



Phytoseiid mites of the tribes Afroseiulini, Kampimodromini and Phytoseiulini, and complementary notes on mites of the tribes Euseiini and Neoseiulini (Acari: Phytoseiidae) from sub-Saharan Africa

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Abstract

This is the sixth publication in a series on the phytoseiid mites of sub-Saharan Africa. Seventeen phytoseiid species are reported in this paper, including all species of the Afroseiulini, Kampimodromini and Phytoseiulini known to occur in sub-Saharan Africa, in addition to one species of Euseiina and two species of Neoseiulini. Species of the latter two groups complement the respective lists of species presented in previous publications in this series. One species, *Paraphytoseius ghanaensis* n. sp., is described for the first time and four species are redescribed. Keys are included to help in the separation of the species in each tribe or subtribe.

Key words: Biological control, phytoseiid, predator, cassava, taxonomy

Introduction

This paper is the sixth in a series dealing with the phytoseiid mites from sub-Saharan Africa. The first paper dealt with species of *Euseius* Wainstein (Moraes *et al.* 2001), the second with the species of the subtribes Typhlodromalina Chant & McMurtry and Euseiina Chant & McMurtry of Euseiini (Moraes *et al.* 2006), the third with the species of *Neoseiulus* Hughes (Zannou *et al.* 2006), the fourth with the species of Typhlodromipsini Chant & McMurtry and of the subtribes Arrenoseiina Chant & McMurtry and Proprioseiopsina Chant & McMurtry of Amblyseiini (Moraes *et al.* 2007) and the fifth with species of the subtribe Amblyseiina Chant & McMurtry of Amblyseiini (Zannou *et al.* 2007).

The whole series, including the present paper, refers to all species so far reported from that region, with information on morphological variation of the species that have been recollected in surveys conducted in South Africa by South African professionals and in other countries of the region by personnel of the International Institute of Tropical Agriculture (IITA). In the latter case, surveys were conducted within the scope of an extensive project for the biological control of the cassava green mite [*Mononychellus tanajoa* (Bondar)] in Africa (Yaninek & Herren 1988); the main objective of those surveys was to evaluate the composition of the phytoseiid fauna in cassava fields and on the surrounding vegetation, before and after the introduction of exotic phytoseiids from the Neotropics for control of the pest.

The objective of the present paper is to report the phytoseiids belonging to 3 tribes of the subfamily Amblyseiinae (Afroseiulini, Kampimodromini and Phytoseiulini) and to present complementary information on

mites of 2 tribes (Euseiini and Neoseiulini) of the same subfamily that were treated more thoroughly in previous papers of the series (Moraes *et al.* 2001; Moraes *et al.* 2006; Zannou *et al.* 2006). Setal nomenclature used in this paper is that of Rowell *et al.* (1978) and Chant & Yoshida-Shaul (1991) for dorsal and ventral surfaces of the idiosoma, respectively. Idiosomal setal patterns are those of Chant & Yoshida-Shaul (1992). All measurements are given in micrometers; the measurement presented for each character corresponds to the average for the number of individuals indicated for each sex of the species, followed (in parentheses) by the respective ranges (if measurement is variable). For some of the redescribed species, measurements of type specimens are provided (when measurements of specimens collected in this study are also given, the type measurements are provided in brackets). Dorsal shield width was always measured at the widest level of the anterior half of the dorsal shield. Where measurements are not provided for macrosetae, the seta should be considered absent. Abbreviations used for depositories of type specimens are: ESALQ-USP (Escola Superior de Agricultura Luiz de Queiroz, Universidade de São Paulo, Piracicaba-SP, Brazil), IITAIM (International Institute of Tropical Agriculture, Insect Museum; Cotonou, Republic of Benin). The world distribution provided for each species is based on the surveys corresponding to the present work and on Moraes *et al.* (2004).

Afroseiulini Chant & McMurtry

Afroseiulini Chant & McMurtry, 2006a; 2006b.

Key characteristics of this monogeneric tribe are: idiosomal setal pattern 9A:5F/JV-3,4;ZV-1,3; setae j5, J2, Z1, S4, S5, JV3, JV4, ZV1 and ZV3 absent; all "lateral setae" except z2 elongate; peritreme extending to level between j3 and z2; female genital shield wider than ventrianal shield, the latter with only 1 pair of preanal setae; 2 pairs of metapodal shields; fixed cheliceral digit with few teeth; legs I–III without macrosetae; leg IV with one macroseta on each of genu, tibia and basitarsus; chaetotaxy of femur III 1-3/1-0, unique among adult phytoseiids.

***Afroseiulus* Chant & McMurtry**

Afroseiulus Chant & McMurtry, 2006a: 20.

The main characteristics of the genus are the same as those listed for the tribe.

***Afroseiulus robertsi* (Baker)**

Mesoseiulus robertsi Baker, 1990: 618.

Afroseiulus robertsi, Chant & McMurtry, 2006a: 20.

Phytoseiulus robertsi, Moraes *et al.*, 2004: 170.

Remarks: This species was described from specimens collected in Bali, near Bamenda, NW Province, Cameroon, phoretic on *Bactrothrips* sp. (Insecta: Thysanoptera) from dead leaves of *Mangifera indica* (Anacardiaceae). No additional specimens were collected in the present study.

World distribution. Cameroon.

Kampimodromini Kolodochka

Kampimodromini Kolodochka, 1998: 59; Chant & McMurtry, 2003b: 179.

Chant & McMurtry (2003b) redefined the tribe Kampimodromini, indicating that it was originally described from taxa that occurred in the Palearctic region. The original description was based almost exclusively on idiosomal chaetotaxy and the stage in which setae first appear in ontogeny. This is a rather variable group, especially with regard to the presence of an incision in the dorsal shield at level of s4, different dorsal shield setae, length of the peritreme and shape of the ventrianal shield. Key characters proposed by Chant & McMurtry (2003b) for the Kampimodromini are: dorsal shield often with several large pores; seta S4 absent on 92 of the known 95 species; dorsolateral setae variable in length and thickness, but mostly thickened, serrate, arising from tubercles; sternal shield about as long as wide; posterior margin of sternal shield straight or concave; deutosternal groove narrow, less than 4 µm wide; genital shield as wide as or slightly wider than ventrianal shield; the latter usually long, narrow, with 2 or 3 pairs of preanal setae often arranged along its lateral margins; calyx of spermatheca cup-, dish- or trumpet-shaped; legs I–III may have thickened setae but true macrosetae absent, except in *Paraphytoseius* Swirski & Shechter.

Subtribe Kampimodromina Chant & McMurtry

Kampimodromina Chant & McMurtry, 2003b: 193.

Key characteristics of this subtribe are: lateral margin of dorsal shield without distinct incision at level of s4 and usually without prominent pores associated with z5; dorsolateral setae usually of approximately the same length; genital shield narrow; imaginary line connecting ZV2, JV1 and JV2 forming an acute angle or those setae sometimes inserted in an approximately longitudinal line; fixed cheliceral digit usually with few teeth; atrium of spermatheca undifferentiated or small; when present, macrosetae on leg IV never very long, greatly thickened.

Four of the 7 genera placed in this subtribe by Chant & McMurtry (2003b) occur in sub-Saharan Africa.

Asperoseius Chant

Asperoseius Chant, 1957: 360; Chant & McMurtry, 2003b: 203; Moraes *et al.*, 2004: 55.

Phytoseiulus (*Asperoseius*), Wainstein, 1962: 17.

Proprioseius (*Asperoseius*), Karg, 1983: 302.

Key characteristics of species in this genus are: dorsal shield rotund, coarsely punctate or lightly imbricate; idiosomal setal pattern 10A:6D/JV-3:ZV±3; setae J2, S4, S5 absent, and seta ZV3 absent from all but *Asperoseius baguioensis* Corpuz-Raros, 1994 (members of the *heveae* species group of the genus *Amblyseiulella* Muma have the same dorsal setal pattern but seta ZV3 is always present); many dorsal setae short, subequal, strongly serrate, flattened; without prominent pores associated with z5; peritreme extending to level of j1; posterior margin of sternal shield concave; posterior margin of genital shield round to truncate; female ventrianal shield much longer than wide, approximately rectangular, without marked waist; preanal pores minute; imaginary line connecting minute ZV2, JV1 and JV2 forming an acute angle; calyx of spermatheca cup-shaped; fixed cheliceral digit with few teeth; legs I–III with many short and thickened setae, but without true macrosetae; leg IV with 2 or 3 stout, elongate macrosetae with tips expanded, flattened.

Both species reported in this paper have preanal pores well separated.

Asperoseius africanus Chant

Asperoseius africanus Chant, 1957: 360; Chant & McMurtry, 2003b: 205; Moraes *et al.*, 2004: 56.

Amblyseius (Asperoseius) africanus, Pritchard & Baker, 1962: 295.

Phytoseiulus (Asperoseius) africanus, Wainstein, 1962: 24.

Proprioseius (Asperoseius) africanus, Karg, 1983: 302.

Typhlodromus southafricanus Hirschmann, 1962: 6 (synonymy, Chant & McMurtry 2003b).

Remarks: This species was described from specimens intercepted at Boston, Massachusetts, USA, on "cut flowers" imported from South Africa. No additional specimens were collected in the present study.

World distribution. South Africa.

Asperoseius henryae Fain & Krantz

Asperoseius henryae Fain & Krantz, 1990: 216; Chant & McMurtry, 2003b: 205; Moraes *et al.*, 2004: 56.

