segments II, III and, to a lesser extent IV, each terminating posteriorly with a slightly enlarged, spiniform granule; dorsosubmedian carinae of other metasomal segments without spiniform granules posteriorly. Intercarinal surfaces smooth, except for lateral surfaces of segments II-V, finely granular in ♂. Telson smooth (♀), or finely granular (♂), and covered in long macrosetae.

Hemispermaphore. Double hook near the base of the distal lamella; distal crest truncate (Figs 22, 23).

Geographic variation. Specimens from higher elevations, which receive more rainfall, in the Khomas, Oshikoto and Otjozondjupa Regions of Namibia (e.g., Khomas Hochland, Otavi Highlands and Waterberg) are smaller and darker in colour, than specimens from lower elevations, which receive less rainfall, in Angola and the Erongo and Kunene Regions of Namibia (e.g., Damaraland and Kaokoveld).

Ontogenetic variation. The presence of a lobe on the movable finger of the pedipalp chela and a corresponding notch in the fixed finger (Figs 12, 13) are indicative of sexual maturity in most species of *Hadogenes* (Lawrence, 1966; Newlands & 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. taeniurus*, in which these characters are present in the 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

TABLE 1. Meristic data for adult ♂ and ♀ *Hadogenes taeniurus* (Thorell, 1876), including the holotype, the syntypes of *Ischnurus halmi* Peters, 1862, and the holotype and paratype of *Hadogenes angolensis* Lourenço, 1999. Measurements following Newlands & Prendini (1997) and Prendini (2001a). <sup>1</sup>Measured from base of condyle to tip of fixed finger. <sup>2</sup>Sum of metasomal segments I-V and telson. <sup>3</sup>Metasomal segment I missing. Consult 'Material Examined' for AMNH specimens from which meristic data were collected.

Specimen:	<i>H. angolensis</i>			<i>I. halmi</i>			<i>H. taeniurus</i>																
	♂	♀		♂	♀		♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♀	♀	
sex																							
collection number	MHING MHNG		ZMHB	ZMHB	ZMHB	ZMHB	TMSA	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	AMNH	NMG	TMSA	AMNH	AMNH	AMNH	AMNH	AMNH
type	holo	para		syn	syn	syn	9416	AH 4132									121	10424					
Carapace:	anterior width	9.62	10.98	8.57	10.91	8.57	9.53	9.82	9.26	9.96	8.51	10.75	8.71	10.45	11.75	11.08	10.45	11.75	11.08	10.14	10.14	8.92	8.92
	posterior width	16.04	17.53	15.79	19.51	15.79	16.41	16.80	14.58	16.39	14.82	17.14	15.50	17.91	20.14	19.12	16.43	20.14	19.12	16.43	16.43	14.43	14.43
	length	16.60	17.35	15.18	18.78	15.18	14.80	16.32	15.01	15.98	14.11	16.57	14.67	16.27	19.40	18.13	16.22	19.40	18.13	16.22	14.01	14.01	14.01
	maximum width	9.35	10.78	9.21	10.13	9.21	8.42	9.55	8.66	9.06	8.60	10.05	8.78	10.43	13.23	12.37	9.89	13.23	12.37	9.89	8.61	8.61	8.61
	maximum height	4.47	5.50	4.51	5.54	4.51	4.31	5.06	4.38	4.97	4.11	4.91	4.48	5.30	7.04	6.51	4.58	7.04	6.51	4.58	4.29	4.29	4.29
	length <sup>1</sup>	29.93	33.62	28.38	35.51	28.38	28.22	30.90	29.30	30.78	26.00	32.12	28.13	31.16	35.34	33.32	30.55	35.34	33.32	30.55	27.92	27.92	27.92
	length of ventroexternal carina	17.46	19.16	16.47	18.98	16.47	16.64	17.97	16.44	17.14	16.07	18.51	15.45	16.70	21.22	18.15	17.61	21.22	18.15	17.61	16.06	16.06	16.06
	length of movable finger	13.76	15.83	13.99	17.41	13.99	13.82	15.14	14.47	14.46	13.56	15.97	13.90	15.11	17.95	17.67	14.42	17.95	17.67	14.42	13.43	13.43	13.43
	<i>E</i> trichobothria						47/47	49/49	49/54	51/51	47/46	50/50	44/45	48/48	50/49	51/55	45/44	50/49	51/55	45/44	47/49	47/49	47/49
	(left/right)																						
	<i>V</i> trichobothria						48/48	44/50	47/44	49/49	49/46	48/48	38/35	48/52	51/49	45/48	42/40	51/49	45/48	42/40	45/40	45/40	45/40
	(left/right)																						
	maximum width	8.50	9.50	8.77	9.75	8.77	7.72	10.02	7.73	8.38	7.38	9.55	8.10	8.56	10.86	10.60	8.75	10.86	10.60	8.75	8.18	8.18	8.18
	maximum height	4.53	5.15	4.47	5.19	4.47	4.17	4.94	4.21	4.77	4.07	5.10	4.23	4.99	6.23	5.80	4.56	6.23	5.80	4.56	4.11	4.11	4.11
	length	14.71	15.69	14.27	15.76	14.27	12.99	14.65	13.82	14.07	13.70	15.93	13.26	14.42	17.36	15.98	15.26	17.36	15.98	15.26	13.25	13.25	13.25
	<i>e</i> trichobothria						59/55	68/65	68/72	62/66	57/60	71/75	58/58	61/56	64/70	73/69	65/64	64/70	73/69	65/64	62/58	62/58	62/58
	(left/right)																						
	<i>v</i> trichobothria						34/35	36/36	44/44	36/36	32/36	39/45	29/28	37/36	44/45	45/46	37/34	44/45	45/46	37/34	32/31	32/31	32/31
	(left/right)																						
	maximum width	5.73	6.25	5.65	6.33	5.65	5.75	6.24	5.83	5.96	5.25	6.37	5.82	6.50	7.40	7.22	6.06	7.40	7.22	6.06	5.34	5.34	5.34
	maximum height	3.74	4.26	3.75	4.33	3.75	3.34	3.99	3.57	3.80	3.47	4.09	3.82	4.66	5.17	4.67	3.79	5.17	4.67	3.79	3.41	3.41	3.41
	length	15.92	16.34	15.04	17.16	15.04	15.15	16.71	15.54	15.91	15.46	17.10	13.71	15.85	18.53	17.16	16.24	18.53	17.16	16.24	15.06	15.06	15.06

