

First report of plant inhabiting predatory mites (Acari: Phytoseiidae) in Maldives

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Original research

ABSTRACT

Although phytoseiid mites are one of the most promising candidates to be used in biological control of mites and insects, nothing is known regarding the native fauna in Maldives. This study reports on six species belongs to four genera for the first time in Maafushi Island, Maldives. Among the species reported, *Typhlodromus (Anthoseius) philippinensis* and *Phytoseius meyeri* are re-described and illustrated in detail. In addition, measurements and other diagnostic characters for *Amblyseius adhatodae*, *A. largoensis*, *Neoseiulus houstoni* and *T. (A.) neobakeri* are provided. Furthermore, the diagnosis of six species improved through including additional morphological characters and new illustrations.

Keywords Indomalayan realm; fauna; predatory mites; new record; biological control

Introduction

Predatory mites of the family Phytoseiidae (Acari: Mesostigmata) have gained a great attention in biological control of spider mites, and small soft bodied insects such as thrips, and whiteflies, in the last quarter of the 20th century (McMurtry *et al.* 2013).


Maldives is an archipelagic country located in the Indian Ocean in the Indian subcontinent of Asia. Although previous studies have been documented the presence of a series of endemic species in its neighbouring countries such as India and Sri Lanka, nothing is known about native phytoseiid fauna in Maldives (Gupta 2003; Moraes *et al.* 2004; Khaustov *et al.* 2021; Kar and Karmakar 2022).

In this study, six species belong to four genera, *Amblyseius adhatodae* Muma 1967, *A. largoensis* (Muma 1955), *Neoseiulus houstoni* (Schicha 1987), *Typhlodromus (Anthoseius) neobakeri* Prasad 1968, *T. (A.) philippinensis* Corpuz 1966, and *Phytoseius meyeri* Gupta 1977, are reported for the first time in Maldives.

Material and methods

Predatory mites were directly collected from *Terminalia catappa* L. (Combretaceae) using a camel hair brush and preserved in 70% ethanol. Subsequently, they were cleared in lactic acid and mounted in Hoyer's medium on microscope slides. Species identification, illustrations and measurements were made using a differential interference contrast (DIC) optical system attached a compound microscope Axio Imager A2 (Carl Zeiss, Germany). The dorsal shield length was measured from the anterior to posterior margins along the midline. We followed the taxonomic system of Phytoseiidae proposed by Chant and McMurtry (2007). The nomenclature of setae used follows Lindquist and Evans (1965) as adapted by Rowell *et al.* (1978) and

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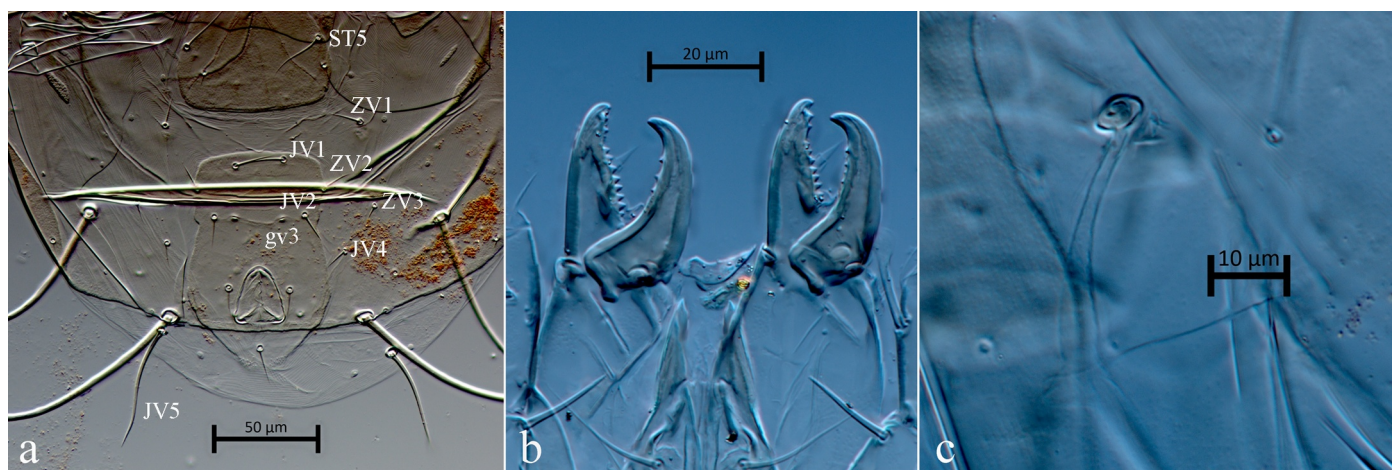


Figure 1 *Amblyseius adhatodae* Muma, 1967 female. a – Ventrianal shield, b – Chelicerae, c – Spermatheca.