Remarks: This species was described from specimens collected in River Nsele, near Kinshasa, Democratic Republic of Congo (former Belgian Congo and Zaire), on the abdomen of an adult black fly, *Simulium* sp. (Diptera: Simuliidae). No additional specimens were collected in the present study.

World distribution. Democratic Republic of Congo.

Kampimodromus Nesbitt

Kampimodromus Nesbitt, 1951: 53; Chant & McMurtry, 2003b: 195; Moraes *et al.*, 2004: 93.

Paradromus Muma, 1961: 286 (Chant & McMurtry 2003b).

Amblyseius (Kampimodromus) section *Kampimodromus*, Wainstein, 1962: 14.

Key characteristics of species in this genus are: dorsal shield usually strongly ornamented; idiosomal setal pattern 10A:8C/JV-3:ZV; S4 absent; setae J2, S2, S5 and JV4 present; lateral dorsal setae medium in length, subequal, slightly thickened; without prominent pores associated with z5; peritreme not extending to level of j1; posterior margin of sternal shield concave; ST3 inserted on or off the sternal shield; posterior margin of genital shield truncate; female ventrianal shield much longer than wide; preanal pores minute; imaginary line connecting ZV2, JV1 and JV2 forming an acute angle; calyx of spermatheca cup-shaped; fixed cheliceral digit with few teeth; legs without macrosetae or with a single macroseta on basitarsus IV.

Both species reported in this paper have peritreme extending to level between z2 and j3.

Kampimodromus alettae (Ueckermann & Loots)

Amblyseius (Kampimodromus) alettae Ueckermann & Loots, 1985: 199.

Kampimodromus alettae, Chant & McMurtry, 2003b: 196; Moraes, *et al.*, 2004: 95.

Remarks: This species was described from specimens collected in Rustenburg Nature Reserve, Transvaal, North-West Province, South Africa, on *Tapinanthus natalitius* (Loranthaceae). No additional specimens were collected in the present study.

This species is unique in that leg IV is devoid of macrosetae, the ventrianal shield bears only two pairs of preanal setae (JV1 on opisthogastric cuticle) and genua II and IV have 8 and 9 setae, respectively.

World distribution. South Africa.

***Kampimodromus molle* (Ueckermann & Loots)**

(Fig. 1)

Amblyseius (*Kampimodromus*) *molle* Ueckermann & Loots, 1985: 195.

Kampimodromus molle, Chant & McMurtry, 2003b: 196; Moraes, *et al.*, 2004: 96.

FEMALE (Specimen measured. South Africa: 1 paratype).

Dorsum (Fig. 1A). Dorsal shield slightly striate, 258 long and 132 wide. Setae j1 16, j3 32, j4 21, j5 24, j6 25, J2 32, J5 13, z2 25, z4 35, z5 22, Z1 32, Z4 30, Z5 32, s4 38, S2 41, S5 16, r3 32, R1 19. Setae distinctly to lightly serrate, except Z1, S5 and R1, smooth.

Venter (Fig. 1B). Sternal shield smooth, with posterior margin convex; distances between ST1–ST3 47, ST2–ST2 59. Genital shield smooth, distance between ST5–ST5 41. Ventrianal shield mostly smooth, rectangular, with few transverse striae between JV2 and anus, 76 long, 47 wide at level of ZV2 and 43 wide at level of anus, with 3 pairs of preanal setae. Two pairs of metapodal shields; caudoventral setae smooth and sharp-tipped, except JV5, serrate.

Chelicera (Fig. 1C). Movable digit 19 long, without distinguishable teeth; fixed digit 19 long, with 3 teeth (one at level with the *pilus dentilis* and 2 distal to it).

Spermatheca (Fig. 1D). Calyx shallow cup-shaped, 4 long, 9 in diameter; atrium nodular.

Legs (Fig. 1E). Sharp-tipped macroseta: Sbt (basitarsus) IV 20. Chaetotaxy: genu II: 2-2/1, 2/0-1; genu III: 1-2/1, 2/0-1.

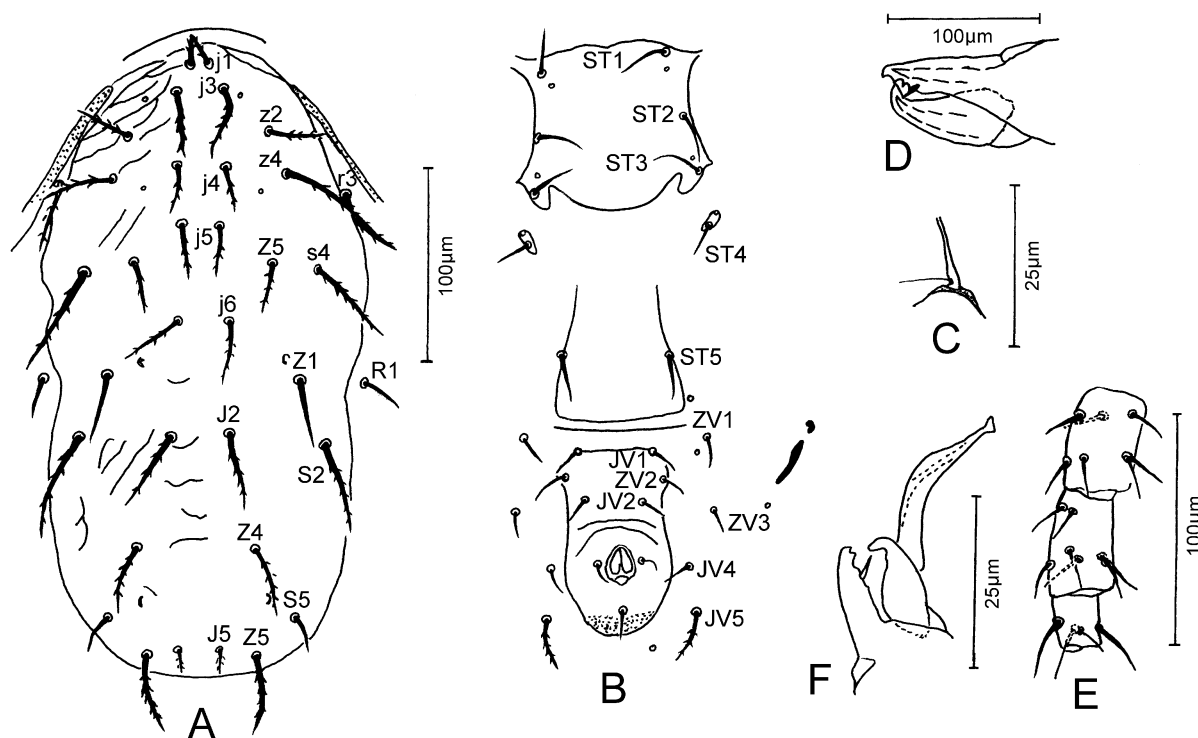


FIGURE 1. *Kampimodromus molle* (Ueckermann & Loots): A. Female dorsal shield; B. Female ventral surface; C. Spermatheca; D. Female chelicera; E. Female leg IV; F. Spermatodactyl.

MALE (Specimen measured: South Africa: 1 paratype).

Dorsum. Dorsal shield pattern as in female, 260 long and 164 wide. Setae j1 19, j3 25, j4 9, j5 9, j6 14, J2 13 J5 6, z2 14, z4 22, z5 9, Z1 13, Z4 28, Z5 38, s4 32, S2 23, S5 14, r3 16, R1 13. Setae smooth, except Z4 and Z5, serrate.

Venter. Ventrianal shield subtriangular and slightly reticulate, 88 long and 113 wide at anterior corners; with 3 pairs of preanal setae; preanal pores and lyrifissures not distinguishable.

Spermatodactyl (Fig. 1F). Straight, narrowing distally and ending in a small "foot"; shaft 23.

Legs. Sharp-tipped macroseta: Sbt IV 19 on left leg and 32 on right leg. Chaetotaxy of genua II and III as in female.

Specimens examined: South Africa: One paratype female and 1 paratype male from *Combretum molle* (Combretaceae), Moria, near Polekwane, Limpopo Province 8-V-1981, E. Kassimatis.

Remarks: Tixier *et al.* (2003) applied morphometric analysis to several *Kampimodromus* species concluding that *Kampimodromus keae* Papadoulis & Emmanouel, *Kampimodromus molle* Ueckermann & Loots and *Kampimodromus ragusai* Swirski & Amitai were probably junior synonyms of *K. aberrans* Oudemans; however, they did not officially synonymize those species. Chant & McMurtry (2003b) also suggested those species to be junior synonyms of *K. aberrans*, but again did not officially synonymize them. We do not agree on those propositions. *Kampimodromus molle* differs from *K. aberrans* having longer setae j5, j6 and z5 (Tixier *et al.*, 2003) and by lacking pre-anal pores (Tixier *et al.*, 2003 depicted pre-anal pores for *K. aberrans*); *K. molle* further differs from *K. aberrans* by having posterior margin of the sternal shield convex instead of concave. We consider the results of the morphometric study of Tixier *et al.* (2003) to indicate *K. molle* and *K. aberrans* to be closely related, but different species. Only the examination of additional specimens collected in the type locality of *K. molle* may substantiate the differences mentioned above to represent just intra-specific variations, and *K. molle* to be a junior synonym of *K. aberrans*. Only the holotype of *K. molle* was measured by Tixier *et al.* (2003).

World distribution. South Africa.

Kampimoseiulella Chant & McMurtry

Kampimoseiulella Chant & McMurtry, 2003b: 198; Moraes *et al.*, 2004: 96.

