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Description of immatures and ontogenetic development of *Africoseiulella flechtmanni* Kreiter, type species of the enigmatic family Africoseiulellidae (Acari: Mesostigmata: Phytoseioidea)

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Original research

ABSTRACT

The genus *Africoseiulella* Kreiter was established to accommodate a species initially included in the family Phytoseiidae. Four species of this genus are currently known, and a recent study has examined its phylogenetic position, placing it within the newly proposed family Africoseiulellidae. All four species have been described based on adult forms, with immature stages remaining unknown or poorly known. In the present work, all developmental stages of the type species, *A. flechtmanni* Kreiter, are described, and the ontogenetic sequence of setal development on the dorsal and ventral idiosoma, palps, and legs is documented. The development of leg chaetotaxy is compared with the commonest pattern in Phytoseiidae. In addition, the patterns of appearance of cuticular organs, including pores and poroids, are reported. A complementary description of the adults, based on specimens collected in the Canarian Island of Fuerteventura, is also provided.

Keywords mite ontogeny; immature stages; chaetotaxy; adenotaxy; Canary Islands
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Introduction

Africoseiulella flechtmanni Kreiter, a peculiar mesostigmatic mite, was first described from an unidentified low shrub in a palm growing inside the Tunisian desert (Kreiter & Tixier, 2006). Aware of the taxon´s originality, the authors erected the new genus *Africoseiulella* Kreiter to accommodate it, and paid particular attention to its taxonomic position within the family Phytoseiidae. They concluded that it is probably a member of the tribe Metaseiulini Chant & McMurtry in the subfamily Typhlodrominae, although they expressed doubts about this placement. Later, El-Banhawy *et al.* (2025) described a second species in the genus, *A. sedishazlensis* El-Banhawy, Nasr & Ramadan, from Egypt, and Mirza *et al.* (2025) transferred the previously described *Nabiseius arabicus* Negm & Alatawi to *Africoseiulella*. Recently, Kazemi *et al.* (2025) described a fourth species, *A. hajiqanbari* Kazemi, Klompen & Faraji, whose females were collected from the house cricket *Acheta domesticus* (L) in Iran, apparently displaying phoretic behaviour. These latter authors conducted a thorough comparative study of the most significant characters of the genus (the reduction in the number of leg tarsi II–IV and palp setae, the undivided palp tarsus apotele, and the presence of a membranous lobe associated with the movable digit of chelicera) among the families of Phytoseioidea. They concluded that

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the absence of basitarsal setae *al3* and *pl3* on tarsi II–IV, of *ad2* on tarsus IV, the undivided palp tarsal apotele and the lobe attached to the cheliceral movable digit are unique and distinctive features in the superfamily Phytoseioidea and very rare within the whole order Mesostigmata. After that, they redefined *Africoseiulella*, removed it from Phytoseiidae, and established a new family, Africoseiulellidae Kazemi & Klompen, to accommodate the genus.

The type species of the genus, *A. flechtmanni*, was originally described from females, males, and deutonymphs, and later redescribed by Kazemi *et al.* (2025) using the same type material. In both cases the deutonymphal stage was not completely characterized, probably due to the bad condition of specimens, and the larva and protonymph were, still, undescribed. In a survey in the Canarian Island of Fuerteventura I had the opportunity to collect an abundant sample of this species in a semidesert environment, within the bed of a dry ravine, which geomorphologically resembles the North African wadis. The sample included all motile developmental stages, which allowed for a complete description of immatures and the documentation of the changes occurring during development in the appearance of idiosomal, leg and palp setae, as well as the cuticular structures, pores and poroids. Hence, this is the first study on the ontogeny of this species and family. The complete ontogenetic description will enable further research to clarify the taxonomic affinities within the subfamily Phytoseioidea and elucidate the independence of characters in the absence of ontogenetic correlations among them.

Material and methods

The mites were collected by the author in Fuerteventura Island and extracted from plants beating twigs and leaves on a fine sieve. Specimens were mounted and clarified in Heinze-PVA medium and stored in an oven at 50 °C until total clarification. After that, they were examined using differential interference contrast (DIC) in a compound microscope Nikon Eclipse Ni-U (Nikon Corporation, Tokyo, Japan). Images were captured with a digital camera Nikon DS-Fi3 (Nikon Corporation, Tokyo, Japan) and edited in Lightroom and Photoshop CC (© Adobe Systems Inc.). Measurements of morphological traits were obtained with the software NIS-Elements D 3.1 and are given in the text in micrometres (μm). They are represented as the range of all the specimens measured. The length of the first cheliceral segment was taken from its base to the base of the second segment; the second segment was measured from the base to the apex of the fixed digit. The cheliceral fixed digit length was measured from dorsal lyrifissure to the tip; the movable digit from basal articulation to tip. The length of adult legs was obtained from the base of the coxa to the end of tarsus, excluding the ambulacrum.

The generic concept is that proposed by Kreiter (in Kreiter and Tixier, 2006), recently modified by Kazemi *et al.* (2025). Idiosomal setal nomenclature follows that of Lindquist and Evans (1965) as adapted by Rowell *et al.* (1978). Leg and palp chaetotaxy is that proposed by Evans (1963; 1964) and Rowell and Chant (1979). Nomenclature for idiosomal solenostomes and poroids follows Athias-Henriot system (Athias-Henriot, 1975) later modified by Moraza (2025).

Results

Family Africoseiulellidae Kazemi & Klompen, 2025

Genus *Africoseiulella* Kreiter, 2006

Africoseiulella flechtmanni Kreiter, 2006

Specimens examined and depository

Twenty-two females, nine males, eight deutonymphs, three protonymphs, two larvae on *Heliotropium ramosissimum* (Boraginaceae) and four females on *Ononis hesperia* (Fabaceae); Tindaya, Barranco de Esquinzo, 28º37′47″N, 14º00′18″W, 59 m a.s.l. (above sea level); 26

May 2024. Three females and one deutonymph on *Suaeda* sp. (Amaranthaceae); El Cotillo, Aljibe de la Cueva beach, 28º39′53″N, 14º00′41″W, 18 m a.s.l.; 27 May 2024. Both localities in the island of Fuerteventura, Canary Islands.

Eleven females, one male, and four deutonymphs were deposited in the Museo de Ciencias Naturales de Tenerife, Santa Cruz de Tenerife, Canary Islands. The remaining specimens are in the Acari collection, Instituto Agroforestal Mediterráneo, Universidad Politécnica de Valencia.

Geographical distribution

Described from a palm oasis in the Tunisian desert. This is the second record of the species.

Description of motile immature stages

Larva (two larvae examined and measured. Figures 1 a–b, 2 a–c)

Dorsal and lateral idiosoma —(Figure 1a). Podonotal shield 121–123 long, 96–99 wide at level of *s4*. Seven pairs of short and pointed setae: *j1*, *j3*, *j4*, *j5*, *j6*, *z2*, *z5* on the shield, *z4*, *s4* off the shield. Shield evenly smooth, bearing poroids *id2*, *id4*, *id5,* and *id6*. Soft integument around the shield forming pebble protuberances. Mesonotal region with three-four shields (mesonotal scutella) arranged as follows: two lateral shields with poroids *id3* and *idl1*?, and a median shield which can be single or divided into two, bearing poroids *idm1*. Pygidial shield (44 long, 42–45 wide) bearing the setae *Z4* and the poroids *idm2*, *idm3*, *idm4*, and *idl4*. Lengths of *j1* 6, *j3* 5–6, *j4*, *j5* 4, *j6* 6, *z2*, *z4*, *z5* 5–6, *Z4* 4–5, *s4* 5.

Ventral idiosoma — (Figure 1b). Total length of tritosternum 57–60, distally divided into two laciniae, 25–29 long; each lacinia with just 2–3 barbs. Sternal shield 85–90 long, 39–43 wide at level of setae *st2*. Setae *st1–st3* present; poroid *iv1* off the shield. Surface of the shield ornamented, with piriform or elliptical cells oriented axially. Soft integument between the sternal and anal plates with protuberances and folds, scarcer and more isolated than on the dorsum. A pair of subcuticular "funicules» (sensu Athias-Henriot, 1971) anterior to the anal plate. Anal plate 24–27 long, 36 wide. Setae *ZV2* and *ZV3*, some setal nubs (*JV5*?), and poroid *ivp* surrounding the anal valves. Setae *ZV3* twice as long as *ZV2*, 6–7 and 3 long, respectively. Cribrum not developed.

Gnathosoma — Base of gnathosoma 35–37 long, 37–41 wide. Anterior margin of tectum straight, not extended forward. First cheliceral segment 7-10; second segment 47–50 long. Hypostomal setae *h1* 8–9, *h2* 5. Fixed digit of chelicera 9 long, movable digit 8–9 long; dentition of both digits undiscernible. Chaetotactic formula of palps (from trochanter to tarsus): 0-4-5-12-11. Anterolateral setae on palp femur and genu thickened, but not expanded distally. Apotele conical, undivided, 7 long.