Chant and Yoshida-Shaul (1991) for the Phytoseiidae. Nomenclature of dorsal solenostomes and poroids follows that of Athias-Henriot (1975). Leg chaetotaxy follows Evans (1963). Measurements are given in micrometers (μm) and presented as mean followed by the range in parenthesis. All mite specimens were collected by the third author. Specimens examined in this study are deposited in the mite collection of Tyumen State University, Zoology Museum, Tyumen, Russia.

Results

New records for Maldives

Amblyseius adhatodae Muma

Amblyseius adhatodae Muma, 1967: 268.

(Figure 1)

Material examined — Three females collected from Maafushi Island, Maldives, $3^{\circ}56'40.5''\text{N}$ $73^{\circ}29'35.2''\text{E}$, *Terminalia catappa* L. (Combretaceae) in 25 December 2021.

Measurements — *Female* ($n = 3$) – Length of dorsal shield 338 (328–355), width at level of *s4* 232 (229–234), width at level of *S2* 256 (250–262). Seven pairs of dorsal solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8* and *gd9*). Setae measurements as follows: *j1* 35 (33–38), *j3* 46 (44–50), *j4* 5 (4–5), *j5* 5 (4–5), *j6* 6 (5–6), *J2* 6 (5–6), *J5* 8 (7–8), *z2* 7 (6–8), *z4* 8 (7–8), *z5* 5 (4–6), *Z1* 10 (10–11), *Z4* 121 (115–125), *Z5* 243 (231–261), *s4* 105 (99–114), *S2* 10 (10–11), *S4* 10 (10–11), *S5* 10, *r3* 11 (11–12), *R1* 10 (10–11) and *JV5* 65 (63–68). Distance between *st1-st3* 60 (59–61), *st2-st2* 70 (69–70), *st5-st5* 67 (64–73); length of ventrianal shield 104 (102–107), width at level of setae *ZV2* 63 (61–64), width at level of anus 67 (64–70), distance between preanal pores (*gv3-gv3*) 23 (22–24) (Figure 1a). Fixed cheliceral digit with 11 teeth and pilus dentilis, movable digit generally with four teeth except one specimen with three teeth in one side (Figure 1b). Calyx of spermatheca 36 (35–38) long (Figure 1c). Chaetotaxy of legs as follows: Leg I; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/0 2/0 1, tibia 1 2/1 1/1 1. Leg III; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/1 1. Leg IV; coxa 0 0/1 0/0 0, trochanter 1 0/1 0/2 1, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/0 1. Length of macrosetae as follows: *SgeI* 42 (41–44), *SgeII* 35 (33–36), *SgeIII* 50 (46–54), *StiIII* 38 (36–41), *StiIII* 31 (30–33), *SgeIV* 115 (104–127), *StiIV* 79 (78–82), *StiIV* 71 (69–73).