Pedipalp:	total length (incl. trochanter)	67.38	73.25	64.10	76.86	62.30	68.54	64.73	67.53	59.90	71.60	74.56	67.88	79.96	73.73	67.89	61.63
Mesosoma:	total length (tergites)	44.61	51.40	43.76	53.63	37.18	45.60	40.56	43.20	38.80	50.03	45.24	47.39	57.52	48.10	48.20	44.47
Sternite VII:	width	10.41	12.46	10.74	14.44	11.01	11.41	10.39	10.23	10.20	11.99	11.53	11.68	16.26	11.87	13.03	12.03
	length	9.13	11.63	10.40	11.84	9.09	11.06	9.51	10.01	9.27	11.36	9.93	10.29	12.81	9.53	10.33	9.31
Metasoma I:	maximum width	3.67	3.67	2.96	3.33	3	4.21	3.34	3.89	3.28	3.81	3.78	3.66	4.33	4.12	3.64	3.16
	maximum height	3.00	3.22	2.90	3.25	—	3.40	2.83	2.93	2.72	3.05	2.98	2.96	3.70	3.35	3.00	2.79
	length	9.65	8.69	10.24	8.75	—	10.97	10.29	11.21	11.04	11.67	9.69	8.10	10.02	7.79	7.56	6.55
Metasoma II:	maximum width	2.61	2.66	2.46	2.74	2.22	2.86	2.53	2.51	1.93	2.44	2.32	2.59	2.97	2.87	2.55	2.21
	maximum height	4.31	4.19	4.02	4.19	3.88	4.69	3.89	4.18	3.90	4.36	4.00	4.15	4.68	4.55	3.86	3.27
	length	15.05	11.29	14.51	12.46	14.31	15.78	13.80	15.90	15.90	17.06	14.72	10.96	13.50	11.62	10.01	9.53
Metasoma III:	maximum width	2.51	2.75	2.54	2.65	2.29	2.78	2.49	2.51	2.33	2.62	2.51	2.56	2.92	2.68	2.41	2.09
	maximum height	4.22	4.25	3.98	4.10	3.89	4.59	4.15	4.30	3.89	4.65	3.99	4.10	4.71	4.43	3.80	3.49
	length	13.93	10.85	13.58	10.02	13.40	15.03	12.78	14.71	14.67	17.11	14.04	10.05	11.96	10.93	9.81	8.75
Metasoma IV:	maximum width	2.41	2.31	2.02	2.47	1.75	2.36	1.96	2.30	1.73	2.19	2.26	2.42	2.66	1.82	2.31	2.11
	maximum height	3.78	3.30	3.15	3.35	3.13	3.89	3.45	3.41	3.23	3.25	3.21	3.31	3.22	3.58	3.11	2.67
	length	16.22	12.65	16.20	13.31	15.73	18.69	15.63	17.42	17.33	19.26	16.24	12.20	14.95	12.57	10.66	10.82
Metasoma V:	maximum width	2.27	2.46	2.15	2.24	2.05	2.45	2.07	2.20	1.87	2.07	2.07	2.19	2.59	2.34	2.14	1.93
	maximum height	3.47	3.30	3.05	3.46	3.35	4.02	3.07	3.14	3.04	3.31	3.15	3.27	3.71	3.60	3.12	2.97
	length	15.81	13.37	16.01	13.97	14.61	18.28	15.79	17.09	16.75	18.36	16.47	13.44	15.37	13.53	11.36	10.98
Telson:	maximum width	2.76	2.98	2.21	2.75	2.92	3.02	2.46	2.68	2.53	2.69	2.37	2.48	3.52	3.16	2.24	2.11
	maximum height	3.39	3.73	3.16	3.44	3.04	3.60	3.07	3.43	3.02	3.45	3.30	3.08	4.31	3.78	2.75	2.61
	aculeus length	2.01	2.10	1.96	1.8	1.41	2.45	1.60	1.79	1.44	1.62	1.37	2.13	1.52	1.76	1.45	1.50
	total length	9.32	10.23	8.41	9.68	8.14	9.36	8.40	9.27	8.97	9.79	8.31	8.14	10.81	9.53	8.28	7.42
Metasoma:	total length <sup>2</sup>	79.98	67.08	78.95	68.19	66.19	88.11	76.69	85.60	84.66	93.25	79.47	62.89	76.61	65.97	57.68	54.05
Total length:	prosoma+mesosoma	134.21	129.46	131.28	132.73	112.90	143.53	132.26	144.78	137.57	154.03	133.42	120.73	153.53	132.20	122.10	112.53
Pectines:	total length	10.38	7.76	9.69	8.62	12.38	10.89	9.92	10.47	9.27	11.32	9.42	7.94	10.75	8.89	7.17	7.43
	length along																
	dentate margin	8.89	5.89	8.23	6.29	11.33	9.32	9.52	9.34	8.71	10.31	7.89	6.20	7.85	7.59	6.32	6.14
	tooth count (left/right)	23/22	16/15	21/20	14/14	20/21	20/20	24/24	23/23	19/18	22/22	18/20	15/15	20/18	14/16	15/15	14/15

of fully developed paraxial organs in males 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 of the female, which opens in a single flap (Fig. 9), whereas in the male, the operculum consists of two unconnected sclerites that open independently and cover a pair of genital papillae (Fig. 8). Secondary sexual characters observed in adult males, compared with adult females and juveniles of both sexes, are as follows (Table 1): more slender pedipalp chela, with a less pronounced lobe on the movable finger and a less pronounced notch in the fixed finger (Fig. 12); more slender mesosoma (Fig. 2); metasoma elongated, longer than the combined length of the prosoma and mesosoma (Fig. 21); increased granulation of the carapace (Fig. 6), tergites and metasoma; granular telson; greater number of pectinal teeth (Fig. 8).

**Chromosome number.** Newlands & Cantrell (1985) recorded a chromosome number of  $2n = 100$ .

**Remarks.** Lourenço (1999: 932) prefaced his description of *H. angolensis* with a commentary on the known records of *Hadogenes* from Angola:

‘Sa présence en Angola est limitée à une seule citation de Lawrence (1959), qui signale *Hadogenes taeniurus* (Thorell) dans ce pays (Vila Arriaga près de Lungo: aujourd’hui Lubango, et Lucira). Newlands (1972), Lamoral (1979) et Lamoral & Reynders (1975) mentionnent à nouveau *Hadogenes taeniurus* pour la partie sud du pays, sans pour autant préciser avoir examiné le matériel en question.

La faune des scorpions d’Angola a été jusqu’à présent très peu connue. Les publications se limitent à celles de Monard (1929, 1937), suivies de Lawrence (1949, 1959, 1961) et Vachon (1950). Seul Lawrence (1959) mentionne le genre *Hadogenes*, mais il m’a été impossible de localiser le matériel en question.

L’étude de trois spécimens collectés dans la région du Plateau de l’Huila, près de Capangombe, permet la description d’une nouvelle espèce, qui présente des similitudes avec *H. taeniurus*. Ceci soulève la question d’une possible erreur d’identification de la part de Lawrence (1959), non vérifiée par Lamoral (1979).’

In this commentary, Lourenço (1999) claimed that Lawrence (1959) was solely responsible for the records of *H. taeniurus* from Angola, that the specimens on which these records were based, were not examined by subsequent authors (i.e., Newlands, 1972a; Lamoral & Reynders, 1975; Lamoral, 1979), and that Lawrence (1959) misidentified these specimens. The implication is that *H. taeniurus* does not occur in Angola and that these, as well as other Angolan *Hadogenes* specimens, represent another species, for which Lourenço (1999) devised the name *H. angolensis*.

Lourenço’s (1999) claims are false. Newlands (1972a, 1980) listed the specimens examined by Lawrence (1959), which reside in the TMSA, proving that Newlands examined them and concurred with Lawrence’s (1959) identification as *H. taeniurus*. The specimens referred to are: Lucira (TMSA 8941); Lungo near Vila



Arriaga (TMSA 8919-8921). Lamoral (1979) did not examine these particular specimens, but examined others from Angola, which he also identified as *H. taeniurus*. These are: Assuncas [Assunção] (TMSA 10240); Benguela (NMSA 10002); Oncocua (NMNW 1602 [old 165]). All three authors evidently examined *Hadogenes* specimens from Angola and considered these specimens to be conspecific with *H. taeniurus*. Meanwhile, Lourenço (1999) provided no reason as to why *H. taeniurus* should not occur in Angola, neglected to mention that the type locality of *H. taeniurus* is unknown and could, in fact, be in Angola – although, as noted by Purcell (1901) and Hewitt (1918), it is more likely to be in the Damaraland region of Namibia – and failed to provide any consistent diagnostic differences by means of which this putative new species might be distinguished from *H. taeniurus*.

According to the brief diagnosis, *H. angolensis* can be separated from *H. taeniurus* according to three differences (Lourenço, 1999): the ‘structure’ of sternite VII; the ‘structure’ of the hemispermatophore, particularly the distal lamella; the number of pectinal teeth (22/23 and 15/16 compared with 17/19 and 13/15 in the males and females of *H. angolensis* and *H. taeniurus*, respectively). The first two alleged differences could not be discerned from the illustrations accompanying Lourenço’s (1999) description. Lourenço’s (1999) figures 16 and 17, purportedly illustrating the structural difference in hemispermatophores, are not even directly comparable with his figure 18, reproduced from Lamoral (1979), and there is no obvious difference between them, besides a slight curvature in the distal lamella of the hemispermatophore of *H. angolensis*, which could be attributed to intraspecific variation or to an artifact of preservation. Lourenço’s (1999) figures 18 and 20 illustrate postero-lateral oval depressions in sternite VII of *H. angolensis*, a diagnostic character for *H. taeniurus* (Lawrence, 1928; Newlands, 1972a, 1980; Lamoral, 1979), as illustrated in Lourenço’s (1999) figures 21 and 22, also reproduced from Lamoral (1979). The third putative difference in pectinal tooth count, based on a sample size of two males and one female, must be dismissed on the grounds that pectinal tooth counts are known to vary considerably both among and within populations of *Hadogenes*, as in many other scorpions (Purcell, 1899; Hewitt, 1918; Lamoral, 1979; Prendini, 2001c), and the alleged differences fall well within the range for *H. taeniurus* based on data presented by Lawrence (1928: 278) and new a survey of 23 males and 38 females (Table 2).

No additional diagnostic differences were discerned in the present study, when the type specimens of *H. angolensis* were compared directly with those of *H. taeniurus* and *I. hahni* and also with 247 non-type specimens of *H. taeniurus* from Angola and

TABLE 2. Pectinal tooth counts in a sample of *Hadogenes taeniurus* (Thorell, 1876), including the holotype, the syntypes of *Ischnurus hahni* Peters, 1862, and the holotype and paratype of *Hadogenes angolensis* Lourenço, 1999.