Legs — (Figure 2 a–c). Coxa of leg I with discontinuous sclerotization at the dorsal side. Interruptions of sclerotization not observed on other coxae or leg segments. Setae on legs short,

Table 1 Above, chaetotaxy of dorsum and venter in all the stages of *Africoseiulella flechtmanni*, with indication of setal additions (in bold). Below, ontogenetic pattern in the development of pores and poroids. Additions of new organs are highlighted in bold.

Stage	Podonotum	Opisthonotum	Intercoxal region	Opisthogastric region
L	*j1, j3, j4, j5, j6, z2, z4, z5, s4*	*Z4*	*st1, st2, st3*	*ZV2, ZV3, pa1, pa2, ps*
PN	*j1, j3, j4, j5, j6, z2, z4, z5, s4,* ***s6*** , ***r3***	***J2*** , ***J5*** , *Z4,* ***Z5*** , ***S2*** , ***S5***	*st1, st2, st3*	***JV2*** , ***JV5*** , *ZV2, ZV3, pa1, pa2, ps*
DN	*j1, j3, j4, j5, j6, z2,* ***z3*** , *z4, z5, s4, s6, r3*	*J2, J5, Z4, Z5, S2, S5*	*st1, st2, st3,* ***st4*** , ***st5***	*JV2, JV5, ZV2, ZV3, pa1, pa2, ps*
A	*j1, j3, j4, j5, j6, z2, z3, z4, z5, s4, s6, r3*	*J2, J5, Z4, Z5, S2, S5*	*st1, st2, st3, st4, st5*	*JV2, JV5, ZV2, ZV3, pa1, pa2, ps*

Stage	Gland openings	Dorsal and lateral poroids	Ventral poroids
L	–	*id2, id3, id4, id5, id6, idl1, idl4, idm1, idm2, idm3, idm4*	*iv1, ivp*
PN	***gp, gvi, gv3***	*id2, id3, id4, id5, id6, idl1,* ***idl2*** , ***idl3*** , *idl4,* ***idl5*** , *idm1, idm2, idm3, idm4,* ***idm5*** , ***ip***	*iv1,* ***iv2*** , ***ivo1*** , ***ivo2*** , *ivp*
DN	*gp, gvi, gv3*	***id1*** , *id2, id3, id4, id5, id6, idl1, idl2, idl3, idl4, idl5, idm1, idm2, idm3, idm4, idm5, ip*	*iv1, iv2,* ***iv3*** , ***iv5*** , *ivo1, ivo2, ivp,* ***ip***
A	*gp, gvi, gv3*	*id1, id2, id3, id4, id5, id6, idl1, idl2, idl3, idl4, idl5, idm1, idm2, idm3, idm4, idm5, ip*	*iv1, iv2, iv3, iv5, ivo1, ivo2, ivp, ip*

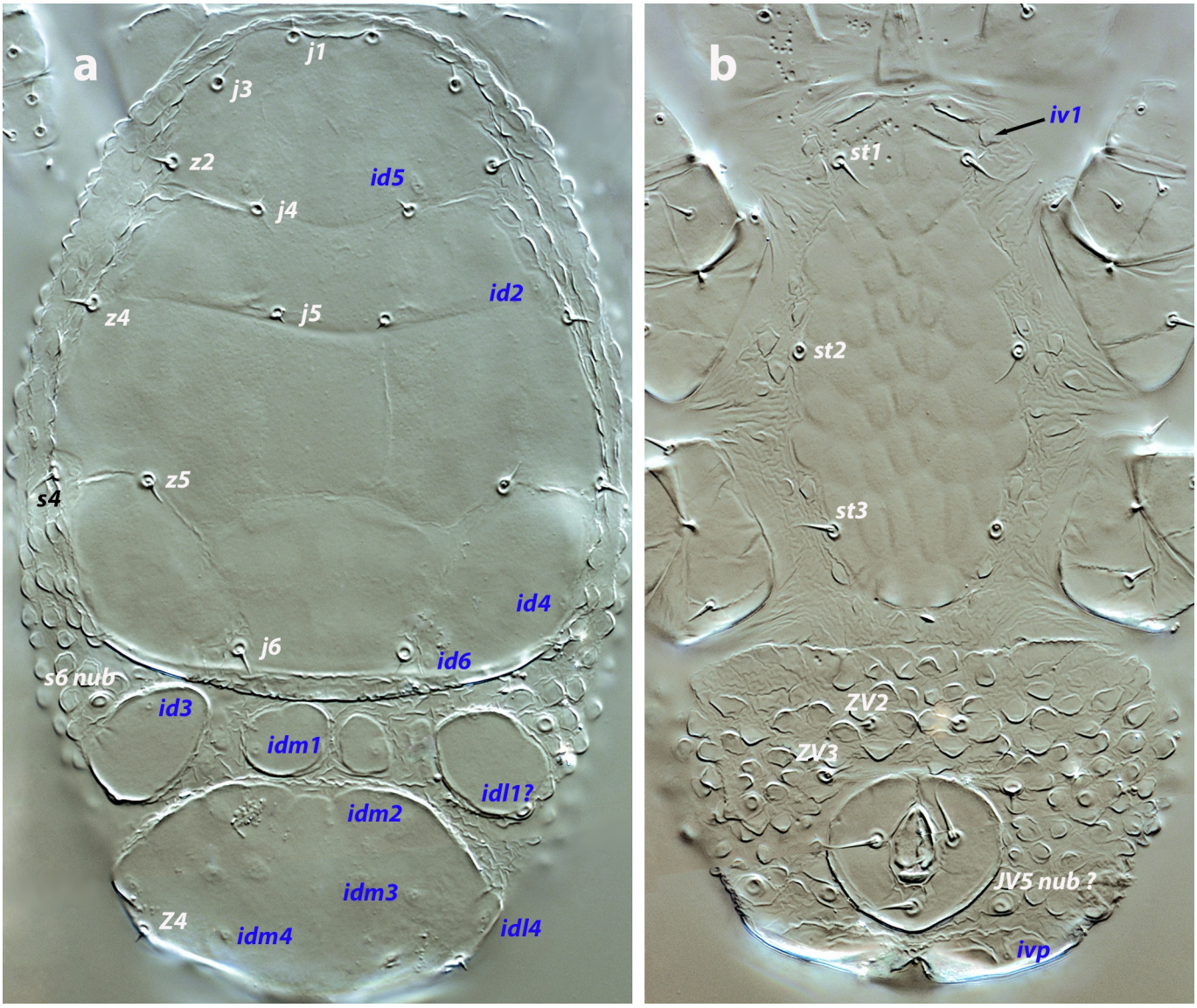

Figure 1 *Africoseiulella flechtmanni* larva. a – dorsal surface. b – ventral surface.

smooth and acuminate, except the longer ventral setae on tarsi I–III. Chaetotaxy of leg segments I–III: coxae 2-2-2; trochanters 4-4-4; femora 10-7-5; genua 8-6-6; tibiae 8-7-7; basitarsi 0-2-2. Detailed leg chaetotaxy in Table 2. Setal formulae from trochanter to basitarsus as follows. Leg I: trochanter 1 0/0, 0/2 1; femur 2 2/1, 2/1 2; genu 1 2/1, 2/1 1; tibia 1 2/1, 2/1 1. Leg II: trochanter 1 0/1, 0/1 1; femur 1 2/1, 2/0 1; genu 1 2/0, 2/0 1; tibia 1 1/1, 2/1 1; basitarsus 0 1/0, 1/0 0. Leg III: trochanter 1 1/1, 0/1 0; femur 1 2/1, 1/0 0; genu 1 2/0, 2/0 1; tibia 1 1/1, 2/1 1; basitarsus 0 1/0, 1/0 0. Without macrosetae.

Protonymph (three protonymphs examined and measured. Figures 2 d; 3 a–b; 8 h)

Dorsal and lateral idiosoma — (Figure 3a). Podonotal shield 121–133 long, 117–122 wide at level of *s4*. Seven pairs of short and pointed setae on the shield: *j1*, *j3*, *j4*, *j5*, *j6*, *z2*, *z5*; *z4*, *s4*, *s6* and *r3* off the shield. Surface of the shield smooth but showing the characteristic punctate pattern, with poroids *id2*, *id4*, *id5,* and *id6*. Pygidial shield 89–102 long, smooth, with five pairs of setae (*J2*, *J5*, *Z4*, *Z5*, *S5*) and nine pairs of poroids (*id3, idm1*, *idm2*, *idm3*, *idm4*, *idm5*,