Key characteristics of species in this genus are: female idiosomal setal pattern 10A:7C/JV-3:ZV; setae S2 and S4 absent; setae J2, S5 and JV4 present; dorsal setae short to medium in length, slender to stout, many serrated; without prominent pores associated with z5; dorsal and ventrianal shields much longer than wide; peritreme extending to level of j1 or of j3; posterior margin of sternal shield concave; posterior margin of genital shield truncate; imaginary line connecting minute ZV2, JV1 and JV2 forming an acute angle; preanal pores minute and widely separated; fixed cheliceral digit with few teeth; calyx of spermatheca cup-shaped; legs without macrosetae or with a single short macroseta on basitarsus IV.

Species in this genus are only known from South Africa.

Kampimoseiulella altusus (Van der Merwe)

Amblyseius (*Proprioseius*) *altusus* Van der Merwe, 1968: 163.

Kampimoseiulella altusus, Chant & McMurtry, 2003b: 199; Moraes *et al.*, 2004: 96.

Remarks: This species was described from specimens collected in Golden Gate Highland National Park, Free State Province (former Orange Free State), South Africa, on *Berkheya* sp. (Asteraceae). No additional specimens were collected in the present study.

World distribution. South Africa.

***Kampimoseiulella reburrus* (Van der Merwe)**

Amblyseius (*Proprioseius*) *reburrus* Van der Merwe, 1968: 165.

Kampimoseiulella reburrus, Chant & McMurtry, 2003b: 199; Moraes *et al.*, 2004: 96.

Remarks: This species was described from specimens collected in Golden Gate Highland National Park, Free State Province (former Orange Free State), South Africa, on *Leucosidea sericea* (Rosaceae). No additional specimens were collected in the present study.

World distribution. South Africa.

***Paraamblyseiulella* Chant & McMurtry**

Paraamblyseiulella Chant & McMurtry, 2003b: 199; Moraes *et al.*, 2004: 156.

Key characteristics of species in this genus are: idiosomal setal pattern 10A:7C/JV-3:ZV; setae S2 and S4 absent; setae J2, S5 and JV4 present; most dorsolateral setae elongate, thick and strongly serrate, and many of them rising from tubercles; with a small pore associated with z5; peritreme extending to level of j1; posterior margin of sternal shield straight; posterior margin of genital shield truncate; female ventrianal shield much longer than wide, without pores; preanal setae almost longitudinally aligned; fixed cheliceral digit with few teeth; calyx of spermatheca cup-shaped; legs without macrosetae.

The single species in this genus is only known from South Africa.

***Paraamblyseiulella transmontanus* (Ueckermann & Loots)**

Amblyseius (*Paraphytoseius*) *transmontanus* Ueckermann & Loots, 1987: 223.

Paraamblyseiulella transmontanus, Chant & McMurtry, 2003b: 199; Moraes *et al.*, 2004: 156.

Remarks: This species was described from specimens collected in a location between Napier and Bredasdorp, Cape Province, South Africa, on *Rhus pyroides* (Anacardiaceae). No additional specimens were collected in the present study.

World distribution. South Africa.

Subtribe Paraphytoseiina Chant & McMurtry

Paraphytoseiina Chant & McMurtry, 2003b: 211.

Key characteristics of this subtribe are: lateral margin of female (but not of male) dorsal shield deeply incised at the level of seta s4; some dorsolateral setae much longer than others; most dorsocentral setae minute; S4 absent; ZV3 present; a prominent pore associated with z5 [except for *Neoparaphytoseius sooretamus* (El-Banhawy, 1984), according to the original description of the species]; peritreme extending to level of j1; ventrianal shield with a pair of minute, widely separated pores; fixed cheliceral digit usually multidentate; leg IV with 3–5 very long, greatly thickened macrosetae.

Only one of the 3 genera that Chant & McMurtry (2003b) placed in this subtribe occurs in sub-Saharan Africa.

Paraphytoseius Swirski & Shechter

Paraphytoseius Swirski & Shechter, 1961: 113; Chant & McMurtry, 2003b: 216; Moraes *et al.*, 2004: 160.

Amblyseius (*Paraphytoseius*), Ueckermann & Loots, 1987: 221.

Amblyseius (*Ptenoseius*) Pritchard & Baker, 1962: 295.

Proprioiseius (*Paraphytoseius*), Karg, 1983: 302.

Ptenoseius, Schuster & Pritchard, 1963: 198.

Key characteristics of species in this genus are: idiosomal setal pattern 10A:6E/JV-3:ZV or 10A:5D/JV-3:ZV; J2, S2 and S4 absent; S5 present or absent; j3, s4, Z4 and Z5 elongate, stout, strongly serrate, arising from tubercles; Z4 and Z5 close to each other; dorsal shield smooth or lightly sculptured, with posterior margin round; posterior margin of sternal shield straight or slightly concave; posterior margin of genital shield broadly rounded; ventrianal shield much longer than wide, with preanal setae vertically aligned along lateral margins; spermatheca with atrium slightly swollen and with calyx cup-, dish- or trumpet-shaped; fixed cheliceral digit with 7 – 11 teeth; legs I, II and III with or without macrosetae; leg IV with 3 – 5 strong macrosetae.

Three species in this genus are reported in this paper. They have idiosomal setal pattern 10A:5D/JV-3:ZV; J2, S2, S4 and S5 absent; one pair of round preanal pores posterior to and almost in line with JV2; 1 pair of metapodal shields.

***Paraphytoseius ghanaensis* Moraes, Zannou & Oliveira, n. sp.**

(Fig. 2)

Diagnosis. This species is characterized by the absence of S5 and by having seta Z1 minute; calyx of spermatheca trumpet-shaped; macroseta on telotarsus of leg IV at least 20% longer than those on genu, tibia and basitarsus of the same leg.

FEMALE (4 specimens measured).

Dorsum (Fig. 2A). Dorsal shield 281(272–296) long and 156(155–157) wide; lightly sculptured, with few rounded elements posterior to j6 and to Z1, a pair of incisions at level of s4 and a pair of medium sized pores postero-mesad of z5. Setae j1 34(30–37), j3 70(66–76), j4 4(3–5), j5 4(3–5), j6 6(5–6), J5 5, z2 8(8–9), z4 7(5–8), z5 5(4–6), Z1 7(6–8), Z4 69(64–72), Z5 89(77–104), s4 114(107–122), r3 40(35–43), R1 20(18–22).

Peritreme (Fig. 2A). Extending to level of j1.

Venter (Fig. 2B). Sternal shield smooth, posterior margin lightly waved; distances between ST1–ST3 66(62–69), ST2–ST2 68(66–69). Genital shield smooth; distance between ST5–ST5 82(80–85). Ventrianal shield smooth, anterior margin convex and lateral margin with light constriction, 106(105–109) long, 59(55–64) wide at level of ZV2 and 55 (53–58) wide at level of anus. Caudoventral setae smooth, except for JV5, serrate.

Chelicera (Fig. 2C). Movable digit 29(27–31) long, with 2 – 3 teeth; fixed digit 24(23–25) long, with 9 – 10 teeth and a *pilus dentilis*.

Spermatheca (Fig. 2D). Calyx trumpet-shaped, 17(14–19) long; atrium nodular.

Legs (Fig. 2E). Macrosetae stout and blunt on genu II and telotarsus IV; spatulate on genu, tibia and basitarsus IV; Sge II 13, Sge IV 30(29–32), Sti IV 38(35–45), Sbt (macroseta of basitarsus) IV 47(43–49) and Stt (macroseta of telotarsus) IV 57(53–59). Chaetotaxy: genu II: 2-2/0, 2/0-1; genu III: 1-2/1, 2/0-1.

MALE (2 specimens measured).

Dorsum (Fig. 2F). Dorsal shield pattern as in female, but without incisions at level of s4, 226(222–230) long and 125 wide. Setae j1 24(21–27), j3 48(45–51), j4 3, j5 3, j6 5(5–6), J5 3, z2 7(6–7), z4 7, z5 3, Z1 6, Z4 43(40–46), Z5 55(53–58), s4 75(74–77), r3 26(24–27), R1 12(12–13). Shape and texture of dorsal setae as well as position of Z4 in relation to Z5 as in female.

Peritreme (Fig. 2F). Extending to level between j3 and z2.