	♂ (n = 23)		♀ (n = 38)	
	left	right	left	right
Range	18-24	18-24	14-20	14-20
Mean	21	20	16	16
Median	21	20	16	16
Mode	19	20	16	16

Namibia, including all the material examined by Lawrence (1959), Newlands (1972a, 1980), and Lamoral (1979). Instead, the type specimens of *H. angolensis* displayed the diagnostic characters of *H. taeniurus*, including the abovementioned depressions in the basal piece and sternite VII, metasomal segment I width greater than height, and the relatively short metasoma of the adult male (23% greater than the combined length of prosoma and mesosoma). On the basis of this evidence, *H. angolensis* is hereby synonymized with *H. taeniurus*.

**Distribution.** *Hadogenes taeniurus* is endemic to rocky and mountainous regions in southern Angola and northern Namibia. Its known distributional range is bordered approximately by the Huíla Plateau to the north, the western limit of the Kalahari sand system to the east, the Namibian Central Highlands to the south, and the Skeleton Coast, Engo-Kunene and Baía dos Tigres-Curoca sand systems to the west (Fig. 1). In Angola, the species has been recorded from the Benguela, Cuanza Sul, Cunene, Huíla and Namibé Districts. In Namibia, it has been recorded from the Erongo Region (Karibib and Omaruru Districts), Khomas Region (Windhoek District), Kunene Region (Khorixas, Opuwo and Outjo Districts), Oshikoto Region (Tsumeb District), and Otjozondjupa Region (Grootfontein, Okahandja and Otjiwarongo Districts). Although Newlands (1980) cited Uis [21°03'S 14°51'E] as the southernmost record, there are many records further south in the Erongo, Khomas and Otjozondjupa Regions, the southernmost being Farm Uitsig [on Uruganus 358, 22°49'S 16°17'E].

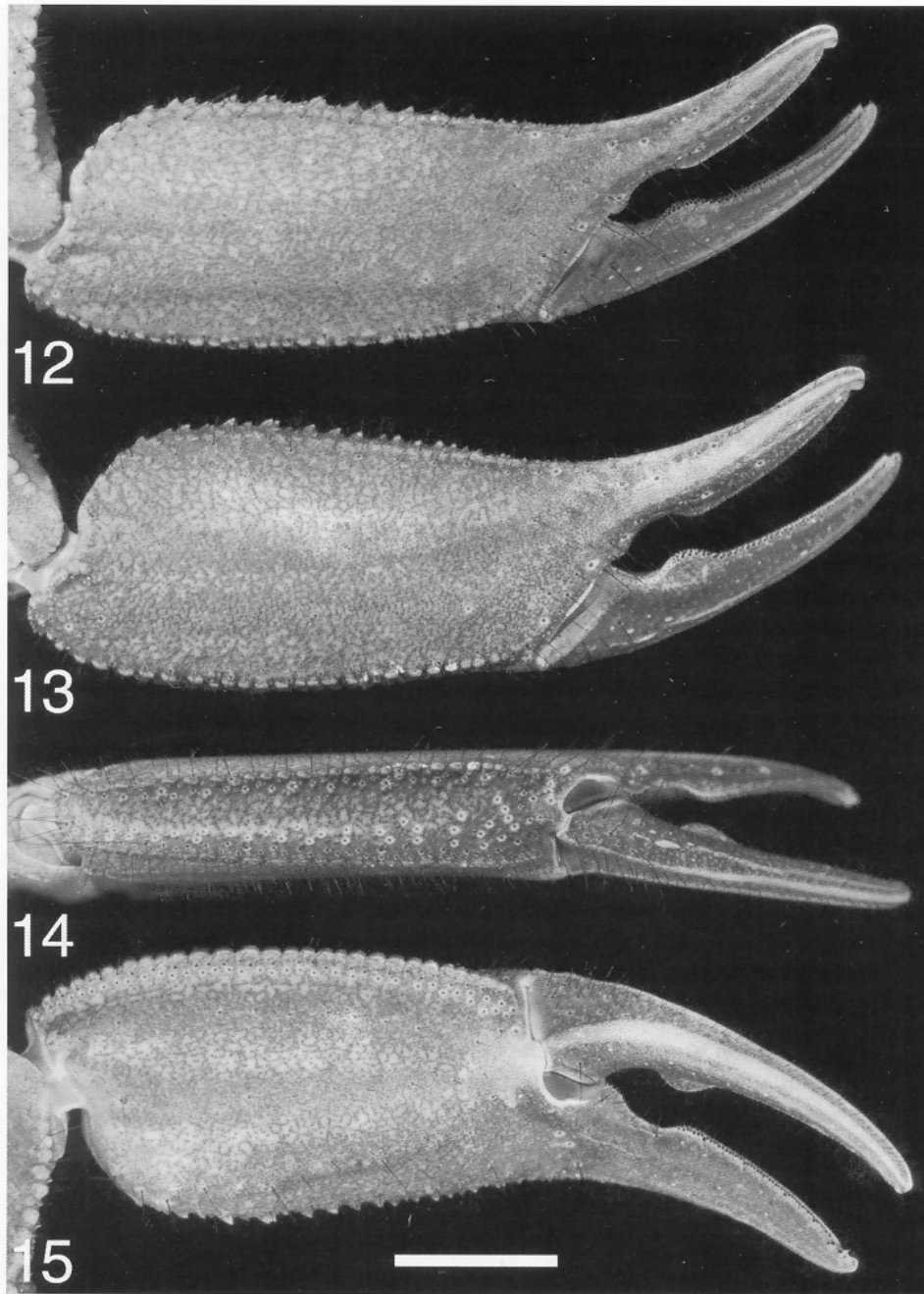
Kraepelin's (1908) records of *H. taeniurus* from Kanya [Kanye] (Southern District, Botswana), Steinkopf and Kamaggas [Komaggas] (Northern Cape Province, South Africa), later listed by Lamoral & Reynders (1975), are erroneous (Kraepelin, 1914; Newlands, 1980). Kraepelin (1908) misidentified the specimens in question and later suggested (Kraepelin, 1914) that the specimens from Kamaggas might represent a new species. These specimens were re-examined during the present investigation, and found to be conspecific with *Hadogenes gunningi* Purcell, 1899 (Kanye, ZMHB 15110) and *Hadogenes phyllodes* Thorell, 1876 (Steinkopf and Komaggas, ZMHB 15111-15113). Kraepelin's (1914) record from 'Ababis, Hereroland' [Farm Abbabis 3] (Hardap Region, Namibia) is also erroneous, although the specimen was examined at the ZMUH and confirmed to be conspecific with *H. taeniurus*.

According to Newlands (1980), records from Kub [Farm Kub 657] (Hardap Region, Namibia) (AMGS), listed in Newlands (1972a), but supplied by Lawrence (*in litt.*, 1969) were also based on misidentifications. This was also confirmed in the present study. The specimens in question (AMGS 8616, 8873, 8914) are conspecific with *Hadogenes zumpti* Newlands in Newlands & Cantrell, 1985.

Lamoral's (1979) records of *H. taeniurus* from the Hoanib River (NMNW 130), Portsmut (NMNW 222) and Gorob Mine (NMNW 517) are also based on misidentifications. These specimens are conspecific with *H. tityrus*.

The known locality records of *H. taeniurus* fall within the following range of altitudes (percentage of locality records indicated in parentheses): 300-600 m (5%), 600-900 m (27%), 900-1200 m (31%), 1200-1500 m (31%), 1500-1800 m (6%).

The distributional range falls mostly within the Savanna biome (Irish, 1994), where locality records occur in the Mopane Savanna (66%), Thornbush Savanna (9%),



FIGS 12-15. *Hadogenes taeniurus* (Thorell, 1876), carinae, trichobothria and macrosetae on the dextral pedipalpal segments of ♂ and ♀ (Farm Uisib 427 [AMNH]). 12. Chela, dorsal aspect, ♂. 13. Chela, dorsal aspect, ♀. 14. Chela, external aspect, ♀. 15. Chela, ventrointernal aspect, ♀. Scale bar = 5 mm.