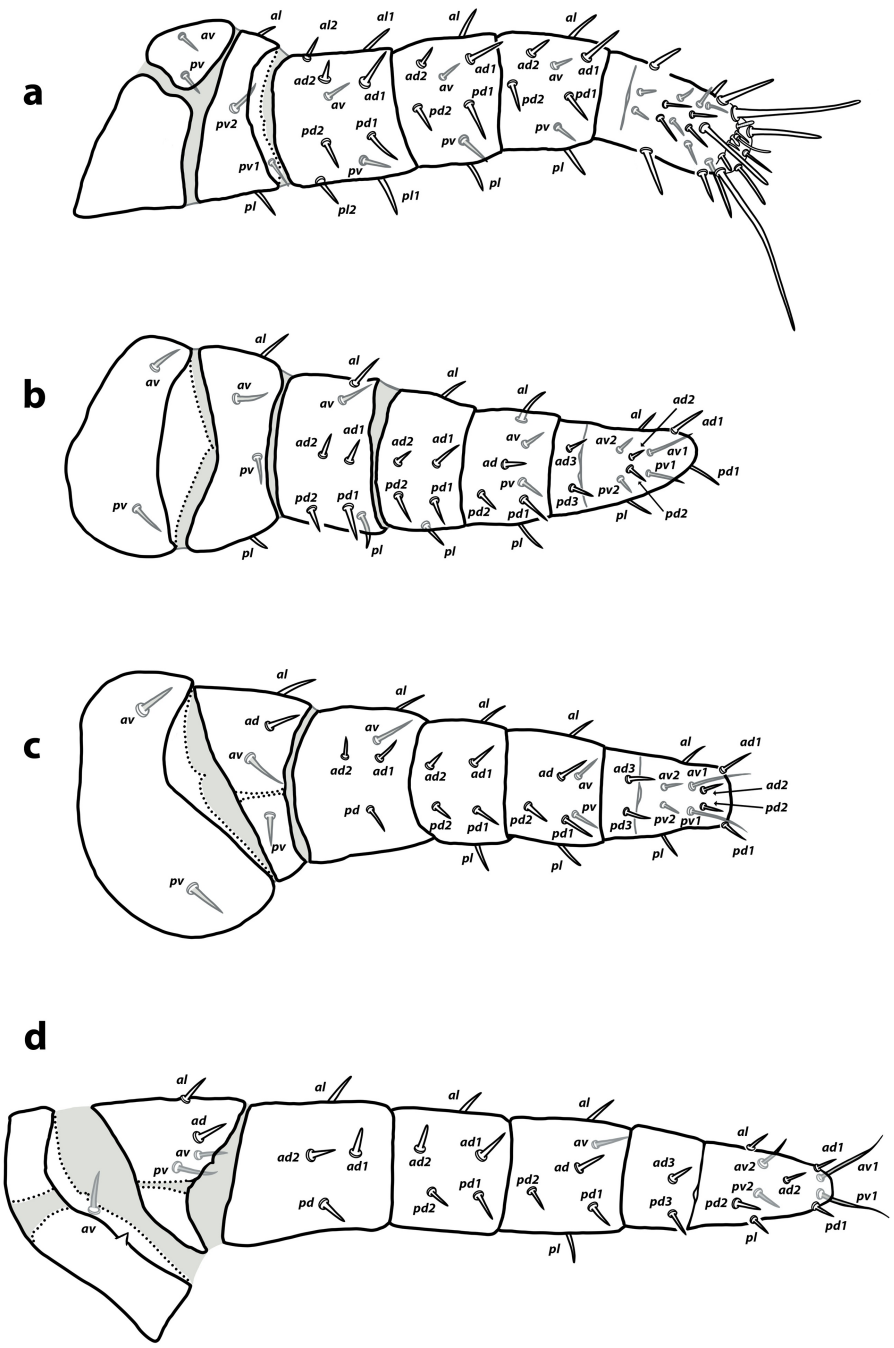

Figure 2 *Africoseiulella flechtmanni* larva. a–c Legs I–III, respectively. Protonymph. d – Leg IV.

idl2, *idl3*, *idl4*); setae *S2* and poroids *idl1* and *idl5* on the lateral integument. Podonotal and pygidial shields contiguous, without soft cuticle between them or mesonotal scutella. Lengths of *j1*, *j3* 5–6, *j4*, *j5* 3–4, *j6, J2* 4–5, *J5* 3, *z2*, 5–6, *z4* 6, *z5, Z4* 4–5, *Z5* 6, *s4* 6–7, *s6* 6, *S2*, *S5* 5–6. Setae *r3* 4–5. Peritremes 19–21 long, covered internally by microvilli, with a posterior

extension bearing the gland pore *gvi* (*gdp* in Athias-Henriot´s system). Primordial peritrematal shield anterior and separated from the peritreme, 19–21 long, not reaching the level of setae *r3* and bearing the solenostome *gp* (*gd3* in Athias-Henriot´s system) and the poroid *ip*.

Ventral idiosoma — (Figure 3b). Tritosternum 62–66 long, its base 14 wide, with two laciniae barely barbed, 36–43. Sternal shield 90–99 long, 46–47 wide at level of setae *st2*. Setae *st1–st3* and poroids *iv1* and *iv2* present. Shield ornamented with a pattern similar to that of larva. Anterior and lateral soft integument folded, posterior integument with protuberances. Preanal pores *gv3* present, but hardly discernible. Region surrounding the anal plate transversally striated or folded, with setae *JV2*, *ZV2*, *ZV3*, *JV5*, and poroids *ivo1*, *ivo2*, and *ivp*. Setae *JV2*, *ZV2*, and *ZV3* similar in length (6–7 long).

Gnathosoma — (Figure 8h). Base of gnathosoma 55–63 long, 51–65 wide. Anterior margin of gnathotectum similar in shape but smaller than in adult. Deutosternal channel with ten rows of single and median spicules. First cheliceral segment 7–10; second segment 47–50 long. Setae *h1* 7–9, *h2* 4–5, *h3* 5–6, *pc* 6. Fixed digit of chelicera 10–12 long, with two small teeth in the middle and two at the base of the digit, subapical denticle undiscernible; movable digit 8–9 long, edentate. Without pilus dentilis. Large membranous lobe attached to movable digit. Chaetotactic formula of palps (trochanter to tarsus): 1-4-5-12-12. Setae *al* on palpfemur and palpgenu acicular. Apotele conical, 7–8 long.

Legs — (Figure 2d). Sclerotization of coxae I–II and trochanter III interrupted; not as clear in other segments due to the poor degree of sclerotization. Setal morphology similar to that of larva. Chaetotaxy of leg segments I–IV (Figure 2 d; Table 2): coxae 2-2-2-1; trochanters 4-4-4-4; femora 10-7-5-4; genua 8-6-6-5; tibiae 8-7-7-6; basitarsi 0-2-2-2. Setal formulae of the three first pair of legs similar to those in the larva (Table 2). Setal formula of leg IV (from trochanter to basitarsus): trochanter 1 1/1, 0/1 0; femur 1 2/0, 1/0 0; genu 1 2/0, 2/0 0; tibia 1 1/1, 2/0 1; basitarsus 0 1/0, 1/0 0. Without macrosetae.

Deutonymph (nine deutonymphs examined; five measured. Figures 4 a–b; 5; 8i)

Dorsal and lateral idiosoma — (Figure 4a). Podonotal and pygidial shields fused into a holodorsal shield, 234–246 long, 105–117 wide. Anterolateral margin of dorsal shield between setae *z2–z4* concave, with setal insertions and poroid *id2* in marginal position. Surface of the shield smooth, finely punctate, apparently more sclerotized on the inner region than on the margins. Absence of solenostomes; poroids sticking out from the surface, elongated; the complete set of sixteen poroids present. All the dorsal setae very short and blunt, subequal in length except the minute *J5*. Setae *s4*, *s6*, *S2*, and *r3* on the soft cuticle. Lengths of *j1*, *j3* 5–6,

Table 2 Changes in leg chaetotaxy of motile stages of *Africoseiulella flechtmanni*. Names of setae in bold indicates the additions to leg segments. L, PN, DN, and A are the larva, protonymph, deutonymph, and adult stages, respectively.