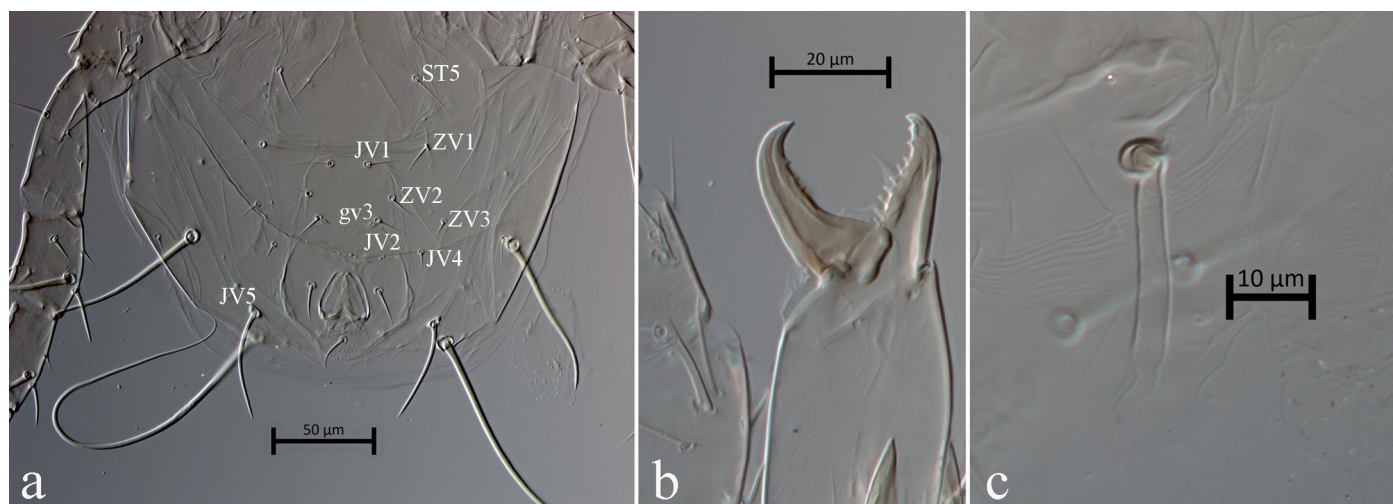


Figure 2 *Amblyseius largoensis* (Muma, 1955) female. a – Ventrianal shield, b – Chelicera, c – Spermatheca.

World Distribution — Brazil (Lawson-Balagbo *et al.* 2008), India and Pakistan (Muma 1967), Kenya (Moraes *et al.* 1989), Sri Lanka (Moraes *et al.* 2004) and Maldives (this study).

Remarks — *Amblyseius adhatodae* was described by Muma (1967) based on the material collected from Pakistan and India. Morphological characters and measurements of the Maldivian material are almost identical to its original description and redescrptions (Denmark and Muma 1989; Moraes *et al.* 1989; Moraes *et al.* 2004; Zannou *et al.* 2007).

***Amblyseius largoensis* (Muma)**

Amblyseiopsis largoensis Muma, 1955: 266.

(Figure 2)

Material examined — Five females collected from Maafushi Island, Maldives, 3°56'40.5"N 73°29'35.2"E, *Terminalia catappa* L. (Combretaceae) in 25 December 2021.

Measurements — *Female* ($n = 5$) – Length of dorsal shield 328 (313–345), width at level of *s4* 206 (190–216), width at level of *S2* 230 (211–247). Seven pairs of dorsal solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8* and *gd9*). Setae measurements as follows: *j1* 35 (34–36), *j3* 48 (45–49), *j4* 7 (6–7), *j5* 7 (6–7), *j6* 8 (7–8), *J2* 12 (11–12), *J5* 9 (8–9), *z2* 11 (10–11), *z4* 11 (10–11), *z5* 8 (7–8), *Z1* 11 (10–12), *Z4* 83 (80–84), *Z5* 252 (243–265), *s4* 87 (83–89), *S2* 12 (12–13), *S4* 13 (12–13), *S5* 13 (12–13), *r3* 11 (10–11), *R1* 11 (10–11) and *JV5* 55 (51–59). Distance between *st1-st3* 63 (59–67), *st2-st2* 69 (67–70), *st5-st5* 70 (69–70); length of ventrianal shield 100 (90–108), width at level of setae *ZV2* 47 (45–48), width at level of anus 64 (56–67), distance between preanal pores (*gv3-gv3*) 25 (23–26) (Figure 2a). Fixed cheliceral digit with 9–11 teeth and pilus dentilis, movable digit with three teeth (Figure 2b). Calyx of spermatheca 29 (28–30) long (Figure 2c). Chaetotaxy of legs as follows: Leg I; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/0 2/0 1, tibia 1 2/1 1/1 1. Leg III; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/1 1. Leg IV; coxa 0 0/1 0/0 0, trochanter 1 0/1 0/2 1, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/0 1. Length of macrosetae as follows: *SgeI* 37 (35–38), *SgeII* 33 (32–34), *SgeIII* 41 (39–43), *StiIII* 34 (32–37), *StiIII* 32 (30–34), *SgeIV* 105 (98–112), *StiIV* 79 (74–83), *StiIV* 61 (58–63).

World Distribution — This species has a cosmopolitan distribution and reported mostly in tropical and subtropical areas of the world (Demite *et al.* 2022) and Maldives (this study).

Remarks — Morphological characters and measurements of the Maldivian specimens are identical to the original description and subsequent redescrptions (Schicha 1987; Denmark

and Muma 1989; Zannou *et al.* 2007; Navia *et al.* 2014; Karmakar *et al.* 2017; Ferragut and Baumann 2019; Liao *et al.* 2020).

***Neoseiulus houstoni* (Schicha)**

Amblyseius houstoni Schicha, 1987: 111.

(Figure 3)

Material examined — Two females collected from Maafushi Island, Maldives, 3°56'40.5"N 73°29'35.2"E, *Terminalia catappa* L. (Combretaceae) in 25 December 2021.