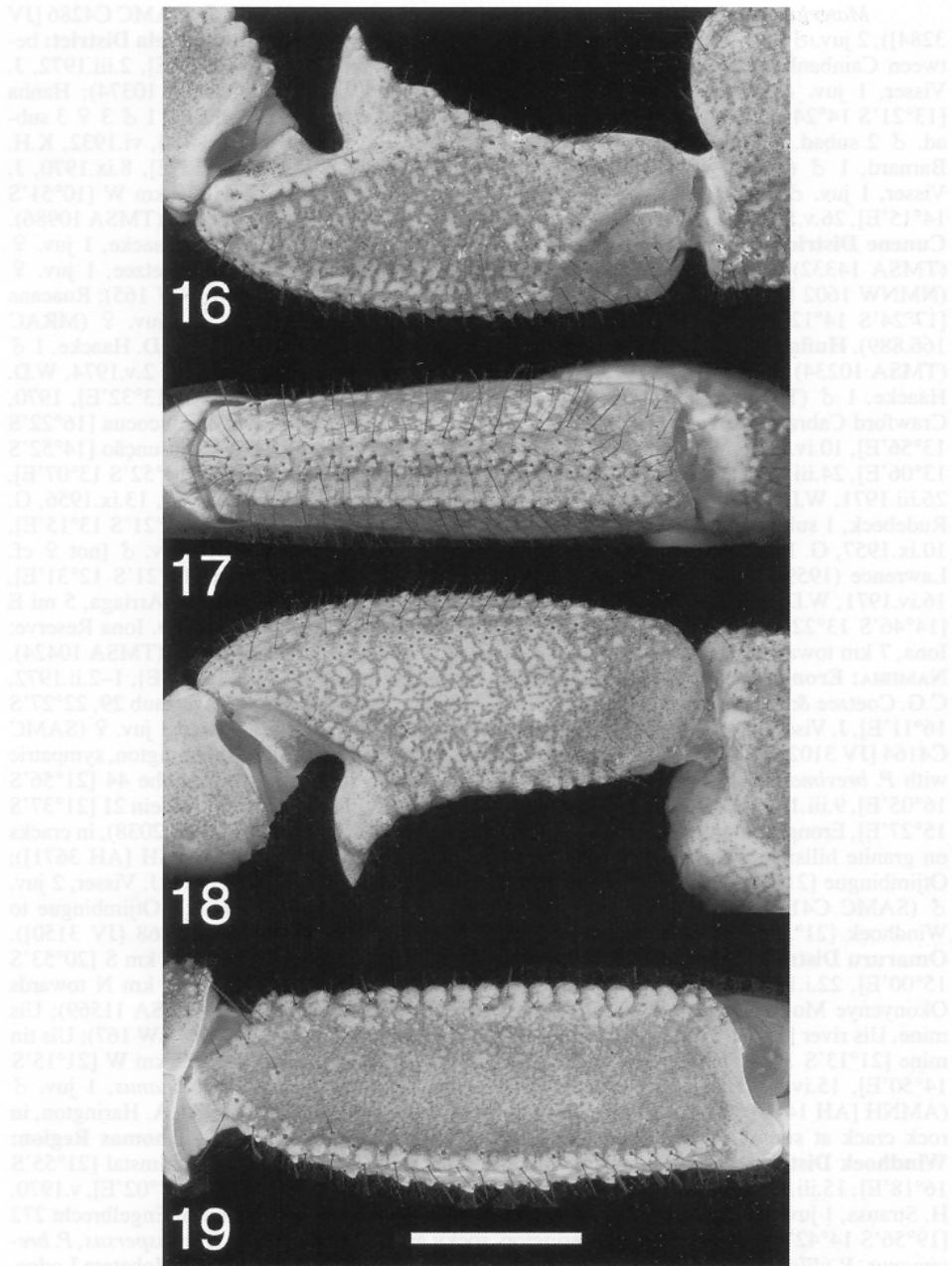
Mountain Savanna and Karstveld (7%), Forest Savanna and Woodland (3%), and Highland Savanna (3%) vegetation zones (Giess, 1971). However, a significant proportion of records fall within the Desert and Nama Karoo biomes (Irish, 1994), in the following vegetation zones (Giess, 1971): Semi-desert and Savanna Transition (10%), Northern Namib (2%).

This species inhabits a moderately to very arid region, receiving less than 650 mm annual rainfall, most of which falls in the summer (December to May). Known locality records fall within the following mean annual rainfall ranges: 0-50 mm (8%), 50-100 mm (4%), 100-150 mm (5%), 150-200 mm (13%), 200-250 mm (13%), 250-300 mm (21%), 300-350 mm (14%), 350-400 mm (13%), 400-450 mm (4%), 500-550 mm (3%), 550-600 mm (2%), 600-650 mm (2%).

*Ecology.* *Hadogenes taeniurus* is an obligate lithophile, which inhabits the narrow cracks, crevices and spaces beneath exfoliations of weathered granite rocks, but can also be found under large flat rocks resting on bedrock (Prendini, 2001b). The distributional range of *H. taeniurus* is allopatric with that of its closest relatives, *H. granulatus* and *H. troglodytes*, which occur on the eastern side of the Kalahari sand system in Botswana, Malawi, Mozambique, Zambia, Zimbabwe and South Africa, and parapatric with that of *H. tityrus*, which occurs in drier habitats further south and west in Namibia and South Africa (Prendini, 1995, 2001a). *Hadogenes taeniurus* has been collected in sympatry with *H. tityrus*, 5 km SE of Blue Drum, Kaokoveld (AMNH), but the two species were not syntopic. *Hadogenes taeniurus* inhabited large crevices in granite outcrops, whereas the much smaller *H. tityrus* inhabited narrow fissures in schist outcrops.

*Hadogenes taeniurus* has also been collected in sympatry with other scorpion species, including the bothriurids, *Lisposoma elegans* Lawrence, 1928 and *L. josehermana* Lamoral, 1979; the bothriids, *Hottentotta conspersus* (Thorell, 1876), *Parabuthus brevimanus* (Thorell, 1876), *P. granulatus* (Ehrenberg, 1831), *P. kraepelini* Werner, 1902, *P. villosus* (Peters, 1862), *Uroplectes otjimbinguensis* (Karsch, 1879), and *U. planimanus* (Karsch, 1879); the scorpionids, *Opisthophthalmus brevicauda* Lawrence, 1928, *O. carinatus* (Peters, 1861), *O. cavimanus* Lawrence, 1928, *O. chrysites* Lawrence, 1967, *O. lamorali* Prendini, 2000, *O. gibbericauda* Lamoral, 1979, and *O. wahlbergii* (Thorell, 1876).

*Conservation status.* *Hadogenes taeniurus* is largely unaffected by the dual threats of habitat destruction and collection for the exotic pet trade that threaten many other species of *Hadogenes* (Prendini, 2001a). This species is presently known from ca. 100 localities, falling within 80 QDS, in a region of low agricultural potential (Barnard, 1998) where, besides mining, which occurs at sporadic sites across its distributional range (e.g., Uis), there are few other threats to its survival. Furthermore, the species has been recorded from at least two protected areas (Iona Reserve in Angola; Waterberg Plateau Park in Namibia) and may occur in others. For example, records of *H. taeniurus* from localities close to the western boundary of Etosha National Park (e.g., Hobatere, Kowares), suggest that it probably occurs in rocky habitats in the south and west of the park. *Hadogenes taeniurus* is therefore assigned the Least Concern IUCN Red List Category.



Figs 16-19

*Hadogenes taeniurus* (Thorell, 1876), carinae, trichobothria and macrosetae on the dextral pedipalpal segments of ♀ (Farm Uisib 427 [AMNH]). 16. Patella, dorsal aspect. 17. Patella, external aspect. 18. Patella, ventral aspect. 19. Femur, dorsal aspect. Scale bar = 5 mm.