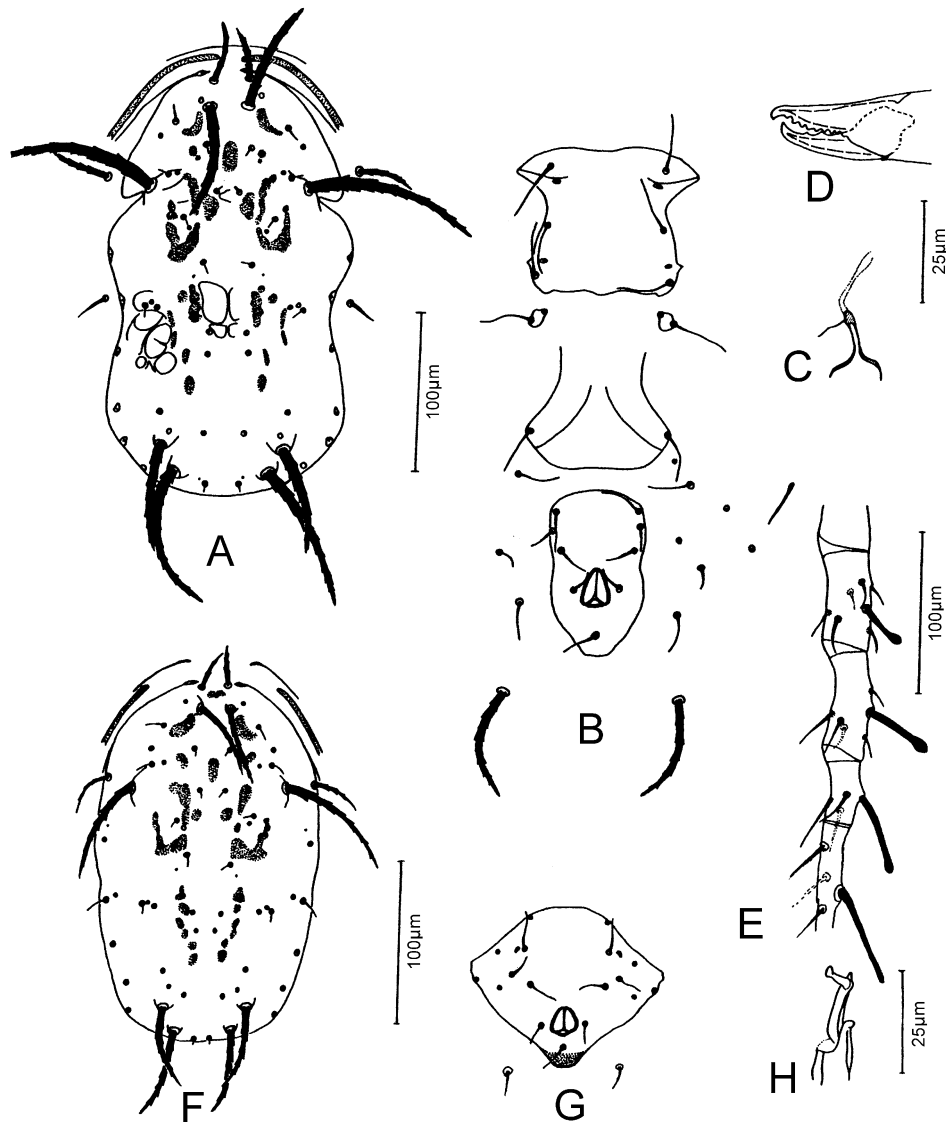


FIGURE 2. *Paraphytoseius ghanaensis* Moraes, Zannou & Oliveira, n. sp.: A. Female dorsal shield; B. Female ventral surface; C. Spermatheca; D. Female chelicera; E. Female leg IV; F. Male dorsal shield; G. Male ventrianal shield; H. Spermatodactyl.

Venter (Fig. 2G). Ventrianal shield almost rhombus-shaped, with anterior margin round, and smooth, 97 long, 116 wide at lateral corners; with 3 pairs of preanal setae, 5 pairs of lyrifissures (1 anterior and vertically in line with Jv1, 1 laterad and about in line and 1 laterad and slightly posterior to JV1, 1 laterad and slightly posterior to ZV2, 1 laterad and slightly posterior to JV2), preanal pores not distinguishable.

Spermatodactyl (Fig. 2H). L-shaped, shaft 18(17–18) long; foot 13(13–14) long.

Legs. Macrosetae of same shapes as in female; Sge II 13(12–14), Sge IV 24(22–25), Sti IV 26(26–27), Sbt IV 38(37–40) and Stt IV 49(45–52). Chaetotaxy of genua II and III as in female.

Locality and type material. Holotype female and 1 paratype female from *Chromolaena odorata* (Asteraceae), 28 km S Dunkwa, Western Region, Ghana, 11-XI-1989, J.S. Yaninek, deposited at ESALQ-USP; 2 paratype females from *Chromolaena odorata*, 28 km S Dunkwa, Western Region, Ghana, 11-XI-1989, J.S. Yaninek, deposited at IITAIM; 3 paratype females and 1 allotype male from *Pueraria* sp. (Fabaceae), 51 km S Dunkwa, Western Region, Ghana, 11-XI-1989, J.S. Yaninek, deposited at ESALQ-USP; 1 paratype female and 1 paratype male from unknown plant, 15 km S Obuasi, Ashanti Region, Ghana, 10-XI-1989, J.S. Yaninek,

deposited at IITAIM; 1 paratype female from unknown plant, 25 km S Tarkwa, Western region, Ghana, 11-XI-1989, J.S. Yaninek, deposited at IITAIM; 1 paratype female, from *Solanum melongena* (Solanaceae), 29 km N Tarkwa, Western region, Ghana, 10-III-1990, J.S. Yaninek, deposited at ESALQ-USP.

Etymology. The epithet *ghanaensis* refers to the country where the types of this species were collected.

Remarks. The absence of S5 characterizes this species as belonging to *orientalis* species group of Chant & McMurtry (2003b). *Paraphytoseius nicobarensis* (Gupta) differs from this species by having Z1 as long as j1 and as r3, and ventrianal shield ca. 45% wider at level of ZV2 than at level of anus. The remaining species of the *orientalis* group [*P. bhadrakaliensis* (Gupta), *P. chihpenensis* Ho & Lo, *P. hilli* Beard & Walter, *P. horrififer* (Pritchard & Baker), *P. orientalis* (Narayanan, Kaur & Ghai), *P. santurcensis* De Leon, *P. seychellensis* Schicha & Corpuz-Raros, *P. urumanus* (Ehara), *P. parabilis* (Chaudhri) and *P. subtropicus* (Tseng)] differ from the new species by having calyx of spermatheca dish-shaped.

***Paraphytoseius horrififer* (Pritchard & Baker)**

(Fig. 3)

Amblyseius (*Ptenoseius*) *horrififer* Pritchard & Baker, 1962: 295.

Amblyseius horrififer, Meyer & Rodrigues, 1966: 30.

Amblyseius (*Paraphytoseius*) *horrififer*, Van der Merwe, 1968: 169.

Proprioseius (*Paraphytoseius*) *horrififer*, Karg, 1983: 302.

FEMALE (Specimens measured. Benin: 1; Kenya: 1; Uganda: 2; Democratic Republic of Congo: holotype).

Dorsum (Fig. 3A). Dorsal shield 300(294–310) [298] long and 158(149–166) [166] wide, with light lateral striae, a pair of incisions at level of s4 and a pair of large pores mesad of z5. Setae j1 38(37–40) [38], j3 85(80–88) [84], j4 3 [3], j5 3 [3], j6 7(6–8) [6], J5 4(3–5) [3], z2 11(10–12) [11], z4 8(6–11) [6], z5 5(4–5) [5], Z1 7(6–8) [5], Z4 80(77–84) [84], Z5 114(112–118) [116], s4 131(122–139) [138], r3 43(40–45) [45], R1 31(27–41) [28].

Peritreme (Fig. 3A). Extending to level of j1.

Venter. Sternal shield smooth, posterior margin crenulate; distances between ST1–ST3 66(64–69) [63], ST2–ST2 73(72–74) [69]. Genital shield smooth; distance between ST5–ST5 83(82–86) [84]. Ventrianal shield subpentagonal, smooth, anterior margin almost straight and lateral margin with light constriction, 103(96–110) long [115], 68(62–74) [75] wide at level of ZV2 and 62 (59–67) [63] wide at level of anus. Caudoventral setae smooth, except JV4 and JV5, lightly serrate.

Chelicera (Fig. 3C). Movable digit 34(33–34) long, with 2–3 teeth; fixed digit 29 long, with 10–11 teeth and a *pilus dentilis*.

Spermatheca (Fig. 3D). Calyx dish-shaped, 4(3–5) [4] deep, 12(9–13) in diameter; atrium nodular.

Legs (Fig. 3E). Macrosetae stout, spatulate, except that on telotarsus IV, knobbed; Sge II 12(11–13) [not checked in holotype], Sge IV 25(24–27) [26], Sti IV 37(35–40) [37], Sbt IV 40(38–43) [39] and Stt IV 41(39–42) [not checked in holotype]. With a small, blunt seta on basitarsus IV and, on some specimens, on femur IV [both not checked in holotype]. Chaetotaxy: genu II: 2-2/0, 2/0-1; genu III: 1-2/1, 2/0-1.

MALE. Not encountered in this study.

Specimens examined. Benin: Ouidah, Département de l'Atlantique, on *Mucuna* sp. (Fabaceae), 1-XI-1989, G.J. Moraes. **Democratic Republic of Congo (= Belgian Congo):** (holotype) Ruwenzori, Kivu, on *Hoslundia opposita* (Lamiaceae), 6-V-1955, E.W. Baker. Muanda, on *Cassia* sp. (Caesalpinaceae), 11-VII-1991, A. Onzo. **Ghana:** Ashanti region, 2 km W Jakobu, on unknown plant, 10-XI-1989, J.S. Yaninek. **Kenya:** 16 km N Mozimo, Nyanza Province, on unknown plant, 2-XII-1989, J.S. Yaninek. **Uganda:** Kamengo, Mpigi, on *Cucurbita maxima* (Cucurbitaceae), 6-X-1990, J.S. Yaninek; 7 miles W Busemba, on *Abutilon mauritanum* (Malvaceae), 1990, J.S. Yaninek.

World distribution. Benin, Democratic Republic of Congo, Ghana, India, Kenya, Madagascar, Mozambique, Uganda and South Africa.