Leg	Stage	Coxa	Trochanter	Femur	Genu	Tibia	Basitarsus
I	L	*av, pv*	*al, pl, pv1, pv2*	*al1, al2, ad1, ad2, av, pl1, pl2, pd1, pd2, pv*	*al, ad1, ad2, av, pl, pd1, pd2, pv*	*al, ad1, ad2, av, pl, pd1, pd2, pv*	–
	PN	*av, pv*	*al, pl, pv1, pv2*	*al1, al2, ad1, ad2, av, pl1, pl2, pd1, pd2, pv*	*al, ad1, ad2, av, pl, pd1, pd2, pv*	*al, ad1, ad2, av, pl, pd1, pd2, pv*	–
	DN	*av, pv*	*al,* ***av****, pl, pv1, pv2*	*al1, al2, ad1, ad2, av, pl1, pl2, pd1, pd2, pv1,* ***pv2***	*al, ad1, ad2, av, pl, pd1, pd2, pv*	*al, ad1, ad2, av, pl, pd1, pd2, pv*	–
	A	*av, pv*	*al, av, pl, pv1, pv2*	*al1, al2, ad1, ad2, av, pl1, pl2, pd1, pd2, pv1, pv2*	*al, ad1, ad2, av, pl, pd1, pd2, pv*	*al, ad1, ad2, av, pl, pd1, pd2, pv*	–
II	L	*av, pv*	*al, av, pl, pv*	*al, ad1, ad2, av, pl, pd1, pd2*	*al, ad1, ad2, pl, pd1, pd2*	*al, ad, av, pl, pd1, pd2, pv*	*ad3, pd3*
	PN	*av, pv*	*al, av, pl, pv*	*al, ad1, ad2, av, pl, pd1, pd2*	*al, ad1, ad2, pl, pd1, pd2*	*al, ad, av, pl, pd1, pd2, pv*	*ad3, pd3*
	DN	*av, pv*	*al, av, pl, pv1,* ***pv2***	*al1,* ***al2****, ad1, ad2, av, pl, pd1, pd2,* ***pv***	*al, ad1, ad2, pl, pd1, pd2*	*al, ad, av, pl, pd1, pd2, pv*	*ad3, pd3*
	A	*av, pv*	*al, av, pl, pv1, pv2*	*al1, al2, ad1, ad2, av, pl, pd1, pd2, pv*	*al, ad1, ad2, pl, pd1, pd2*	*al, ad, av, pl, pd1, pd2, pv*	*ad3, pd3*
III	L	*av, pv*	*al, ad, av, pv*	*al, ad1, ad2, av, pd*	*al, ad1, ad2, pl, pd1, pd2*	*al, ad, av, pl, pd1, pd2, pv*	*ad3, pd3*
	PN	*av, pv*	*al, ad, av, pv*	*al, ad1, ad2, av, pd*	*al, ad1, ad2, pl, pd1, pd2*	*al, ad, av, pl, pd1, pd2, pv*	*ad3, pd3*
	DN	*av, pv*	*al, ad, av, pv*	*al, ad1, ad2, av,* ***pl****, pd*	*al, ad1, ad2, pl, pd1, pd2*	*al, ad, av, pl, pd1, pd2, pv*	*ad3, pd3*
	A	*av, pv*	*al, ad, av, pv*	*al, ad1, ad2, av, pl, pd*	*al, ad1, ad2, pl, pd1, pd2*	*al, ad, av, pl, pd1, pd2, pv*	*ad3, pd3*
IV	PN	*av*	*al, ad, av, pv*	*al, ad1, ad2, pd*	*al, ad1, ad2, pd1, pd2*	*al, ad, av, pl, pd1, pd2*	*ad3, pd3*
	DN	*av*	*al, ad, av,* ***pl****, pv*	*al, ad1, ad2,* ***av****,* ***pl****, pd*	*al, ad1, ad2,* ***av****,* ***pl****, pd1, pd2*	*al, ad, av, pl, pd1, pd2*	*ad3, pd3*
	A	*av*	*al, ad, av, pl, pv*	*al, ad1, ad2, av, pl, pd*	*al, ad1, ad2, av, pl, pd1, pd2*	*al, ad, av, pl, pd1, pd2*	*ad3, pd3*

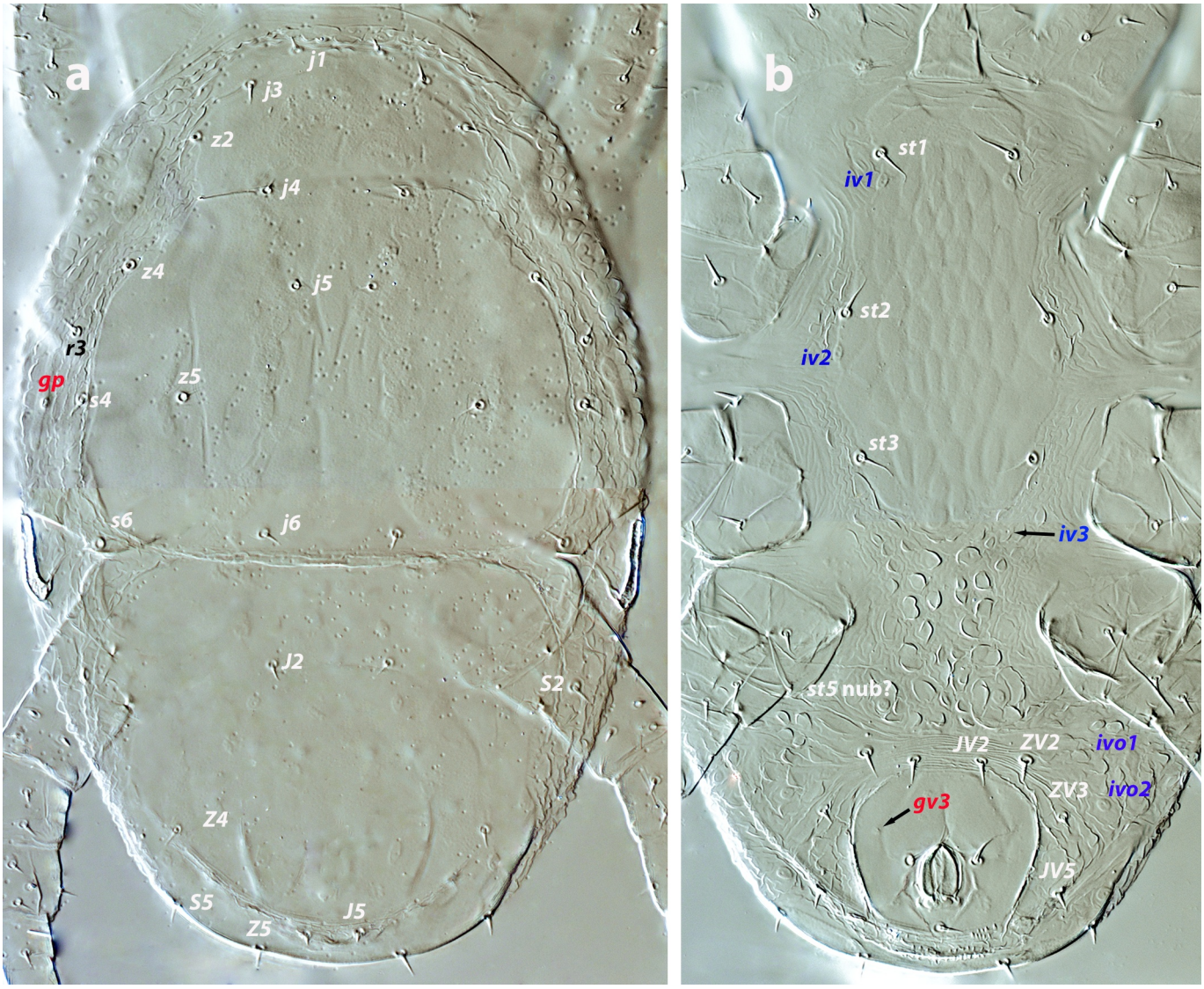

Figure 3 *Africoseiulella flechtmanni* protonymph. a – dorsal surface. b – ventral surface.

j4, j5, J2 4–5, *J5* 3, *z2*, *z3* 5–6, *z4* 6–7, *z5* 5–6, *Z4* 5–7, *Z5* 6–8, *s4* 6–7, *s6* 6–8, *S2*, *S5* 6–7. Setae *r3* 5–6. Integument around the shield folded, with pebble protuberances. Peritremes short, 23–26, isolated from the anterior part of the peritrematal shield, which ends at the level of setae *z2* and is not fused with the dorsal shield.

Ventral idiosoma — (Figure 4b). Tritosternum 66–70 long, with two laciniae, 39–45 long. Sternal shield 90–95 long, 47–50 wide, bearing setae *st1–st3* and poroids *iv1–iv3*; both setae and poroids on the margins. Shield ornamented with a reticulated pattern consisting of elongate and contiguous cells oriented axially. Setae *st4* on the soft integument. Inverted tongue-shaped epigynal shield with longitudinal grooves; 56–62 long, 37–44 wide; setae *st5* and poroids *iv5* off the shield. Anal shield 48–54 long, 42–47 wide, smooth, with preanal pores. Cuticle between epigynal and anal shields transversally striated, mostly plicate on both sides of the anal plate. Setae *ZV2*, *ZV3*, *JV2*, *JV5*, and poroids *ivo1, ivo2,* and *ivp* around the shield. Setae *JV5* 5–7 long.

Gnathosoma — (Figure 8i). Base of gnathosoma 51–60 long, 43–55 wide. Hypostomal and capitular setae *h1* 9–11, *h2* 5–7, *h3* 6–9, *pc* 7–9. First cheliceral segment 11–14; second