*Material examined* (type material, see above). No data: J. Visser, 1 ♀ (SAMC C4286 [JV 3284]), 2 juv. ♂ (SAMC C4264 [JV 3119], C4265 [JV 3120]). **ANGOLA: Benguela District:** between Cainbanbo [Caibambo, 13°01'S 14°00'E] and Cubal [13°02'S 14°15'E], 2.iii.1972, J. Visser, 1 juv. ♂ (TMSA 10373), 3.iii.1972, J. Visser, 1 subad. ♂ (TMSA 10374); Hanha [13°21'S 14°24'E], 13–18.v.1925, Lang & Boulton, Vernay Angola Expedition, 1 ♂ 3 ♀ 3 subad. ♂ 2 subad. ♀ 2 juv. ♂ (AMNH [27278]); Lobito Bay [12°20'S 13°34'E], vi.1932, K.H. Barnard, 1 ♂ (SAMC B7343); near Baia Farta, Benguela [12°36'S 13°13'E], 8.ix.1970, J. Visser, 1 juv. ♂ 1 juv. ♀ (NMSA 10002). **Cuanza Sul District:** Gabela, 25 km W [10°51'S 14°15'E], 26.v.1974, W.D. Haacke, 2 subad. ♀ (TMSA 10987, 10988), 1 juv. ♂ (TMSA 10986). **Cunene District:** Cahama, 2 mi NW [16°17'S 14°19'E], 22.iii.1971, W.D. Haacke, 1 juv. ♀ (TMSA 14332); Oncocua, 23 km W [16°39'S 13°13'E], 6.ix.1969, C.G. Coetzee, 1 juv. ♀ (NMNW 1602 [old 165]), 6–7.ix.1969, C.G. Coetzee, 1 ♂ 1 subad. ♂ (NMNW 165); Ruacana [17°24'S 14°12'E], 3.xii.1972, Crawford Cabral, 1 subad. ♂ 1 subad. ♀ 1 juv. ♀ (MRAC 166.889). **Huíla District:** Chibemba, 5 km S [15°46'S 14°45'E], 24.iii.1971, W.D. Haacke, 1 ♂ (TMSA 10234), 1 ♀ (TMSA 10235); Chibemba, 11 km S [15°47'S 14°45'E], 2.v.1974, W.D. Haacke, 1 ♂ (TMSA 10933), 1 juv. ♀ (TMSA 10934); Hungueria [15°19'S 13°32'E], 1970, Crawford Cabral, 1 juv. ♂ (MRAC 207.424); Otchinjau, 15 km W towards Oncocua [16°22'S 13°56'E], 10.iv.1971, W.D. Haacke, 1 ♀ (TMSA 10425). **Namibé District:** Assunção [14°52'S 13°06'E], 24.iii.1971, W.D. Haacke, 1 ♀ (TMSA 10236); Assunção, 5 km E [14°52'S 13°07'E], 26.iii.1971, W.D. Haacke, 1 juv. ♀ (TMSA 10240); Lucira [13°52'S 12°32'E], 13.ix.1956, G. Rudebeck, 1 subad. ♀ (TMSA 8941 [ex NMSA]); Lungo near Vila Arriaga [14°21'S 13°15'E], 10.ix.1957, G. Rudebeck, 1 ♀ (TMSA 8919), 1 subad. ♀ (TMSA 8921), 1 juv. ♂ [not ♀ cf. Lawrence (1959: 386)] (TMSA 8920); Saiona River, 25 km NW Cainde [15°21'S 12°31'E], 16.iv.1971, W.D. Haacke, 1 ♀ (TMSA 10422), 1 juv. ♀ (TMSA 10423); Vila Arriaga, 5 mi E [14°46'S 13°22'E], 21.v.1958, E.S. Ross & R.E. Leech, 1000 m, 1 ♀ (CASC). Iona Reserve: Iona, 7 km towards Oncocua [16°56'S 12°37'E], 8.iv.1971, W.D. Haacke, 1 ♀ (TMSA 10424). **NAMIBIA: Erongo Region: Karibib District:** Farm Ameib 60 [21°49'S 15°37'E], 1–2.ii.1972, C.G. Coetzee & M.-L. Penrith, 2 juv. ♀ (NMNW 333); Dawisaub [Farm Davetsaub 29, 22°27'S 16°11'E], J. Visser, 1 juv. ♂ (SAMC C4179 [JV 3169]), 1–16.iv.1984, J. Visser, 1 juv. ♀ (SAMC C4164 [JV 3102]); Farm Dobbelsberg 99 [21°53'S 16°01'E], 13.i.1981, A. Harington, sympatric with *P. brevimanus*, 1 juv. ♂ (AMNH [AH 1792]); Farm Johann Albrechtshöhe 44 [21°56'S 16°05'E], 9.iii.1970, H. Mittendorf, 1 juv. ♂ (NMNW 160); Farm Springbokfontein 21 [21°37'S 15°27'E], Erongo Mountains, 25.xii.1988, A. Harington, 1 ♀ 2 juv. ♀ (NMNW 2038), in cracks on granite hillside, sympatric with *P. kraepelini* and *O. carinatus*, 1 ♀ (AMNH [AH 3671]); Otjimbingue [21°21'S 16°08'E], Wilhelmstal [21°55'S 16°18'E], 1–16.iv.1984, J. Visser, 2 juv. ♂ (SAMC C4170 [JV 3147], C4187 [JV 3148]), 1 juv. ♀ (SAMC C4171); Otjimbingue to Windhoek [21°55'S 16°18'E], 1–16.iv.1984, J. Visser, 1 juv. ♀ (SAMC C4268 [JV 3150]). **Omaruru District:** 'Damaraland', ix.1911, 1 subad. ♂ (ZMUH); Khorixas, 84 km S [20°53'S 15°00'E], 22.i.1986, J. Visser, 1 ♂ (SAMC C4215 [JV 4155]); Ozondati, 16 km N towards Okonyenye Mountains [20°52'S 15°21'E], 1.iv.1979, W.D. Haacke, 1 ♀ (TMSA 11569); Uis mine, Uis river [21°11'S 14°52'E], 12.ix.1962, B. Grobbelaar, 1 subad. ♂ (NMNW 167); Uis tin mine [21°13'S 14°51'E], Uis, 30.iii.1969, J.J. Nel, 1 ♂ (TMSA 9416); Uis, 5 km W [21°15'S 14°50'E], 15.iv.1980, A. Harington, in rock cracks, syntopic with *U. planimanus*, 1 juv. ♂ (AMNH [AH 1416]); Uis, at Kamanjab turnoff [21°14'S 14°51'E], 18.iv.1980, A. Harington, in rock crack at summit of extremely rocky hill, 1 ♀ (AMNH [AH 1356]). **Khomas Region: Windhoek District:** Farm Uitsig [on Uruganus 358, 22°49'S 16°17'E], Wilhelmstal [21°55'S 16°18'E], 15.iii.1963, C. de Wet, 1 ♂ (NMNW 61); Goreangab Dam [22°32'S 17°02'E], v.1970, H. Strauss, 1 juv. ♀ (NMNW 252). **Kunene Region: Khorixas District:** Farm Engelbrecht 272 [19°56'S 14°42'E], 14.xii.1988, A. Harington, rocky area, sympatric with *H. conspersus*, *P. brevimanus*, *P. villosus*, *O. carinatus* and *O. wahlbergii*, 1 ♂ (AMNH [AH 4132]); Hobatere Lodge, Farm Marenphil 641, 19°19.89'S 14°22.45'E, 20.i.1998, L. Prendini & E. Scott, 1050 m, granitic hills near camp, in crevices of rock outcrops at night, syntopic with *L. elegans*, *P. kraepelini*, *P. villosus*, *O. carinatus*, and *O. gibbericauda*, 3 ♀ (AMNH); Hobatere Lodge [19°19'S 14°22'E], 10.viii.1990, S. Braine, 1 ♀ (NMNW 1475), 11.x.1993, B. Brell, 1 juv. ♂ (NMNW 2037), iii.1997, S. Braine, 1 ♂ (NMNW 2046), 2000, S. Braine, 1 ♂ (NMNW 2048); Hobatere [19°15'S 14°23'E], 12.x.1993, M. Griffin & M.A. de Kock, 1 subad. ♂ (NMNW 1556);