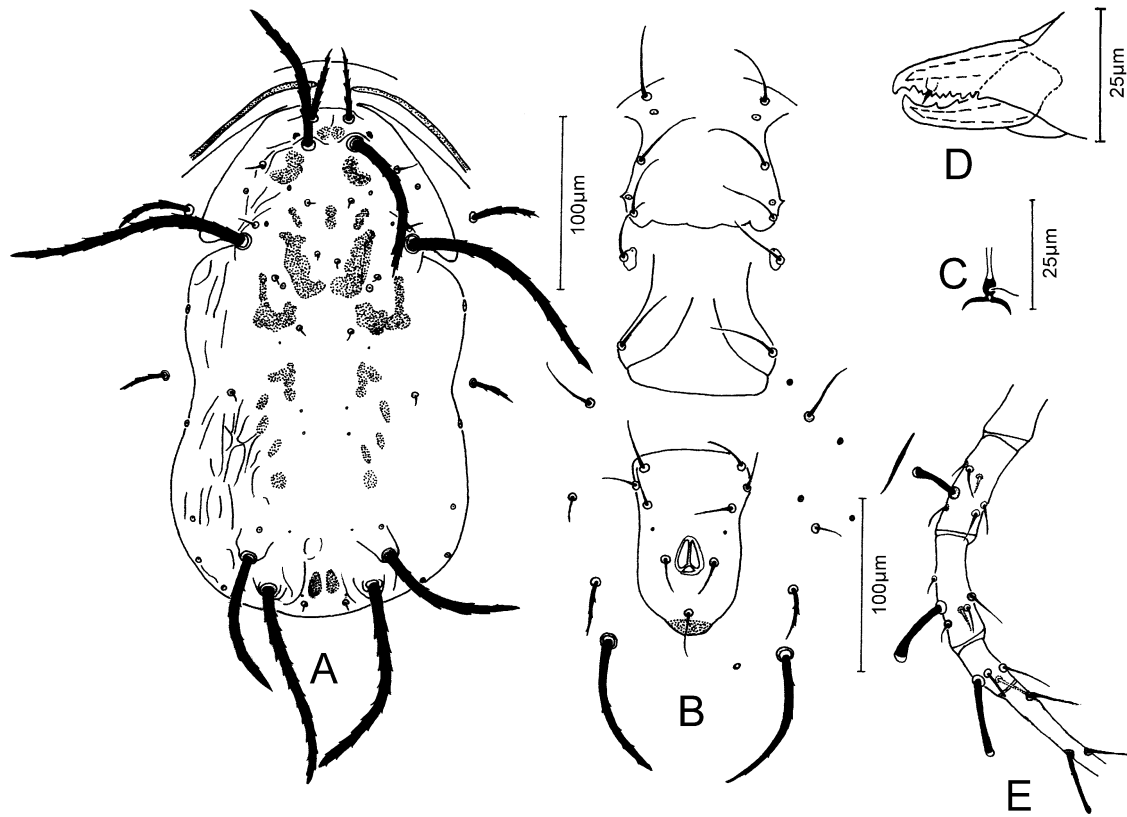


FIGURE 3. *Paraphytoseius horrifera* (Pritchard & Baker) (female): A. Dorsal shield; B. Ventral surface; C. Spermatheca; D. Chelicera; E. Leg IV.

***Paraphytoseius orientalis* (Narayanan, Kaur & Ghai)**

(Fig.4)

Typhlodromus (Amblyseius) orientalis Narayanan, Kaur & Ghai, 1960: 394.

Paraphytoseius orientalis, Chant & McMurtry, 2003b: 220; Moraes *et al.*, 2004: 162.

Amblyseius ipomeai Narayanan, Kaur & Ghai, in El-Banhawy (1984): 126; *Amblyseius (Paraphytoseius) narayanani* Ehara & Ghai, in Ehara (1967): 77; *Paraphytoseius multidentatus* Swirski & Shechter, 1961: 114 (synonymy, Chant and McMurtry 2003b).

FEMALE (Specimens measured. Burundi: 1; Kenya: 2; Rwanda: 1; Hong Kong: 1 paratype of *P. multidentatus*).

Dorsum (Fig. 4A). Dorsal shield 291(280–304) [306] long and 159(149–168) [165] wide, with lateral striae, a pair of incisions at level of s4 and a pair of large pores mesad of z5. Setae j1 32(29–37) [36], j3 83(72–90) [81], j4 3(2–3) [4], j5 3(2–3) [4], j6 6(5–6) [6], J5 4(3–5) [5], z2 9(8–10) [9], z4 9(8–10) [11], z5 5 [3], Z1 7(6–8) [8], Z4 72(67–77) [71], Z5 96(90–101) [94], s4 117(110–126) [118], r3 42(38–46) [45], R1 28(26–30) [25].

Peritreme (Fig. 4A). Extending to level of j1.

Venter (Fig. 4B). Sternal shield smooth, posterior margin waved; distances between ST1–ST3 64(61–66) [66], ST2–ST2 65(62–67) [66]. Genital shield smooth; distance between ST5–ST5 82(80–85) [79]. Ventrianal

shield subpentagonal, smooth, anterior margin almost straight and lateral margin with light constriction, 99 [97] long, 61(56–64) [52] wide at level of ZV2 and 59 (56–62) [55] wide at level of anus. Caudoventral setae smooth, except JV4 and JV5, lightly serrate.

Chelicera (Fig. 4C). Movable digit 28 long, with 2 teeth; fixed digit 26 long, with 7 – 8 teeth and a *pilus dentilis*.

Spermatheca (Fig. 4D). Calyx dish-shaped, 3 long, 13(13–14) in diameter; atrium nodular.

Legs (Fig. 4E). Macrosetae stout and spatulate on legs II and IV, except that on telotarsus IV, knobbed; sharp-tipped on genu and tibia of leg III; with a distinctly stout, spatulate and short seta on genu I, 1 stout, knobbed or blunt seta on femur IV, 1 or 2 similar seta(e) on genu IV, 1 similar seta on tibia IV and on basitarsus IV; spatulate seta on genu I 8 [6], Sge II 12(11–13) [13], Sge III 13(11–14) [13], Sti III 13(11–14) [14], Sge IV 28(24–32) [25], Sti IV 34(33–37) [35], Sbt IV 41(40–42) [43], Stt IV 38(35–40) [36]. Chaetotaxy: genu II: 2-2/0, 2/0-1; genu III: 1-2/1, 2/0-1.

MALE. Not encountered in this study.

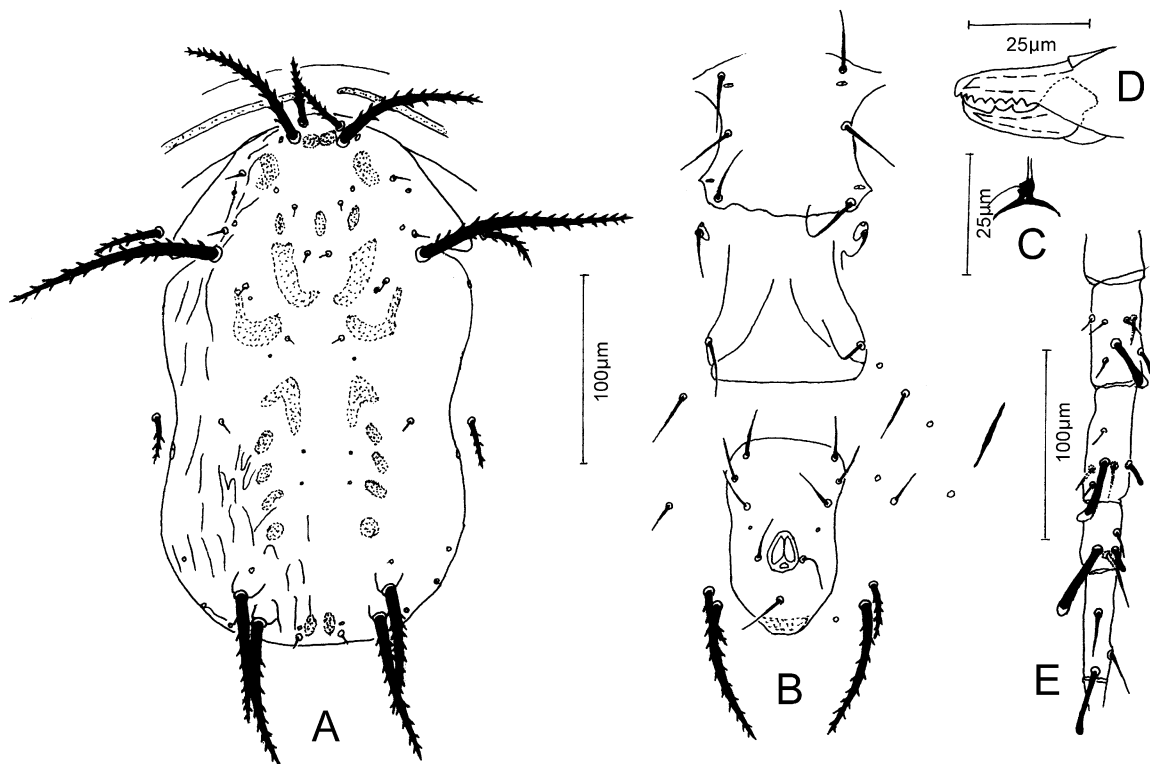


FIGURE 4. *Paraphytoseius orientalis* (Narayanan, Kaur & Ghai) (female): A. Dorsal shield; B. Ventral surface; C. Spermatheca; D. Chelicera; E. Leg IV.

Specimens examined. Burundi: Murongwe, on unknown plant, 25-V-1990, J.S. Yaninek. **Kenya:** 13 km W Kwale, Coastal Province, on *Terminalia catappa* (Combretaceae), 29-XI- 1989, J.S. Yaninek; 13 km N Sigya, Nyanza Province, on unknown plant, 2-XII-1989, J.S. Yaninek. **Mozambique:** Mitilili, Zambezia Province, on *Cajanus cajan* (Fabaceae), 25-IV-2001, B. Agboton. **Rwanda:** ISAR Station, Rubosa, Butare, on *Solanum* sp. (Solanaceae), 6-XII-1989, J.S. Yaninek. **Hong Kong:** (paratype) on *Urena lobata* (Malvaceae), 23-VIII-1960, E. Swirski.