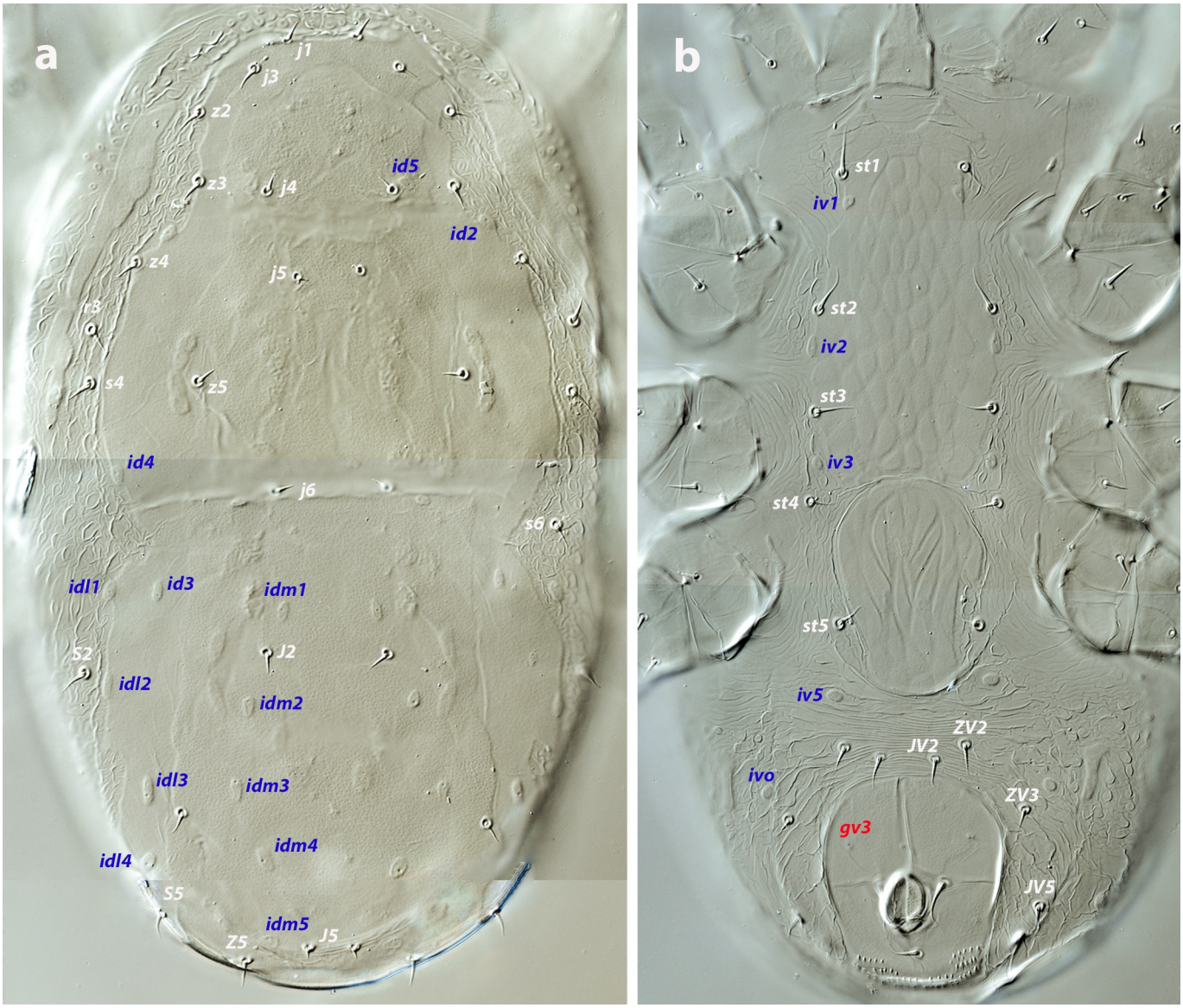

Figure 4 *Africoseiulella flechtmanni* deutonymph. a – dorsal surface. b – ventral surface.

segment 49–58 long. Fixed digit of chelicera 15–18 long, with a small subapical denticle, two teeth at mid-length and two contiguous basal teeth, just anterior to the hyaline flap; movable digit 13–15 long, without dentition; both digits with the same morphology as in female. Pilus dentilis absent. Membranous lobe attached to the movable digit. Palp chaetotaxy from trochanter to tarsus: 2-5-5-12-12.

Legs — (Figure 5)″ Coxae I–IV and, occasionally, trochanters III–IV with interrupted dorsal sclerotization. Setal morphology as in the larva and protonymph. Chaetotaxy of leg segments I–IV: coxae 2-2-2-1; trochanters 5-5-4-5; femora 11-9-6-6; genua 8-6-6-7; tibiae 8-7-7-6; basitarsi 0-2-2-2 (Figure 5; Table 2). Setal formulae from trochanters to basitarsi as follows. Leg I: trochanter 1 0/1, 0/2 1; femur 2 2/1, 2/2 2; genu 1 2/1, 2/1 1; tibia 1 2/1, 2/1 1. Leg II: trochanter 1 0/1, 0/2 1; femur 2 2/1, 2/1 1; genu 1 2/0, 2/0 1; tibia 1 1/1, 2/1 1; basitarsus 0 1/0, 1/0 0. Leg III: trochanter 1 1/1, 0/1 0; femur 1 2/1, 1/0 1; genu 1 2/0, 2/0 1; tibia 1 1/1, 2/1 1; basitarsus 0 1/0, 1/0 0. Leg IV: trochanter 1 1/1, 0/1 1; femur 1 2/1, 1/0 1; genu 1 2/1, 2/0 1; tibia 1 1/1, 2/0 1; basitarsus 0 1/0, 1/0 0. Without leg macrosetae.

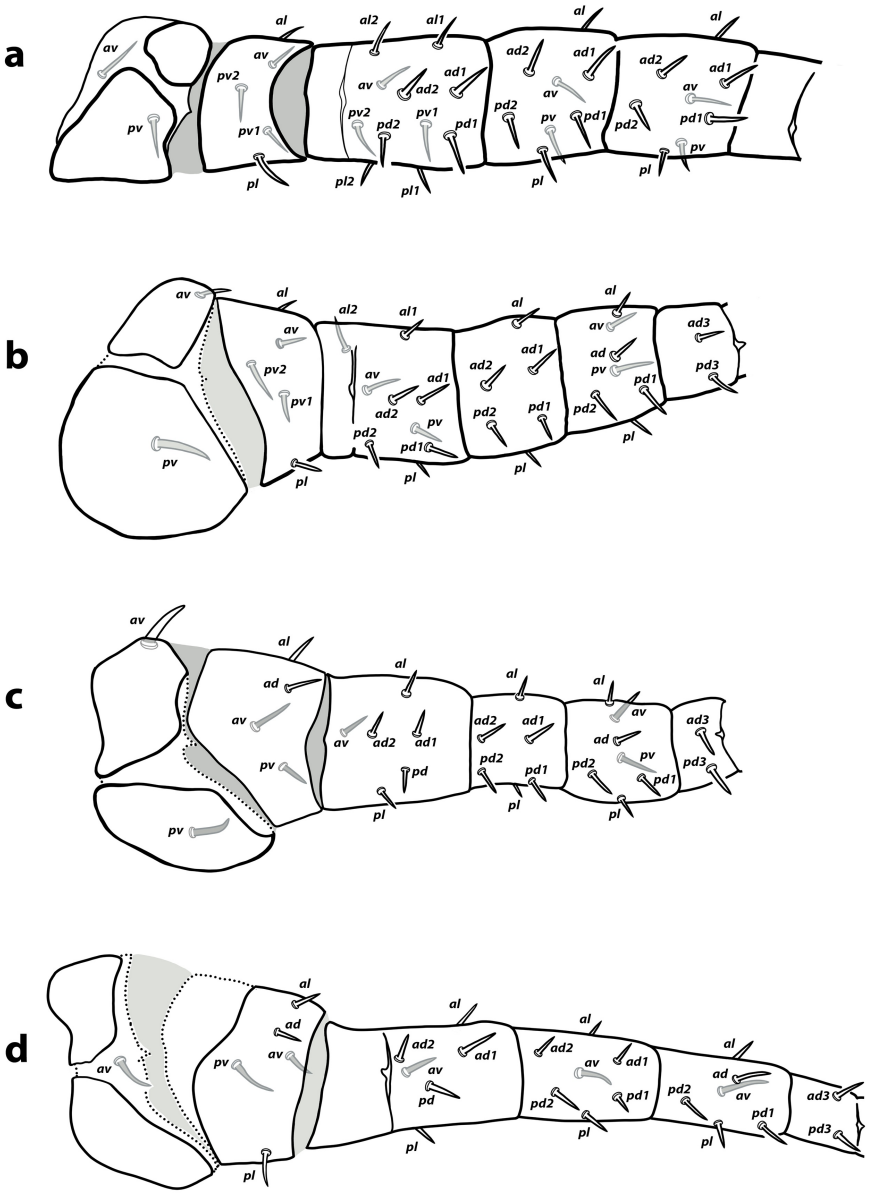

Figure 5 *Africoseiulella flechtmanni* deutonymph. a – leg I; b – leg II; c – leg III; d – leg IV.