Kamanjab, 68 km W [19°49'S 14°11'E], J. Visser, 1 juv. ♀ (SAMC C4208 [JV 4019]); Khorixas, 2 km E [20°22'S 14°59'E], 19.iv.1980, A. Harington, sympatric with *O. wahlbergii*, 1 subad. ♀ (AMNH [AH 1399]); Khorixas, 5 km S [20°24'S 14°58'E], 13.xii.1988, A. Harington, sympatric with *H. conspersus*, *P. brevimanus*, *P. granulatus*, *P. kraepelini*, *O. carinatus* and *O. wahlbergii*, 1 ♂ (AMNH [AH 4066]); Makukous Spring, 6 km N [19°33'S 13°53'E], 27.iv.1976, W.D. Haacke, 1 juv. ♂ (TMSA 11226); Onguati, 44.3 km N [19°34'S 14°29'E], 18.vi.1993, A. Bauer, 1 ♀ (NMNW 1529); Welwitschia (Khorixas) [20°22'S 14°58'E], i.1963, F. Gaerdes, 1 juv. ♂ (NMSA 9049). **Opuwo District:** Anabib (Orupembe), about 100 mi W Ohopoho (Opuwo) [18°11'S 12°31'E], 6.vi.1951, P. & G. Brinck, G. & I. Rudebeck, on dry hillside, 1 juv. ♂ [not ♀ cf. Lawrence (1955: 223)] (ZMLU L51/4285); base of Vanzyl's Pass, 17°39.827'S 12°40.852'E, 11.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N. Martins, 635 m, UV detection, in crevices in schist slope in arid savanna, syntopic with *H. conspersus*, *U. otjimbinguensis*, *U. planimanus* and *O. brevicauda*, 1 ♀ (AMNH); Beesvlakte [19°02'S 14°14'E], 15.vi.1992, M. Griffin & M.A. de Kock, 1 ♂ 1 juv. ♀ (NMNW 2036); Blue Drum, 5 km SE on S bank of Ondondujengo River, 17°48.894'S 12°25.626'E, 15.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N. Martins, 841 m, UV detection, in crevices in granite outcrops near riverbed, arid savanna, syntopic with *H. conspersus*, *P. brevimanus*, *P. granulatus*, *P. villosus*, *U. otjimbinguensis*, *U. planimanus*, *O. brevicauda*, *O. cavimanus* and *O. chrysites*, *H. tityrus* collected on same slopes from crevices in schist, 1 ♂ [measured] 1 ♀ (AMNH), 1 subad. ♂ 1 subad. ♀ (NMNW 2665), 1 subad. ♂ (AMCC 126098); Caimaais [19°20'S 14°00'E], i-iv.1926, S.A. Museum expedition, 1 juv. ♂ 1 juv. ♀ [rehydrated] (SAMC B6071); Epupu falls on Kunene River [17°01'S 13°15'E], 26.iv.1970, W.D. Haacke, 1 subad. ♀ (TMSA 9799); Epupa falls, Kunene River, 8 km SE [17°03'S 13°14'E], 25.iv.1970, W.D. Haacke, 1 juv. ♂ (TMSA 9798); Farm Kowares 276 [19°03'S 14°21'E], i-iv.1926, S.A. Museum expedition, 1 ♀ [rehydrated] (SAMC B6967), 1 juv. ♂ [rehydrated] (SAMC B6974); Hartmann Valley, S of Angola border [17°34'S 12°17'E], iii.1995, C.R. Owen, 2 ♀ (NHRM [JF 80]); Hartmann's Valley, ca. 39 km N of Orange Drum, 17°26.396'S 12°15.868'E, 14.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N. Martins, 699 m, UV detection, in crevices on granite inselberg on gravel plain, syntopic with *H. conspersus*, 2 ♂ [measured] (AMNH); Kaoko Otavi [18°18'S 13°39'E], i-iv.1926, S.A. Museum expedition, 2 juv. ♂ [rehydrated] (SAMC B6801); Kaokoland [17°37'S 12°12'E], 15.x.1988, M. Griffin & H. Kleynhans, between stones, rocky hillside, 1 juv. ♀ (NMNW 1069); Kaokoveld, 1.ix.1955, E. van Koen, 1 ♀ 1 juv. ♂ (SMF 39267); Kaokoveld, 17°36.842'S 12°52.107'E, 9.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N. Martins, 1339 m, arid savanna, found walking on rock in the late afternoon, 1 juv. ♀ (AMNH); Kunene River [17°26'S 14°02'E], iii.1923, R.F. Lawrence, 1 juv. ♂ 1 juv. ♀ (SAMC B5420, damaged), 1 juv. ♀ (SAMC B5428, damaged); Kunene River, 37 km E of Epupa [17°01'S 12°55'E], 10-11.iv.1991, M. Griffin, 2 juv. ♂ (NMNW 2049); Ohopoho [Opuwo], 40 km N [17°43'S 13°53'E], 12.ii.1975, L. Schulze, 1 juv. ♂ (TMSA 10969); Okokatuwo [17°27'S 12°32'E], 10.v.1991, E. Griffin, between rock slabs, 3 juv. ♂ 1 juv. ♀ (NMNW 1449); Ongongo Community Campsite, 6 km N of Warmquelle, 19°08.427'S 13°49.173'E, 20.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N. Martins, 730 m, UV detection, in crevices in calcrete on rocky slope near freshwater spring, arid savanna, syntopic with *H. conspersus*, *P. brevimanus*, *U. otjimbinguensis*, *U. planimanus*, *O. brevicauda* and *O. cavimanus*, 1 ♀ [measured] (AMNH), 1 juv. ♀ (NMNW 2666); Opura [Opuwa?], 18°04'S 13°51'E], vii-ix.1982, J. Coetzer, 1 ♀ (NCA 84/83); Oruhona [17°41'S 13°36'E], 28.iv.1970, W.D. Haacke, 2 ♀ (TMSA 9807, 9809), 1 subad. ♂ (TMSA 9808); Orumana [18°15'S 13°54'E], iii.1973, Mr Vermaak, 1 juv. ♀ (NMNW 437); Otjihopa Mountains [17°16'S 12°39'E], 11.vi.1992, M. Griffin & M.A. de Kock, 3 ♂ (NMNW 2052); Otjijangasemo [Otjijandjasemo, 17°26'S 13°16'E], 27.iv.1970, W.D. Haacke, 1 juv. ♀ (TMSA 9800); Otjitanda, 5 km E, 17°38.820'S 13°51.814'E, 9.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N. Martins, 1338 m, UV detection, in crevices in granitic hillside in fairly dense broadleaf savanna, syntopic with *P. brevimanus*, *P. granulatus*, *P. kraepelini*, *P. villosus*, *U. otjimbinguensis*, *U. planimanus* and *O. carinatus*, 1 ♂ [measured] 4 ♀ (AMNH), 1 subad. ♂ 2 subad. ♀ (NMNW 2667), 3 juv. ♂ 1 juv. ♀ (AMCC 126102); Otjitundua [18°39'S 14°14'E], i-iv.1926, S.A. Museum expedition, 1 juv. ♂ (SAMC B6973, damaged, without metasoma); Ruacana [17°26'S 14°21'E], 21.iv.1970, W.D. Haacke, 1 juv. ♂ (TMSA 9839); Ruacana, 2 km NNE, 17°26.709'S 14°21.396'E, 6.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N.

Martins, 1138 m, UV detection, in crevices in calcrete on rocky slope (edge of Kunene River valley), arid savanna, syntopic with *H. conspersus*, *P. brevipennis* and *O. carinatus*, 1 ♀ (AMNH), 1 juv. ♂ (AMCC 126101), 1 juv. ♂ (NMNW 2673); Ruacana, 5 km NNE, 17°25.869'S 14°21.522'E, 6.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N. Martins, 1109 m, UV detection, in crevices in sandstone at base of rocky slope (edge of Kunene River valley), arid savanna, syntopic with *H. conspersus*, *P. brevipennis*, *U. planimanus* and *O. carinatus*, 1 ♀ (AMNH), 2 subad. ♀ (NMNW 2668), 1 juv. ♂ 1 juv. ♀ (AMCC 126099); Sanitatas [18°17'S 12°40'E], 30.iv.1970, W.D. Haacke, in crack of layered sandstone-slate, 1 subad. ♂ (TMSA 9811); Swartboois Drift, on Kunene River [17°22'S 13°52'E], 23.iv.1970, W.D. Haacke, 1 ♀ (TMSA 9790), 1 juv. ♀ (TMSA 9789), 24.iv.1970, W.D. Haacke, 1 ♀ (TMSA 9793), 1 subad. ♂ (TMSA 9792), 1 subad. ♀ (TMSA 9791), 1 juv. ♂ (TMSA 9794); Swartbooisdrif, 2 km E, 17°20.693'S 13°51.427'E, 7.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N. Martins, 732 m, UV detection, in crevices in sandstone on S bank of Kunene River, arid savanna, syntopic with *H. conspersus*, *P. brevipennis*, *U. planimanus*, *O. carinatus* and *O. gibbericauda*, 1 ♀ 1 subad. ♂ (AMNH), 1 ad. [pedipalp chela] 1 juv. ♂ 1 juv. ♀ (AMCC 126100), 4 juv. ♀ (NMNW 2669); Warmquelle [19°01'S 13°49'E], J. Visser, 1 juv. ♂ (SAMC C4210 [JV 4092]); Zebra Mountain North [17°08'S 13°27'E], 31.i.1972, G.J. Menge, 1 juv. ♂ 1 juv. [fragment] (TMSA 10442).