Remarks. There is a controversy in relation to the status of several species of *Paraphytoseius* (Chant & McMurtry, 2003b). Denmark *et al.* (1999) and Matthyse & Denmark (1981) considered *P. horrifera* to be a junior synonym of *P. orientalis* (= *multidentatus*), but Chant & McMurtry (2003b) preferred to consider them different species until the respective type specimens are compared side by side. Our examination of the holo-

type of *P. horrifera* and of a paratype of *P. multidentatus* at different times indicates that the major differences between them are that the former has longer (ca. 20%) Z4, Z5 and s4, and lacks: a distinctly short, thick, spatulate seta on genu I; macrosetae on leg III; and a short, thick, blunt or knobbed seta on both genu and tibia IV. The specimens of *P. horrifera* collected in the present study have a short blunt seta on basitarsus IV and sometimes on femur IV (both apparently absent in the holotype of *P. horrifera*).

World distribution. Benin, Brazil, Burundi, China, Colombia, Costa Rica, Democratic Republic of Congo, Guadeloupe, Hong Kong, India, Japan, Kenya, Madagascar, Malaysia, Martinique, New Caledonia, Nigeria, Pakistan, Philippines, Reunion Island, Rwanda, Taiwan and Venezuela.

Key to the subtribes, genera and species of the tribe Kampimodromini treated in this paper (based on adult females)

- 1 Lateral margin of dorsal shield with distinct incision at level of s4 (Figs. 2A, 3A, 4A) subtribe Paraphytoseiina Chant & McMurtry ... *Paraphytoseius* Swirski & Shechter 2
- Lateral margin of dorsal shield without distinct incision at level of s4 subtribe Kampimodromina Chant & McMurtry ... 4
- 2 Calyx of spermatheca trumpet-shaped (Fig. 2C) *P. ghanaensis* n. sp.
- Calyx of spermatheca dish-shaped (Figs. 3C, 4C) 3
- 3 Fixed cheliceral digit with 7 – 8 teeth; macrosetae present on leg III; short, stout, blunt or knobbed seta present on both genu and tibia IV (Figs. 4D, 4E) *P. orientalis* (Narayanan, Kaur & Ghai)
- Fixed cheliceral digit with 10 – 11 teeth; macrosetae absent on leg III; short, stout, blunt or knobbed seta absent on both genu and tibia IV (Figs. 3D, 3E) *P. horrifera* (Pritchard & Baker)
- 4 Setae J2, S2 and S5 present; with 32 pairs of idiosomal setae; with 8 pairs of dorsal opisthosomal setae (Fig 1A) *Kampimodromus* Nesbitt ... 5
- At least one of setae J2, S2 and S5 absent; with fewer than 32 pairs of idiosomal setae; with fewer than 8 pairs of dorsal opisthosomal setae 6
- 5 Ventrianal shield with 2 pairs of preanal setae (JV1 off ventrianal shield) leg IV; without macrosetae *K. alettae* (Ueckermann & Loots)
- Ventrianal shield with 3 pairs of preanal shield (JV1 on ventrianal shield); leg IV with short, sharp macroseta on basitarsus (Fig. 1E) *K. molle* (Ueckermann & Loots)
- 6 Setae J2 and S5 absent; S2 present *Asperoseius* Chant ... 7
- Setae J2 and S5 present; S2 absent 8
- 7 Seta R1 on membrane surrounding dorsal shield; ventrianal shield oblong and parallel-sided; 2 pairs of setae on membrane surrounding ventrianal shield (JV4 absent) *A. africanus* Chant
- Seta R1 on dorsal shield; ventrianal shield subtriangular; 3 pairs of setae on membrane surrounding ventrianal shield (JV4 present) *A. henryae* Fain & Krantz
- 8 Dorsal setae extremely stout along entire length; female ventrianal shield without pores; dorsocentral setae relatively short, Z1 at least 5 times as long as j6 *Paraamblyseiulella* Chant & McMurtry
- *P. transmontanus* (Ueckermann & Loots)
- Dorsal setae of medium thickness, gradually tapering; female ventrianal shield with a pair of pores; dorsocentral setae relatively long, Z1 at most 2.5 times as long as j6 *Kampimoseiulella* Chant & McMurtry ... 9
- 9 Setae j3, z4, Z1, Z4, Z5, s4 and sometimes j1 and j4 faintly serrate; other setae smooth; Z1 ca. 2.4 times as long as j6; ventrianal shield striate *K. altusus* (Van der Merwe)
- All dorsal setae obviously serrate, except for J5 and z5, which are smooth; Z1 ca. 1.4 times as long as j6; ventrianal shield smooth *K. reburrus* (Van der Merwe)

Phytoseiulini Chant & McMurtry

Phytoseiulini Chant & McMurtry, 2006a: 7.

Key characteristics of this monogeneric tribe are: idiosoma rotund; setae J2, S2 and S4 absent; setae j5 and S5 present or absent; some dorsal setae (j3, j6, z4, s4, Z4, Z5) much longer than others; sternal shield wider than long; female ventrianal shield reduced, with 0 to 1 pair of preanal setae; genital shield wider than ventrianal shield; peritreme extending to level between j3 and z2; legs I – III without macrosetae; leg IV with 1 – 3 or more macrosetae.

***Phytoseiulus* Evans**

Phytoseiulus Evans, 1952: 397; Moraes *et al.*, 2004: 167; Chant & McMurtry, 2006a: 17.

Amblyseius (*Mesoseiulus*), Van der Merwe, 1968: 172.

Amblyseius (*Phytoseiulus*), Pritchard & Baker, 1962: 294.

Mesoseiulus Gonzalez & Schuster, 1962: 18 (Moraes *et al.*, 2004).

Phytoseiulus (*Phytoseiulus*), Wainstein, 1962: 17.

Three species in this genus are reported in this study; idiosomal setal patterns are 9A:5D/JV-3:ZV-3 for *P. longipes* Evans, 10A:6E/JV-3,4:ZV-3 for *P. macropilis* (Banks) and *P. persimilis* Athias-Henriot (Chant & McMurtry, 2006a). They have 2 pairs of metapodal shields and peritreme extending to level of j3.

***Phytoseiulus longipes* Evans**

Phytoseiulus longipes Evans, 1958: 307; Moraes *et al.*, 2004: 167; Chant & McMurtry, 2006a: 20.

Amblyseius (*Amblyseius*) *longipes*, Tseng, 1976: 108.

Amblyseius (*Mesoseiulus*) *longipes*, Van der Merwe, 1968: 172.

Amblyseius (*Phytoseiulus*) *longipes*, Pritchard & Baker, 1962: 294.

Mesoseiulus longipes, Gonzalez & Schuster, 1962: 18.

Remarks: This species was described from specimens collected in Salisbury, Mashonaland South, Zimbabwe (former Rhodesia), on foxglove (*Digitalis purpurea*: Plantaginaceae). It was also reported from South Africa (Van der Merwe, 1968). No additional specimens were collected in the present study.

World distribution. Argentina, Brazil, Chile, South Africa and Zimbabwe.

***Phytoseiulus macropilis* (Banks)**

Laelaps macropilis Banks, 1904: 59.

Amblyseius (*Amblyseius*) *macropilis*, Tseng, 1976: 108.

Amblyseius (*Phytoseiulus*) *macropilis*, Van der Merwe, 1968: 162.

Phytoseiulus macropilis, Moraes *et al.*, 2004: 167; Chant & McMurtry, 2006a: 20.

Phytoseiulus (*Phytoseiulus*) *macropilis*, Wainstein, 1962: 17.

Typhlodromus macropolis [sic], Hirschmann, 1962: 4.

Phytoseiulus chanti Ehara, 1966: 135 (synonymy, Denmark & Muma 1973).

Phytoseiulus speyeri Evans, 1952: 398 (synonymy, Denmark & Muma 1973).

Remarks: This species was described from specimens collected in Eustis, Florida, USA, on water hyacinth (*Eichhornia crassipes*: Pontederiaceae). In Africa, it was reported only from Angola (Carmona, 1968). No additional specimens were collected in the present study.

World distribution. Angola, Argentina, Barbados, Brazil, Canada, Canary Islands, Colombia, Cook Island, Costa Rica, Cuba, Fiji, French Polynesia, Guadeloupe, Guatemala, Hawaii, Honduras, Jamaica, Les Saintes, Marie Galante, Martinique, Mexico, Montenegro, Moto Quavarei, New Caledonia, Panama, Peru, Poland, Portugal, Puerto Rico, Saint Martin, Tahiti, USA and Venezuela.

***Phytoseiulus persimilis* Athias-Henriot**

Phytoseiulus persimilis Athias-Henriot, 1957: 347; Moraes *et al.*, 2004: 169; Chant & McMurtry, 2006a: 20.

Phytoseiulus (Phytoseiulus) persimilis, Wainstein, 1962: 17.

Typhlodromus persimilis, Hirschmann, 1962: 4.

Phytoseiulus riegeli Dosse, 1958: 48 (synonymy, Chant 1959; Kennett & Caltagirone 1968).

Amblyseius tardi Lombardini, 1959: 166 (synonymy Kennett & Caltagirone 1968).