Complementary description of adults

Female (twenty-nine females examined; seven females measured. Figures 6 a–c; 8 a–e)

Dorsal shield pyriform, with a characteristic punctate pattern more evident on the podonotum (Figure 6a); 289–322 long, much wider in the opisthosoma (159–179) at level of *S2*, than

on the podosoma (131–143 at level of *s4*). Lateral margins irregular, always concave at the level of setae *z3*, *s4*, and between *s4* and *s6*, and strongly constricted between podosoma and opisthosoma. All the mentioned setae inserted on the shield margin. Sixteen pairs of short dorsal setae. Lengths of *j1* 6–7, *j3* 8–9, *j4* 6–7, *j5* 4–5, *j6*, *J2* 6–8, *J5* 4–5, *z2*, *z3*, *z4* 8–9, *z5* 7–8, *Z4* 6–8, *Z5*, *s4*, *s6*, *S2*, *S5* 8–9. Setae *r3* 7–8; absence of *R1*. Dorsal solenostomes absent, but with the complete set of sixteen pairs of poroids, large, elliptical, about 7–8 long, most of them longitudinally oriented. Peritrematal shield broadly merged with the dorsal shield between *z2* and *z3*, bearing the gland pore *gp* and the poroid *ip* at the anterior level of the peritremes, and the pore *gvi* on the poststigmatic extension of the shield. Peritremes very short, 40–45 long, reaching anteriorly the level of setae *s4* and gland pore *gp*; internal groove evenly covered by papillae. Base of tritosternum broad, subrectangular, distinctly wider than the combined width of the two laciniae, 15 wide, 12 long; total length of tritosternum 76–81, laciniae, 48–52. Sternal shield elongate and trapezoidal (Figure 6b), without anterior arms, bearing setae *st1–st2* and poroids *iv1–iv2*; 80–86 long, 43–49 wide at the level of *st2*; anterior margin concave, with two lateral and sclerotized areas transversally striated, posterior margin subtriangular and weakly sclerotized; surface of the shield with a delicate pattern of elongate cells oriented axially. Setae *st3–st4* and poroid *iv3* free on the soft cuticle. Epigynal shield 106–118 long, covered by longitudinal furrows; posterior margin concave; distance *st5–st5* 52–56. Ventrianal shield vase-shaped, anterior margin concave (Figure 6c); 82–94 long, 64–69 wide at level of setae *ZV2*, 56–62 wide at the level of anus. Surface evenly smooth, with two pairs of preanal setae (*ZV2*, *JV2*) and a pair of small and punctiform preanal solenostomes *gv3*, situated posterior and distant to the insertions of *JV2*, and separated 32–41 µm from each other. Most of spicules of cribrum joined in both laterals, arranged into three-four rows, with a bridge of two rows of spicules posterior to post-anal seta and connecting the two lateral areas. Opisthogastric soft integument with setae *ZV3* and *JV5*, two pairs of poroids *ivo* and poroid *ivp*, and a bacillar platelet placed near the anterior corners of the ventrianal shield, in the triangle formed by the setae *ZV2*, *ZV3* and anterior poroid *ivo*. Setae *JV5* 8–9, placed at the level of anal opening. A single metapodal shield, very long (40–46) and narrow, with a longitudinal ridge. Major duct of spermatheca 20–28 long, well-sclerotized, cylindrical, with a ring near the calyx; atrium very small, at the same bases of calyx; calyx shallow, 3–4 deep, 9–10 wide near the vesicle. Base of gnathosoma 40–47 long, 52–58 wide. Tectum developed as a narrow projection rounded anteriorly. Subcapitular setae short, *h1* 9–11, *h2* 6–7, *h3* 8–9, *pc* 9–11. Fist cheliceral segment 14–19, second segment 60–65. Fixed digit of chelicera straight, 16–18 long, with a small subapical denticle, two median teeth, and two basal teeth, pilus dentilis not discerned in the examined specimens; movable digit curved, with a broad base abruptly reduced in width at the middle and ending into a sharp and angled hook, 13–15 long, without teeth (Figures 8 a–e); a large and hyaline lobe attached to the movable digits and a hyaline flap at the base of fixed digit (Figure 8a). Palp 53–60 long, setation as in deutonymph. Palpfemur with setae *al* blunt, not expanded distally; palpgenu without *al2*. Palptarsus apotele undivided.

Legs — Short; lengths of leg I 152–169, leg II 126–148, leg III 136–152, leg IV 163–177. Coxa II with seta *pv* more than twice as long as seta *av*; seta *av* on coxa III spur-like. Leg chaetotaxy of segments I–IV and setal formulae similar to deutonymph. Without differentiate macrosetae.

Male (nine males examined; five males measured. Figures 7 a–c, 8 f–g)

Dorsal shield suboval, 242–255 long, 123–138 wide, attached to the peritrematal shield at level of setae *z4*. Shield surface finely punctate, but porous ornamentation typical of the female not visible (Figure 7a). Rectangular unsclerotized area inside the shield, between setae *z2* and *z4*, bearing in its internal margin the seta *z3* and the poroid *id2*. This area corresponds to the marginal concavity between *z2–z4* in the female shield and results from the merging of the male peritrematal and dorsal shields. Sixteen pairs of short dorsal setae. Lengths of *j1* 6–7, *j3* 7–8, *j4* 5–6, *j5* 4–5, *j6* 6–7, *J2* 5–6, *J5* 3–4, *z2* 7–8, *z3* 8, *z4* 7, *z5* 6–7, *Z4* 6–7, *Z5* and *s4* 8, *s6* 7–8, *S2* and *S5* 8, *r3* 6–7. Setae *R1* absent, *r3* always off the shield. Peritremes short,

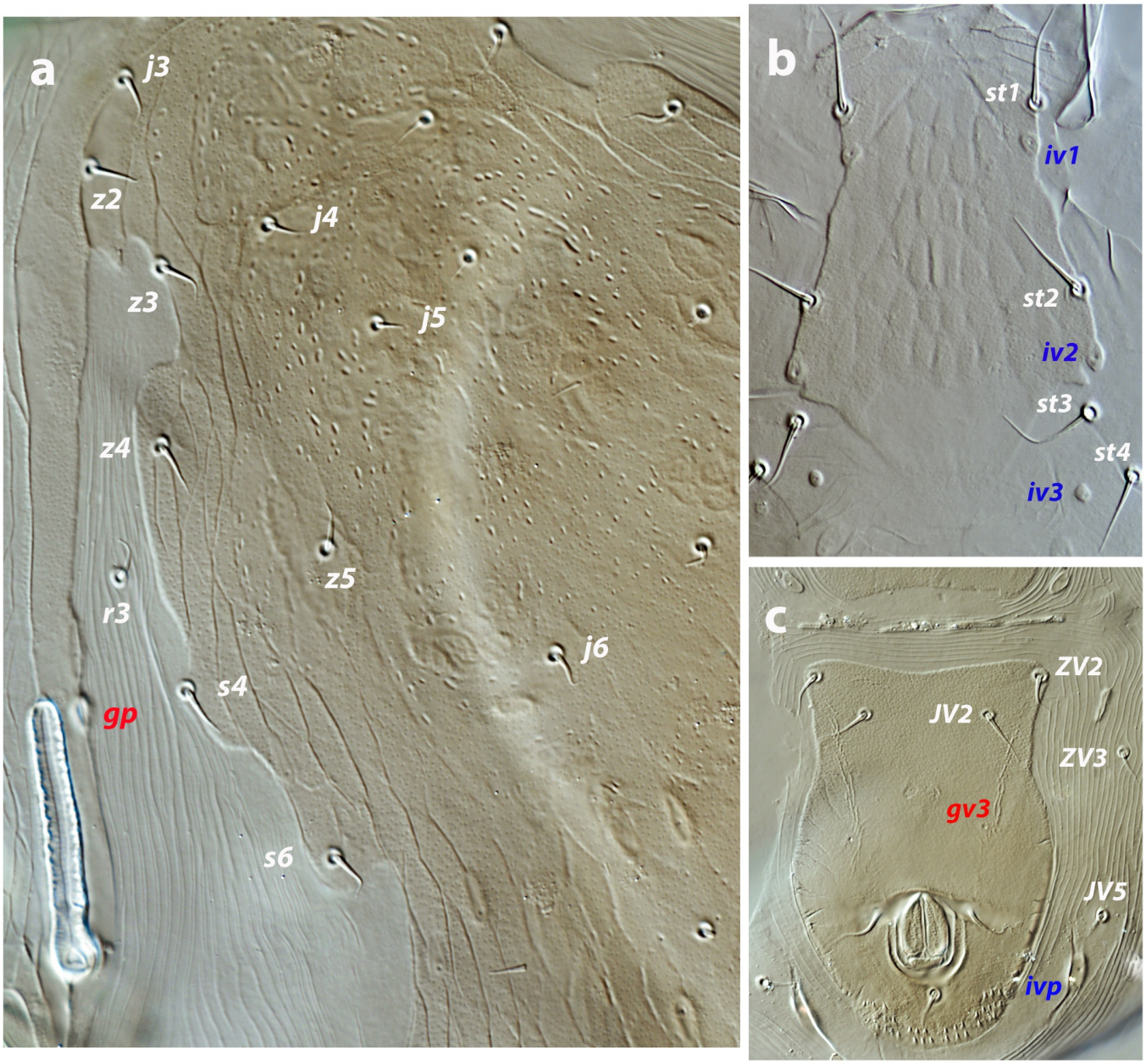

Figure 6 *Africoseiulella flechtmanni* female. a – lateral margin of dorsal shield at level of podosoma. b – sternal shield. c – ventrianal shield.