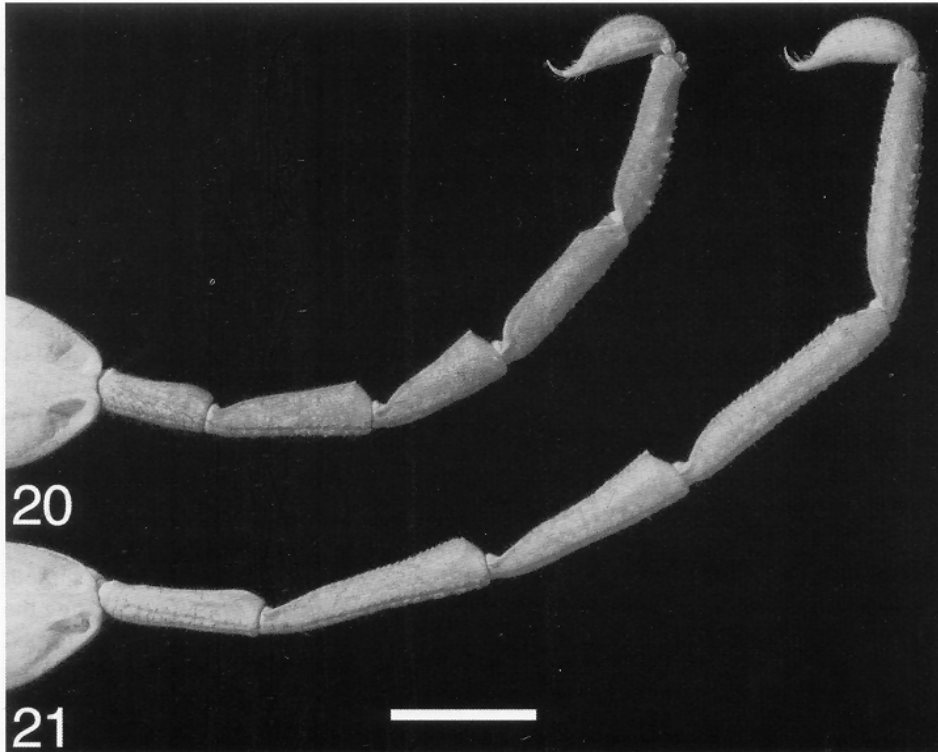
**Outjo District:** Farm Glücksburg 152 [20°15'S 16°06'E], 23.iv.1980, A. Harington, sympatric with *H. conspersus*, *P. brevipennis*, *U. planimanus*, *O. carinatus* and *O. wahlbergii*, 1 ♀ (AMNH [AH 3578]); Farm Hoas 273 [19°55'S 14°45'E], 1971, J.R. Labuschagne, 1 ♀ (TMSA 10132), 1 juv. [pedipalp] (TMSA 10152), 18.i.1972, J.R. Labuschagne, 1 subad. ♂ (TMSA 10269); Farm Kamanjab 104, ca. 2 km towards Ruacana [19°37'S 14°50'E], 21.iv.1980, A. Harington, in granite rock cracks, 1 ♀ (AMNH [AH 1317]); Farm Kamanjab 190 [19°34'S 14°52'E], 21.iv.1980, A. Harington, in granite rock cracks near town, 1 ♀ (AMNH [AH 1387]), 1 subad. ♀ (AMNH [AH 1386]); Farm Kaross 237 [19°21'S 14°31'E], 7.x.1986, E. Griffin, in rocks, 1 juv. ♂ (NMNW 1209), 10.ii.1987, E. Griffin, between slabs of stone, 1 juv. ♀ (NMNW 1022); Farm Palafontein 158 [20°15'S 16°11'E], iv.1980, A. Harington, 2 subad. ♀ (AMNH [AH 3586, 3587]); Farm Weerlig 11 [20°03'S 15°01'E], 21.iv.1980, A. & L. Harington, in granitic rock cracks, sympatric with *O. carinatus* and *O. wahlbergii*, 2 ♀ (AMNH [AH 1333, 1334]); Kamanjab [19°38'S 14°50'E], J. Visser, 1 juv. ♂ (SAMC C4206 [JV 4007]), 1 juv. ♀ (SAMC C4207 [JV 4006]), i-iv.1926, S.A. Museum expedition, 1 subad. ♀ [rehydrated] (SAMC B6089), 21.iv.1980, A. Harington, 1 juv. ♂ 1 juv. ♀ (AMNH [AH 4260]); Kamanjab, 3 km N [19°37'S 14°48'E], 5.iv.1976, B. Lamoral & L. Ferguson, in vertical crevices of rocky outcrops, at night, 1 juv. ♀ (NMSA 10747); Kamanjab, 30 km W [19°36'S 14°33'E], J. Visser, 1 subad. ♀ (SAMC C4211 [JV 4093]); Kamanjab, 34 km W [19°36'S 14°10'E], J. Visser, 1 juv. ♀ (SAMC C4205 [JV 4002]), 23.i.1986, J. Visser, 1 ♀ (SAMC C4299 [JV 4167]), 1 ♀ (SAMC C4305 [JV 4166]).

**Oshikoto Region: Tsumeb District:** Farm Varianto on Elandshoek 771, 19°22.773'S 17°44.456'E, 4.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N. Martins, 1500 m, UV detection, in crevices in dolomite at base of rocky hill in dense broadleaf savanna, fairly humid with dense litter layer, syntopic with *L. josephermans*, *U. otjimbinguensis*, *U. planimanus* and *O. carinatus*, 1 ♀ (AMNH), 1 subad. ♂ 1 juv. ♂ (NMNW 2670); Farm Uithoek 770, 9 mi S Tsumeb [19°20'S 17°39'E], 6.iv.1970, W.D. Haacke, 1 ♀ (TMSA 9786); Tsumeb [19°13'S 17°43'E], iv.1984, J. Visser, 1 ♀ (SAMC C4282 [JV 3227]).

**Otjozondjupa Region: Grootfontein District:** Farm Uisib 427, 15 km NW of Otavi, 19°33.132'S 17°14.124'E, 2.i.2004, L. Prendini, E. Scott, T. & C. Bird, Q. & N. Martins, 1293 m, UV detection, in crevices in dolomite at base of rocky hill in dense broadleaf savanna, fairly humid with dense litter layer, syntopic with *L. josephermans*, *U. otjimbinguensis*, *U. planimanus* and *O. carinatus*, 7 ♂ [1 measured] 14 ♀ 2 subad. ♂ 5 subad. ♀ (AMNH), 4 subad. ♀ 7 juv. ♂ 5 juv. ♀ (NMNW 2671), 1 juv. ♂ 1 juv. ♀ (AMCC 126103); Tsumeb, 40 km S [19°34'S 17°30'E], J. Visser, 2 juv. ♀ (SAMC C4165 [JV 3116], C4166 [JV 3117]).

**Okahandja District:** Gross Barmen [22°06'S 16°45'E], xii.1981, H. Otto, 1 subad. ♀ (AMNH [AH 2234]); Okahandja [21°59'S 16°55'E], 1955, F. Gaerdes, 1 juv. ♂ 1 juv. ♀ (SMF 39323), v.1960, F. Gaerdes, 1 juv. ♂ [not ♀ cf. Lamoral (1979: 657)] (NMSA 7318).

**Otjiwarongo District:** Waterberg [20°25'S 17°15'E], 5.iv.1970, P.J. Buys & P.G. Olivier, 1 juv. ♂ (NMNW 168); Waterberg [20°31'S 17°14'E], 5.iv.1970, W.D. Haacke, 1 ♂ [fragmented, dehydrated] 3 juv. ♀ 1 juv. [exuvium] (TMSA 9835). Waterberg Plateau Park: Main camp, 20°30.803'S 17°14.753'E, 1.i.2004, L. Prendini, E. Scott,



FIGS 20-21

*Hadogenes taeniurus* (Thorell, 1876), metasoma and telson of ♂ and ♀ (Farm Uisib 427 [AMNH]). 20. Lateral aspect, ♀. 21. Lateral aspect, ♂. Scale bar = 10 mm.

Q. & N. Martins, 1440 m, UV detection, in crevices in sandstone on eastern slope of Waterberg, fairly dense mixed savanna, sympatric with *L. josehermana*, *U. otjimbinguensis*, *U. planimanus* and *O. carinatus*, 3 ♀ [2 measured] (AMNH), 1 subad. ♂ 1 subad. ♀ 1 juv. ♀ (NMNW 2672).

**Dubious records:** NAMIBIA: **Erongo Region: Swakopmund District:** Hentiesbaai [22°07'S 14°17'E], iv.1970, J. Viljoen, 1 ♀ (NMNW 74). **Hardap Region: Maltahöhe District:** Ababis [Farm Abbabis 3, near Solitaire, 23°57'S 16°03'E], 10.x.1910, G.E. Müller, 1 subad. ♀ (ZMUH). **Karas Region: Bethanie District:** Helmeringhausen, just south [25°55'S 16°50'E], J. Visser, 1 juv. ♀ (SAMC C4209 [JV 4025]).