Remarks. This species was described from specimens collected in Staoueli, Alger, Algeria, on *Rosa* sp. (Rosaceae). It was also reported from South Africa (Meyer, 1981). No additional specimens were collected in the present study.

World distribution. Algeria, Australia, Canary Islands, Chile, China, Costa Rica, Finland, France, Greece, Guatemala, Hungary, Israel, Italy, Jordan, Lebanon, Libya, Morocco, New Caledonia, Netherlands, Peru, Reunion Island, South Africa, South Korea, Spain, Tunisia, Turkey, USA (introduced) and Venezuela.

Key to the species of *Phytoseiulus* treated in this paper

- 1 Setae j5 and S5 absent, JV4 present *P. longipes* Evans
- Setae j5 and S5 present, JV4 absent 2
- 2 Ventrianal shield with 1 pair of preanal setae *P. macropilis* (Banks)
- Ventranal shield without preanal setae *P. persimilis* Athias-Henriot

Euseiini Chant & McMurtry

Euseiini Chant & McMurtry, 2005: 191.

Chant & McMurtry (2005) characterized this tribe as having setae s4, Z4 and Z5 rarely much longer than other dorsolateral setae; peritremal shield narrow, fused anteriorly with dorsal shield; peritreme short in many species; sternal shield with a posterior projection (quite often indistinct in mounted specimens); deutosternal groove more than 7 µm wide; genital shield wider than ventrianal shield; female usually with vase-shaped or ovoid ventrianal shield, with some forward migration of preanal setae JV2 and ZV2; occasionally, ventral and anal shields separate.

Subtribe Euseiina Chant & McMurtry

Euseiina Chant & McMurtry, 2005: 191.

Key characteristics of this subtribe are: dorsal shield often more rotund than usual, dorsal setal pattern 10A:9B in all species, except *Moraeseius papayana* (Van der Merwe) in which this pattern is 10A:8A (Z1 absent); setae s4, Z4 and Z5 never greatly elongate or whip-like (except *M. papayana*); peritreme usually not extend-

ing to level of j1; ventral or ventrianal shield with 3 pairs of preanal setae; a pair of prominent crescentic preanal pores on ventrianal shield or between ventral and anal shields; if ventral and anal shields fused, ventrianal shield usually vase-shaped, with marked forward migration of seta JV2 and ZV2; seta JV1 often inserted well behind anterior margin of ventrianal shield; spermatheca variable; chelicera reduced, stubby, with a number of small teeth clustered at the distal end of the fixed digit; males with 3 or 4 pairs of preanal setae arranged approximately in a transverse row.

All of the 3 genera placed in this subtribe (Chant & McMurtry 2005), *Euseius* Wainstein, *Moraeseius* Chant & McMurtry, and *Iphiseius*, are known from sub-Saharan Africa. Moraes *et al.* (2001 & 2006) reported the sub-Saharan African species of the first two genera; the single known species of *Iphiseius* is mentioned in this paper.

Iphiseius Berlese

Iphiseius Berlese, 1916, *nomen nudum*: 33; Berlese, 1921: 95; Moraes *et al.*, 2004: 91; Chant & McMurtry, 2005: 218.

Amblyseius (*Iphiseius*), Muma, 1961: 288.

Iphiseius (*Iphiseius*) Pritchard and Baker, 1962: 298.

The single species in this genus has idiosomal setal pattern 10A:9B/JV-3:ZV, most dorsal shield setae very small; heavily sclerotized shields; peritreme almost reaching j3; projection of posterior margin of sternal shield forked; both sexes with separate ventral and anal shields; preanal pores between ventral and anal shields; female with 2 pairs of metapodal shields.

Iphiseius degenerans (Berlese)

(Fig. 5)

Seius degenerans Berlese, 1889: 9.

Iphiseius degenerans, Moraes *et al.*, 2004: 92; Chant & McMurtry, 2005: 218.

Iphiseius (*Iphiseius*) *degenerans*, Pritchard & Baker, 1962: 298.

FEMALE. (Specimens measured. Benin: 1; Burundi: 1; Cameroon: 1; Ghana: 1; Kenya: 2; Malawi: 1; Rwanda: 1; Sierra Leone: 1; Uganda: 2; Zambia: 1).

Dorsum (Fig. 5A). Dorsal shield 373(363–387) long and 309(290–317) wide, smooth (with lateral striae between z4 and s4 in 1 specimen from Uganda) and heavily sclerotized. Setae j1 24(14–32), j3 5(4–8), j4 4(3–6), j5 4(3–5), j6 5(4–6), J2 6(4–7), J5 6(5–7), z2 5(4–8), z4 5(4–9), z5 4(3–5), Z1 6(5–8), Z4 7(5–9), Z5 14(11–20), s4 9(7–12), S2 8(6–9), S4 9(6–11), S5 9(7–11), r3 12(10–13), R1 9(7–10). All setae smooth.

Venter (Fig. 5B). Sternal shield mostly smooth, with few anterolateral striae; distances between ST1–ST3 49(42–52), ST2–ST2 71(67–73). Genital shield smooth; distance between ST5–ST5 96(91–103). Ventral shield 32(29–34) long and 65(58–73) wide at level of ZV2, smooth, preanal pores posterior to and almost in line with JV2; anal shield smooth, 65(58–73) long and 72(68–77) wide at level of anus. Caudoventral setae smooth and sharp-tipped.

Chelicera. Movable digit 31(27–35) long, with 1–2 teeth; fixed digit 26(24–27) long, with 6–8 teeth and a *pilus dentilis*.

Spermatheca (Fig. 5C). Calyx narrow, tubular, 27(25–28) long; atrium almost same diameter as calyx and major duct.

Legs (Fig. 5D). Macrosetae knobbed; Sge II 22(17–30), Sge III 31(25–42), Sti III 24(20–27), Sge IV 43(35–51), Sti IV 32(26–40), St IV 29(20–38). Chaetotaxy: genu II: 2-2/0,2/0-1; genu III: 1-2/1,2/0-1.

MALE (Specimens measured. Ghana: 1; Kenya: 1; Rwanda: 1; Sierra Leone: 1; Uganda: 1).

Dorsum. Dorsal shield pattern as in female, 318(283–356) long and 255(244–261) wide. Setae j1 20(11–25), j3 5(4–5), j4 3(3–5), j5 3(3–4), j6 4(4–5), J2 4(3–4), J5 5(4–6), z2 4(3–5), z4 4(3–5), z5 3(3–4), Z1 5, Z4 5(4–5), Z5 13(9–16), s4 7(6–9), S2 6(5–7), S4 6(5–8), S5 7(5–10), r3 11(10–12), R1 7(6–9). All setae smooth.

Peritreme. Extending to level between j3 and z2.

Venter (Figs 5F, H, J). Ventral shield 72(65–85) long and 176(172–179) wide at anterior corners, reticulate, with 5 pairs of lyrifissures (3 anterior to JV1, 1 lateral and posterior to JV2, 1 lateral and well posterior to ZV2); preanal pores posterior to and almost in line with JV2; anal shield 50(48–53) long and 66(63–75) wide at level of anus, reticulate laterally.

Spermatodactyl (Figs 5E, G, I). L-shaped; shaft 29(22–45) long.

Legs. Macrosetae knobbed; Sge II 21(18–24), Sge III 27(21–32), Sti III 21(20–24), Sge IV 36(30–40), Sti IV 28(27–30) and St IV 28(26–32). Chaetotaxy of genua II and III same as in female.

Specimens examined: Two females, **Benin:** 14 km S Tamarou, Département de Borgou, on *Daniella oliveri* (Liliaceae), 22-XI-1989, J.S. Yaninek. Five females, **Burundi:** Rumonge, Buriri Province, on *Manihot esculenta* (Euphorbiaceae), 14-XII-1989, J.S. Yaninek. One female, **Cameroon:** 12 km S Obala, on *Elaeis guineensis* (Arecaceae), 5-II-1991, L. Louis. Two females and 1 male, **Ghana:** Pokoase, Great Accra Region, on *Annona* sp. (Annonaceae), 7-XI-1989, G.J. Moraes. Seven females and 7 males, **Kenya:** 10 km E Kisii, on *Ricinus communis* (Euphorbiaceae), 3-XII-1989 J.S. Yaninek; Kericho, Rift valley Province, on *Brachychiton acerifolium* (Sterculiaceae), 4-XII-1989, J.S. Yaninek. Ten females, **Malawi:** Zomba, Southern Province, on *Manihot esculenta*, 12-VI-1984, I. Robertson; 10 km SSE Chiweta, Northern Province, *Manihot esculenta*, 06-V-2000, I.D. Zannou. Two females and 1 male, **Rwanda:** unknown location, on *Musa sapientum* (Musaceae), 9-XII-1989, J.S. Yaninek. Two females and 1 male, **Sierra-Leone:** 5 km E Rokimbi, on *Elaeis guineensis*, 14-I-1992, A. Kebbie. **Uganda:** 22 km N Kagadi, Hoima, on *Saccharum officinarum* (Poaceae), 10-X-1990, J.S. Yaninek; Kabarole, on *Manihot esculenta*, 8-X-1990, E. Karamura.