reaching the level of pore *gp* on the peritrematal shield and almost the insertions of *s4* on the dorsum. Tritosternum relatively short, with a broad base 14 wide, 10 long, divided into two laciniae; total length of tritosternum 58, of the laciniae 40–42. Sternogenital shield elongate (Figure 7b), anterior margin concave. Poroid *iv1* posterior and close to the insertions of *st1*, poroid *iv2* free on the soft integument between *st3* and *st4*. Lateral margins invaginated at the level of *st4*; posterior margin rounded. Setae *st1–st3* on the margin of the shield, *st4–st5* off the shield. Surface mostly smooth, but in the posterior part it is punctate and forms five pairs of areolae of different size arranged in a characteristic pattern. Distance *st1–st5* 113–126, *st3–st3* 36–41. Poroids *iv5* between the sternogenital and ventrianal shields. Ventrianal shield divided into three plates (Figure 7c), the central plate being larger and columnar in shape, bearing the

setae *ZV2* and *JV2*, the small and punctiform solenostomes *gv3* posteroantiaxial to *JV2* (34–38 between them), the anal opening, and the para-anal and postanal setae. The lateral plates bear one poroid *ivo* and, sometimes, the setae *ZV3*. Setae *JV5* in posterolateral position in relation to the shield, somewhat anterior to the large poroid *ivp*. The anterior part of the central plate is transversally striated and both lateral plates have longitudinal striae. Although the lateral shields were previously reported attached to the central plate, this character is variable, as some of the males examined have the three plates separated (as can be seen in Figure 7c). Cribrum as in females. All the opisthoventral setae short o very short; *JV5* 6–7 long. Fixed digit of chelicera straight, distally attenuated,17–18 long, with a wide base and a strong median tooth, apparently with a minute subapical tooth; movable digit 15–17, edentate, with a broad and rounded bases and a strongly angled hook (Figure 8f). Spermatodactyl sinuous, with a broad shaft 13–15 long, a short foot 5–7, and a small and pointed lateral process (Figure 8g). Vellum present. Most of leg setae very short and pointed, some of them clearly subconical, spur-like; e.g., seta *av* on coxa I, *pv* on coxa II, and *av*, *pv*, on coxa III. Seta *v* on coxa IV setaceous. Leg chaetotaxy of segments I–IV and setal formulae similar to deutonymph. Without macrosetae.

Remarks

At first glance, *A. flechtmanni* is a small, slow-moving mite with a fusiform idiosoma and short legs. It was found at high densities inside the inflorescences of *Heliotropium ramosissimum*, a plant native to Tunisia, Morocco, and the Macaronesian islands (Sauerbier *et al.*, 2023). This particular morphology may represent an adaptation to life in highly confined spaces. Because no other microarthropods were observed on the plants, the mite presumably feeds on plant resources, most likely pollen.

In their comparative study of the genus, Kazemi *et al.* (2025) highlighted both the shared and distinctive morphological traits between *Africoseiulella* and other phytoseioid families, supporting their decision to establish a new family. Examination of the immature stages of *A. flechtmanni* provides further insights and additional arguments reinforcing the distinction between Africoseiulellidae and Phytoseiidae. Although descriptions of phytoseiid immatures are still the exception rather than the rule, available data indicate that larvae are generally weakly sclerotized and that the outlines of dorsal shields are often poorly defined. By contrast, the larva of *A. flechtmanni* possesses well-sclerotized dorsal shields and, remarkably, two pairs of large mesonotal scutella, structures that have never been described in phytoseiids (for a list of papers describing immature phytoseiids up to 2017, see Ma *et al.*, 2018). The occurrence of larval mesonotal scutella has been reported in species from other phytoseioid families, such as the Blattisociidae *Lasioseius allii* Chant (illustrated in Lindquist & Evans, 1965), *L. corticeus* Lindquist, *L. serripes* Moraza & Lindquist (Lindquist, 1971; Moraza & Lindquist, 2018), and in the Treatiidae *Hemipteroseius womersleyi* Evans (Prasad, 2018). In contrast, the larvae of other members of Treatiidae lack developed scutella between the podonotal and pygidial shields, e.g., *Nabiseius duplicisetus* Chant & Lindquist and *N. palifer* Joharchi & Khaustov (Prasad, 2018; Joharchi *et al.* 2022).

Ontogenetic changes in the development of gnathosomal structures — In the subcapitulum, the hypostomatic setae *h1*, *h2* are present in the larva, with *h3* and the capitular *cs* added in the protonymph, following the common pattern observed in Gamasina (Lindquist and Evans, 1965). Likewise, palp setation from trochanter to genu is consistent with that described by Evans (1964) for the free-living Gamasina with the exception of palpgenu seta *al2* which is not expressed in *Africoseiulella*. One seta *v* is added at the protonymphal stage on the trochanter, while one seta *v2* and a third dorsal seta *d3* are incorporated into the trochanter and femur, respectively, in the deutonymph. The chaetome of tibia and tarsus in the larva is 12 and 11 setae, respectively. An additional seta is added to tarsus in the protonymph, and the complement of 12 setae on each of the two distal segments is apparently determined at the protonymphal stage. The apotele is undivided and conical in shape from the larval stage onward.

The examination of the chelicerae has revealed some differences from previous information. This structure was originally described as having an edentate fixed digit (Kreiter & Tixier,

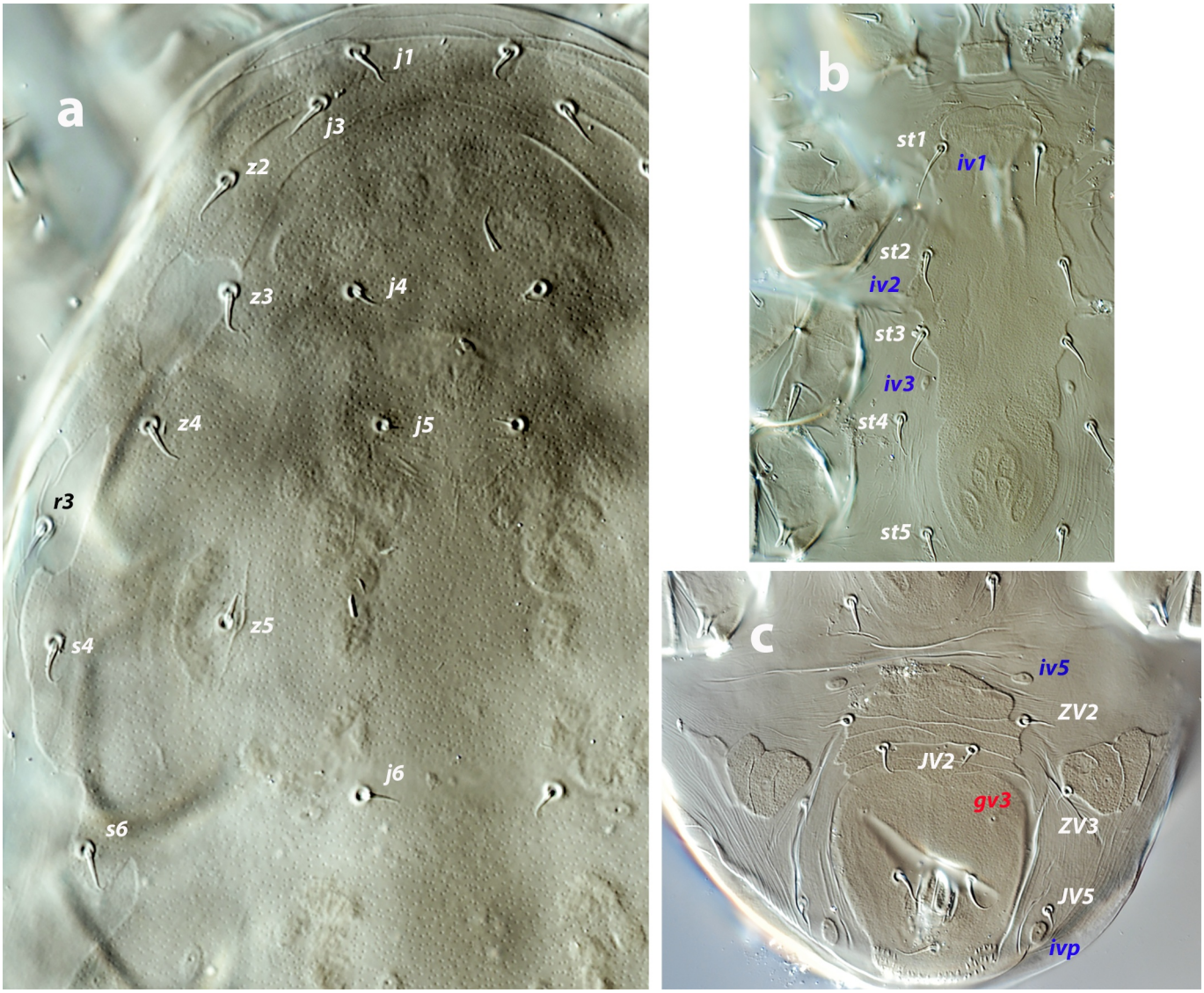

Figure 7 *Africoseiulella flechtmanni* male. a – anterolateral margin of dorsal shield. b – sternogenital shield. Note the spur-like setae on coxae II and III and the punctate areolae on the posterior part of the shield. c – ventrianal shield.

2006), and according to Kazemi *et al.* (2025) the fixed digit lacks a subapical denticle and bears only a median tooth. However, the presence of a minute denticle near the apex, as well as teeth in both paraxial and antiaxial positions, is evident in the specimens from Fuerteventura (Figure 8 a–e). This figure shows different views of the chelicera in which two contiguous teeth can be observed at mid-length, along with two additional contiguous teeth in a basal position, located just anterior to the hyaline basal lobe. All these structures, particularly the anterior projection and the small subapical tooth, are extremely small and can only be clearly observed at maximum magnification and when the cheliceral digits are fully opened.