***Hadogenes tityrus* (Simon, 1888)**

*Ischnurus tityrus* Simon, 1888: 383–384.

*Hadogenes tityrus*: Kraepelin, 1894: 118; Kraepelin, 1896: 136; Kraepelin, 1899: 145–146; Kraepelin, 1901: 272; Kraepelin, 1908: 268; Kraepelin, 1914: 117; Hewitt, 1918: 163; Hewitt, 1925: 270; Werner, 1936: 189; Roewer, 1943: 232; Lawrence, 1955: 252; Lawrence, 1961: 154; Lawrence, 1962: 221; Lawrence, 1966: 5–7, fig. 3c; Newlands, 1972a: 135; Vachon, 1974, fig. 95, 109, 125–127; Lamoral & Reynders, 1975: 540; Lamoral, 1979: 657–661, fig. 302, 303, 310–317; Newlands & Cantrell, 1985: 37–43, fig. 1–3, tab. 1, 2; Lourenço, 1989: 166, pl. 4, fig. 9–11; Newlands & Prendini, 1997: 80, 81;

Kovařík, 1998: 133; Fet, 2000: 389, 390; Prendini, 2000b: 110, tab. 1; Prendini, 2001a: 148, tab. 1; Prendini, 2001b: 137.

*Hadogenes bifossulatus* Roewer, 1943: 222-234, fig. 10, 10a-d, pl. 5 (synonymized by Kovařík, 1998: 133); Lawrence, 1955: 254; Newlands, 1972a: 134, 135; Lamoral & Reynders, 1975: 538; Lamoral, 1979: 661; Fet, 2000: 387.

*Hadogenes taeniurus*: Lamoral, 1979: 657 (NMNW 130, 222, 517).

*Hadogenes tityrus*: Bücherl, 1964: 61.

*Type material* (examined). *Ischnurus tityrus*: holotype ♀ (not ♂) (MNHN RS 0378), 'Kalahari', South West Africa [NAMIBIA]. *Hadogenes bifossulatus*: holotype subad. ♂ (not ♀) (SMF 6739/146), Waterberg [Otjozondjupa Region: Otjiwarongo District], South West Africa [NAMIBIA].

*Remarks.* *Hadogenes bifossulatus* has long been regarded as a dubious species on account of the inadequate original description (Lawrence, 1955; Newlands, 1972a, 1980; Lamoral & Reynders, 1975; Lamoral, 1979; Fet, 2000). Newlands (1972a) suggested that *H. bifossulatus* might be synonymous with *H. taeniurus*, perhaps because the type locality of *H. bifossulatus* occurs in an area from which *H. taeniurus* had previously been recorded, and different *Hadogenes* species are seldom sympatric. However, after examining the holotype of *H. bifossulatus*, Newlands (1980) synonymized the species with *H. tityrus*. Newlands' (1980) unpublished synonymy of *H. bifossulatus* was later published (and thereby validated) by Kovařík (1998), without explicit mention of the source, but Fet (2000) did not accept the synonymy. During the present investigation, the holotype of *H. bifossulatus* was re-examined and confirmed to be conspecific with *H. tityrus*, rather than with *H. taeniurus*. Although not adult, the holotype presents many of the diagnostic characters of *H. tityrus*: small size; pale colouration; greatly enlarged lateral ocelli; long, slender pedipalp chela with short fingers, and with dorsal and ventral margins of manus subparallel; less than 140 trichobothria per pedipalp; very short metasoma, total length 25% less than combined length of prosoma and mesosoma; distinctive shape of the metasomal segments (e.g., metasomal segment I width greater than height, dorsosubmedian carinae of segment III only terminating posteriorly with enlarged, spiniform granules); lateral margins of sternite VII strongly convex. The type locality of *H. bifossulatus* nevertheless remains questionable, because the nearest records of *H. tityrus* are much further south and west, in habitats considerably drier than the Waterberg, as is typical for this species. It seems unlikely, although perhaps not impossible, that *H. tityrus* occurs in the Waterberg.

*Material examined* (type material, see above). **NAMIBIA: Erongo Region: Omaruru District:** Brandberg [21°14'S 14°30'E], B.H. Lamoral, 1977, 1 ♀ (TMSA 18350); Brandberg, Basswald Rinne [21°10'S 14°38'E], 17-18.iv.1980, A. Harington, in cracks in red rocks, 2 ♀ 2 subad. ♀ (AMNH [AH 1369-1371]); Brandberg, Goaseb gorge [21°14'S 14°35'E], 20.xii.1988, A. Harington, on foothills, under granite rocks, 1 ♀ (AMNH [AH 4001]); Numas Valley, 21°06'S 14°23'E, 13.viii.1995, M. & E. Griffin, between slabs of stone, 1 ♂ (NMNW 1863); Numaskloof, Brandberg, 21°07.48'S 14°25.54'E, 17.i.1998, L. Prendini & E. Scott, 470 m, rocky granite slopes at base of mountain, UV detection, 1 ♂ (AMNH); Brandberg West mine [21°00'S 14°09'E], 27.iii.1964, F. Motonane, 1 ♀ 1 subad. ♂ (NMNW 90); Brandberg West, 7 km from turnoff towards Uis [21°06'S 14°17'E], 28.i.1981, A. Harington, 1 ♀ 1 juv. ♂ (AMNH [AH 2221]); 5 km SE of Brandberg West-Cape Cross-Uis T-junction [21°05'S 14°16'E], 22.xii.1988, A. Harington, granite exfoliations of low boulders, no hill per se, 1 ♀ (AMNH [AH 3757]). **Swakopmund District:** Namib-Naukluft Park: Gorob Mine [23°33'S 15°25'E], 15.iii.1974, J. Tebje, 1 ♂ (NMNW 517) [misidentified as *H. taeniurus* by Lamoral (1979: 657)]; Rössing, Crusher Dust Area [22°28'S 15°02'E], 28.viii-25.ix.1984, J. Irish &





FIGS 22-23

*Hadogenes taeniurus* (Thorell, 1876), hemispermaphore (holotype ♂ of *H. angolensis* Lourenço, 1999, MHNG). 22. Ental aspect. 23. Ectal aspect. Scale bar = 1 mm.

H. Rust, preservative pitfall traps, 1 ♀ (NMNW 867). **Khomas Region: Windhoek District:** Farm Portsmut [33 23°06'S 16°26'E], 7.ii.1969, P.G. Olivier, 1 juv. ♂ (NMNW 222) [misidentified as *H. taeniurus* by Lamoral (1979: 657)]. **Kunene Region: Opuwo District:** Skeleton Coast Park: Hoanib River, 8 mi E of dunes [19°23'S 13°06'E], 11.xi.1965, C. Brits, 1 ♀ (NMNW 130) [misidentified as *H. taeniurus* by Lamoral (1979: 657)].

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**Note added in proof**

While this paper was in press, Acosta & Fet (2005) reinstated *Hadogenes hahni* (Peters, 1862) as the valid name for the species referred to in this paper as *Hadogenes taeniurus* (Thorell, 1876). As noted on p. 372 of the present paper, Prendini (in Fet, 2000: 389) examined the syntypes of *Ischnurus hahni* Peters, 1862, determined them to be conspecific with *H. taeniurus*, and proposed that *I. hahni* and *H. taeniurus* were synonymous. Fet (2000) gave precedence to Thorell's (1876) binomen, *H. taeniurus*, because Peters' (1862) name, *I. hahni*, had not been cited since the original description, and *H. taeniurus* was the only name used for the species since 1876. However, as pointed out by Acosta & Fet (2005), Fet's (2000) action violates the Principle of Priority (ICZN, 1999). The nearest provision is the Reversal of Precedence (Art. 23.9), according to which priority may be reversed when long unused names are involved, but only if two conditions are met. In this particular case, the first condition (Art. 23.9.1.1) is fulfilled. The senior synonym was not used as a valid name for the species after 1899. However, the second condition (Art. 23.9.1.2) is not. In the 50 years immediately preceding Fet's (2000) action, there are only nine works citing *H. taeniurus* as the valid name for the species, although 25 are required. Recognition that *H. hahni* is the valid name for this species implies that *Hadogenes angolensis* Lourenço, 1999 = *Hadogenes hahni* (Peters, 1862), **syn. n.**

ACOSTA, L. E. & FET, V. 2005. Nomenclatural notes in Scorpiones (Arachnida). *Zootaxa* 934: 1-12. Available from: <http://www.mapress.com/zootaxa/>.

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