Remarks. The lengths of several dorsal shield setae of this species are markedly variable within and between specimens from the same or from different countries. The greatest variations were observed for j1, Z5 and s4. For each of those setae, the maximum length corresponded to ca. twice the minimum length. Those setae were shorter for specimens from Cameroon. The length of the spermatodactyl and the number of setae on the ventrianal shield of males were also variable. In Kenya, 3 males collected on *Ricinus communis* ca. 10 km E Kisii had spermatodactyl ca. 46 long and 4 pairs of preanal setae (Figs. 5I, 5J). Most other males collected in Kenya, as well as all males collected in other countries had spermatodactyl ca. 23 long and 3 pairs of preanal setae (Figs. 5E, 5F). Males from Tanzania reported by Evans (1954), from South Africa reported by van der Merwe (1968) as well as from Italy (our own unpublished observation), have the short type of spermatodactyl and 3 pairs of preanal setae. A single female was found associated with males that have 4 pairs of preanal setae and long type of spermatodactyl; that female fits very well the description of *I. degenerans*. The characteristics of the morphologically different males from Kenya suggested that those specimens could correspond to a new species, whose female was similar to *I. degenerans*. However, one male collected on *Brachychiton acerifolium* in Kericho, also in Kenya, had the short type of spermatodactyl and 4 pairs of preanal setae (Figs. 5G, 5H); the position of the extra preanal seta was not the same as in the 3 males collected near Kisii. This male could represent an intermediate between the specimens found near Kisii and other specimens. Thus, because of this variation in the morphology of males from different populations, it was decided for the time being to consider all of those specimens as *I. degenerans*.

World distribution. Algeria, Benin, Burundi, Cameroon, Canary Islands, Cape Verde, Democratic Republic of Congo, Egypt, Ghana, Georgia, Greece, Israel, Italy, Kenya, Lebanon, Madeira Island, Madagascar, Malawi, Morocco, Nigeria, Portugal, Rwanda, Sierra Leone, South Africa, Tanzania, Turkey, Uganda, Yemen and Zimbabwe.

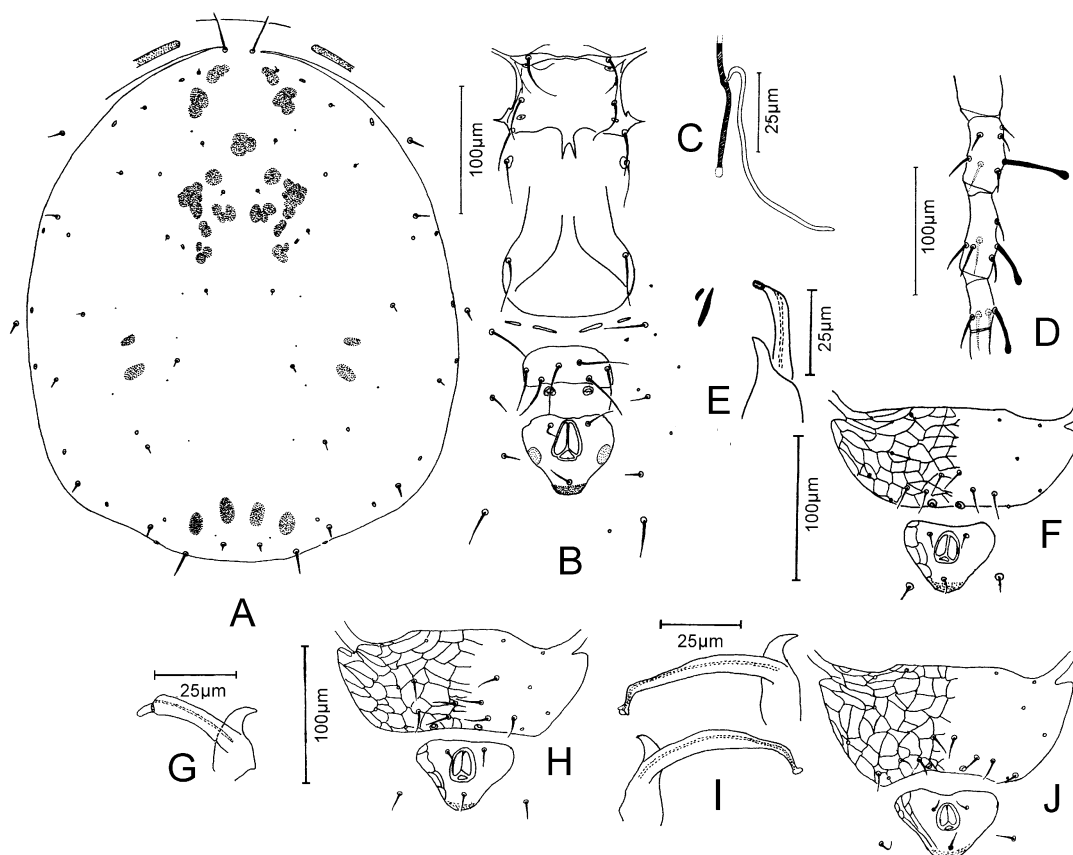


FIGURE 5. *Iphiseius degenerans* (Berlese): A. Female dorsal shield; B. Female ventral surface; C. Spermatheca; D. Female leg IV; E. Short type spermatodactyl of a male (from Kericho, Kenya) with 3 pairs of preanal setae; F. Ventrianal shield a male (from Kericho, Kenya) with short type spermatodactyl; G. Short type spermatodactyl of a male (from Kericho, Kenya) with 4 pairs of preanal setae; H. Ventrianal shield of a male (from Kericho, Kenya) with short type spermatodactyl; I. Long type spermatodactyl of a male (from ca. 10 km E Kisii, Kenya) with 4 pairs of preanal setae; J. Ventrianal shield of a male (from ca. 10 km E Kisii, Kenya) with long type spermatodactyl.

Neoseiulini Chant & McMurtry

Neoseiulini Chant & McMurtry, 2003a: 6.

Key characteristics of species of this tribe are: ratio between the lengths of s4 and Z1 less than 3.0; dorsolateral setae short or of medium length, subequal (except for seta Z5 on some species); dorsocentral setae not minute [except in the *canadensis* species group of Chant & McMurtry (2003a), in the genus *Neoseiulus* Hughes, 1948], s4 usually less than 3 times as long as j6 and less than 2 times as long as z4; setae z2 and z4 never minute; dorsal setae setiform, at most lightly serrated, never arising from tubercles (except for *C. camposi*); setae J2, Z1, S2, S4 and S5 present; peritreme usually extending to level of seta j1; sternal shield without posterior projection, posterior margin straight or concave; deutosternal groove relatively narrow (< 4-5 µm wide); genital shield narrower than ventrianal shield, or of about the same width; female ventrianal shield usually pentagonal, without forward migration of setae JV2 or ZV2; spermatheca variable; fixed cheliceral digit usually with few teeth; leg I always and legs II–III usually without macrosetae.

Of the 10 genera of this subtribe (Chant & McMurtry 2003a), only *Neoseiulus* Hughes and *Paragigagnathus* Amitai & Grinberg are known from sub-Saharan Africa. Zannou *et al.* (2006) reported the sub-Saharan African species of *Neoseiulus*; only the species of *Paragigagnathus* are reported in this paper.

Paragigagnathus Amitai & Grinberg

Paragigagnathus Amitai & Grinberg, 1971: 327; Chant & McMurtry, 2003a: 39; Moraes *et al.*, 2004: 158.
Afrogigagnathus Yousef, 1974: 381 (synonymy, Chant & McMurtry 2003a).
Amblyseius (Pamiroseius), Karg, 1983: 313. (Chant & McMurtry 2003a).
Ansaria Chaudhri, Akbar & Rasool, 1979: 63 (synonymy, Chant & McMurtry 2003a).
Pamiroseius Wainstein, 1973: 954 (synonymy, Chant & McMurtry 2003a).
Phytocerus Amitai & Swirski, 1978: 124 (synonymy, Chant & McMurtry 2003a).

Key characteristics of species in this genus are: dorsal shield strongly sclerotized, often strongly ornamented; idiosomal setal pattern 10A:9B/JV-3:ZV; peritreme reaching or almost reaching level of j1; sternal shield as long as wide, with posterior margin variable, ST3 inserted on or off the shield; genital shield with posterior margin truncate; ventrianal shield much longer than wide, usually sole-shaped, with 2 or 3 pairs of preanal setae, with seta JV2 well posterior to JV1; seta ZV2 close to longitudinal line between bases of JV1 and JV2; spermatheca with atrium usually bulbous and calyx cup-, dish- or funnel-shaped; fixed cheliceral digit with 1 – 3 apical teeth; primary metapodal shield usually long, narrow; legs without macrosetae or with a single macroseta on basitarsus IV.

Paragigagnathus cataractus (Ueckermann & Loots)

Amblyseius (Amblyseius) cataractus Ueckermann & Loots, 1988: 115.
Paragigagnathus cataractus, Chant & McMurtry, 2003a: 44; Moraes *et al.*, 2004: 159.

Remarks: This species was described from specimens collected from Aughrabies Falls National Park, Cape Province, South Africa, on *Acacia mellifera* (Mimosaceae). No additional specimens were collected in the present study.

World distribution. South Africa.

Paragigagnathus namibiaensis (Ueckermann & Loots)

Amblyseius (Amblyseius) namibiaensis Ueckermann & Loots, 1988: 118.
Paragigagnathus namibiaensis, Chant & McMurtry, 2003a: 44; Moraes *et al.*, 2004: 159.

Remarks: This species was described from specimens collected in Gobabeb, Namibia, on *Tamarix* sp. (Tamaricaceae). No additional specimens were collected in the present study.

World distribution. Namibia.

Key to the species of *Paragigagnathus* treated in this paper

- 1 All dorsal setae serrate except z5, smooth; spermatheca with atrium bulbous and calyx dish-shaped
..... *P. cataractus* (Ueckermann & Loots)
- All dorsal setae smooth; spermatheca with atrium almost indistinct and calyx funnel-shaped
..... *P. namibiaensis* (Ueckermann & Loots).

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