The general appearance of the chelicerae and the dentition in the immature stages is similar to that of the female, although the smaller structures can only be distinguished in the deutonymph and it remains unclear whether they are also present in the protonymph. Unfortunately, the positioning of the chelicerae in the larva did not allow observation of the internal dentition. The hyaline lobe associated with the movable digit is present in all mobile stages but I could not identify any structure similar to a pilus dentilis.

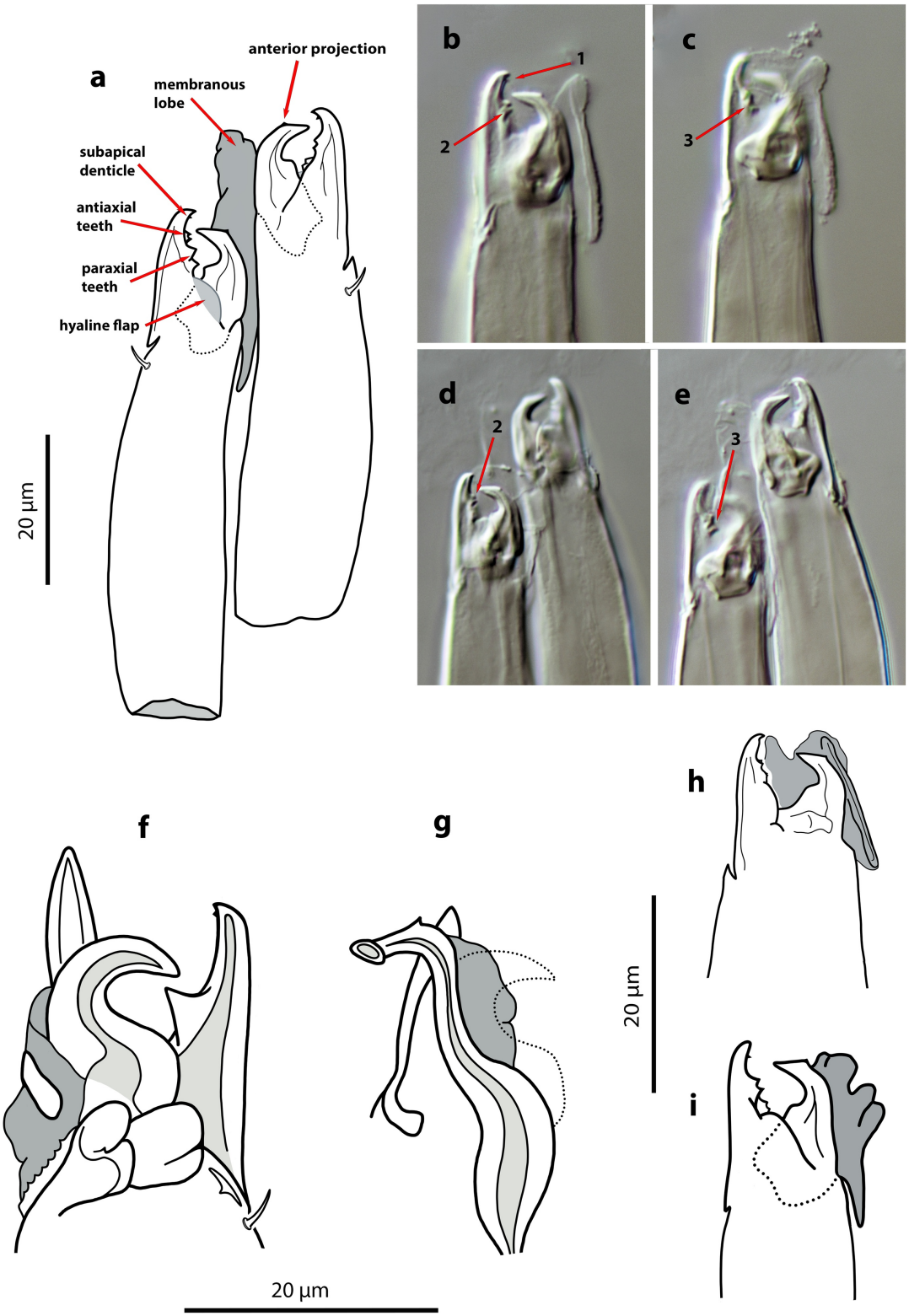

Figure 8 *Africoseiulella flechtmanni*. a – female chelicerae showing the details of dentition. b–e – dentition of two females with the picture focused on the antiaxial (b, d) or paraxial (c, e) teeth of the fixed digit. f – male chelicera without spermatodactyl. g – spermatodactyl. h – chelicera of protonymph. i – chelicera of deutonymph. Legend of micrographies b–e: 1 – subapical denticle. 2 – antiaxial teeth. 3 – paraxial teeth.

Ontogeny of idiosomal and leg setation — All podonotal setae are expressed in the larval stage except for *s6* and the lateral *r3*, which appear in the protonymph, and *z3* in the deutonymph (Table 1). All opisthonotal setae occur in the protonymph, with only *Z4* present on the larval pygidial shield. This pattern of setal additions coincides with that of phytoseiids, except in the opisthonotum, where phytoseiid larvae exhibit greater variation in the number of setae, ranging from 1 to 5, although *Z4* remains the unique constant seta. On the ventral surface, *JV2* and *JV5* first appear in the protonymph, and *st4*, *st5* in the deutonymph, while the remaining setae are already present at the larval stage.

As pointed out by Kazemi *et al.* (2025), the adult leg chaetome is reduced in comparison to the common pattern in other mesostigmatic families. By contrast, the leg chaetome in larvae and protonymphs generally matches the phytoseiid pattern, except that the two lateral setae on basitarsi II–IV are absent. There are two discrepancies in notation of setae on trochanter and tibia IV between the redescription by Kazemi *et al.* (2025) and the specimens I examined. According to the mentioned authors, the adult setal formula of trochanter IV is 1 1/1, 1/1 0, indicating the presence of a posterodorsal seta and the absence of posterolateral seta; however, in my opinion, the correct notation is 1 1/1, 0/1 1, as can also be seen in Figure 26 of the cited publication. Likewise, the reported formula for tibia IV (1 2/1, 1/0 1) should be stated as 1 1/1, 2/0 1, because a second *pd* seta is clearly in line with the other seta posterodorsal. The reduction of leg setae becomes evident in the deutonymph and remains unchanged in the adults. Compared to the most common pattern in Phytoseiidae (that can be drawn from the literature; e.g., Evans, 1963; Rowell and Chant, 1979; Aponte and McMurtry, 1987; Ma *et al.* 2018, 2020, 2024; Khaustov, 2020; Döker *et al.* 2023, 2024), the chaetotaxy of *A. flechtmanni* includes 15 absences, six of which occur on the first pair of legs. On leg I, the seta *ad* on trochanter, *ad3* on femur, and the setae *al2* and *pl2* of the genu and tibia are missing; on femur II, seta *ad3* is absent; and on trochanter III, seta *pv2* is lacking. To these absences must be added those previously mentioned lateral setae on basitarsi II–IV, and seta *ad2* on telotarsus IV.

Larva and protonymph shares the same chaetotaxy on the first three leg pairs. There are 11 setal ontogenetic additions on leg segments (excluding telotarsi) (Table 2). The following setae are added to the deutonymphal complement: on trochanter I seta *av*, on femur I seta *pv2*; on trochanter II seta *pv2*, on femur II setae *al2* and *pv*; on femur III seta *pl*. In the leg IV the setae *pl* on the trochanter, and *av*, *pl* on both femur and genu are added in the moult to the deutonymphal instar.

Ontogenetic development of gland pores and poroids — This species lacks dorsal solenostomes and only has the peritrematal gland pore *gp* and the ventral solenostomes *gvi* (associated with the posterior end of the peritrematal shield) and *gv3*, all of which develop in the protonymphal stage.

The larva possesses a complement of 13 pairs of poroids (Table 1), 11dorsal poroids: *id2, id3, id4, id5, id6, idl1, idl4, idm1, idm2, idm3, idm4*, and the ventral poroids *iv1* and *ivp*. The anterodorsal poroid *id1* first appears in the deutonymph, while *idl2*, *idl3*, *idl5*, *idm5*, and *ip* are added in the protonymph. The protonymph also expresses the ventral poroids *iv2*, *ivo1*, and *ivo2*. The deutonymphal stage incorporates the dorsal poroid *id1* and the ventral poroids *iv3*, *iv5*, and *ip*. It is not clear whether *id1* is first expressed in the deutonymph, where it is distinctly noticeable, or in the protonymph. In the latter stage, the cuticle bearing this poroid appears corrugated in mounted specimens, making observation difficult and uncertain.

The full set of peritrematal pores and poroids is already present in the protonymphal stage, whereas the anterior and posterior portions of the future peritrematal shield remain separated throughout the juvenile active instars. These portions do not fuse with each other, nor with the dorsal shield, until the adult stage is reached.

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