Measurements — *Female* ($n = 2$) – Length of dorsal shield 278–288, width at level of $s4$ 140–155, width at level of $S2$ 150–157 (Figure 3a). Six pairs of dorsal solenostomes ($gd1$, $gd2$, $gd5$, $gd6$, $gd8$ and $gd9$). Setae measurements as follows: $j1$ 18–22, $j3$ 33–36, $j4$ 18–19, $j5$ 18–20, $j6$ 22–23, $J2$ 25–28, $J5$ 7, $z2$ 32–33, $z4$ 34–37, $z5$ 21, $Z1$ 28–29, $Z4$ 45–47, $Z5$ 47–50, $s4$ 44–45, $S2$ 42–44, $S4$ 23–25, $S5$ 20–23, $r3$ 32, $R1$ 29–33 and $JV5$ 37–42. Distance between $st1$ – $st3$ 55–56, $st2$ – $st2$ 62–63, $st5$ – $st5$ 62–63; length of ventrianal shield 89–91, width at level of setae $ZV2$ 70–73, width at level of anus 61–63, distance between preanal pores ($gv3$ – $gv3$) 17 (Figure 3b). Fixed cheliceral digit with three teeth (two apical and one basal) and pilus dentilis, movable digit with one tooth (Figure 3c). Calyx of spermatheca 11–13 long (Figure 3d). Chaetotaxy of legs as follows: Leg I; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/0 2/0 1, tibia 1 2/1 1/1 1. Leg III; coxa 0 0/1 0/1 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/1 1. Leg IV; coxa 0 0/1 0/0 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/0 1. Length of macrosetae as follows: $SgeIV$ 23, $StiIV$ 18–21, $StIV$ 29–30 (Figure 3e).

World Distribution — Australia (Schicha 1987), Brazil (reported as *N. barreti* Kreiter by Furtado *et al.* 2005), Mauritius (Kreiter and Abo-Shnaf 2020), Reunion Island (Kreiter *et al.* 2020, reported as *N. recifensis* Gondim Jr. & Moraes, 2001 by Moraes *et al.* 2012) and Maldives (this study).

Remarks — *Neoseiulus houstoni* was described by Schicha (1987) based on the material collected on *Vigna unguiculata* (Fabaceae): in Murray Island, Queensland, Australia. Kreiter *et al.* (2020) recently reported this species from Reunion Island. Based on the examination of the type materials, the authors suggested *N. barreti* Kreiter in Furtado *et al.* (2005) and *N. recifensis* Gondim Jr. & Moraes, 2001 as junior synonyms of *N. houstoni*. Morphological characters and measurements of the Maldivian specimens are almost identical to the original descriptions and subsequent redescrptions of all three species mentioned above (Schicha 1987; Gondim Jr. and Moraes 2001; Furtado *et al.* 2005; Kreiter *et al.* 2020).

***Typhlodromus (Anthoseius) neobakeri* Prasad**

Typhlodromus neobakeri Prasad, 1968: 1369.

(Figure 4)

Material examined — Five females collected from Maafushi Island, Maldives, 3°56'40.5"N 73°29'35.2"E, *Terminalia catappa* L. (Combretaceae) in 25 December 2021.

Measurements — *Female* ($n = 5$) – Length of dorsal shield, 333 (330–334), width at level of $s4$ 163 (160–166), width at level of $S2$ 173 (172–174) (Figure 4a). Five pairs of solenostomes ($gd2$, $gd4$, $gd6$, $gd8$ and $gd9$). Setae measurements as follows: $j1$ 18 (16–21), $j3$ 14 (14–15), $j4$ 11 (11–12), $j5$ 12 (11–12), $j6$ 12 (12–13), $J2$ 14 (13–14), $J5$ 10 (10–11), $z2$ 13 (12–14), $z3$ 13 (12–14), $z4$ 14 (14–15), $z5$ 13 (12–14), $Z4$ 19 (18–21), $Z5$ 34 (31–36), $s4$ 16 (15–17), $s6$ 17 (16–18), $S2$ 19 (17–20), $S4$ 22 (22–23), $S5$ 22 (21–24), $r3$ 15 (15–16), $R1$ 17 (16–18) and $JV5$ 31 (28–33). Distance between $st1$ – $st2$ 60 (59–62), $st2$ – $st2$ 55 (55–56) (Figure 4d), $st5$ – $st5$ 54 (53–54); length of ventrianal shield 115 (112–118), width at level of setae $ZV2$ 90 (88–93), distance between preanal pores ($gv3$ – $gv3$) 15 (15–16) (Figure 4b). Fixed cheliceral digit with four teeth and pilus dentilis, movable digit with two teeth (Figure 4c). Calyx of spermatheca 21 (20–22) long (Figure 4e). Chaetotaxy as follows: Leg I; coxa 0 0/1 0/1 0, trochanter 1 1/1

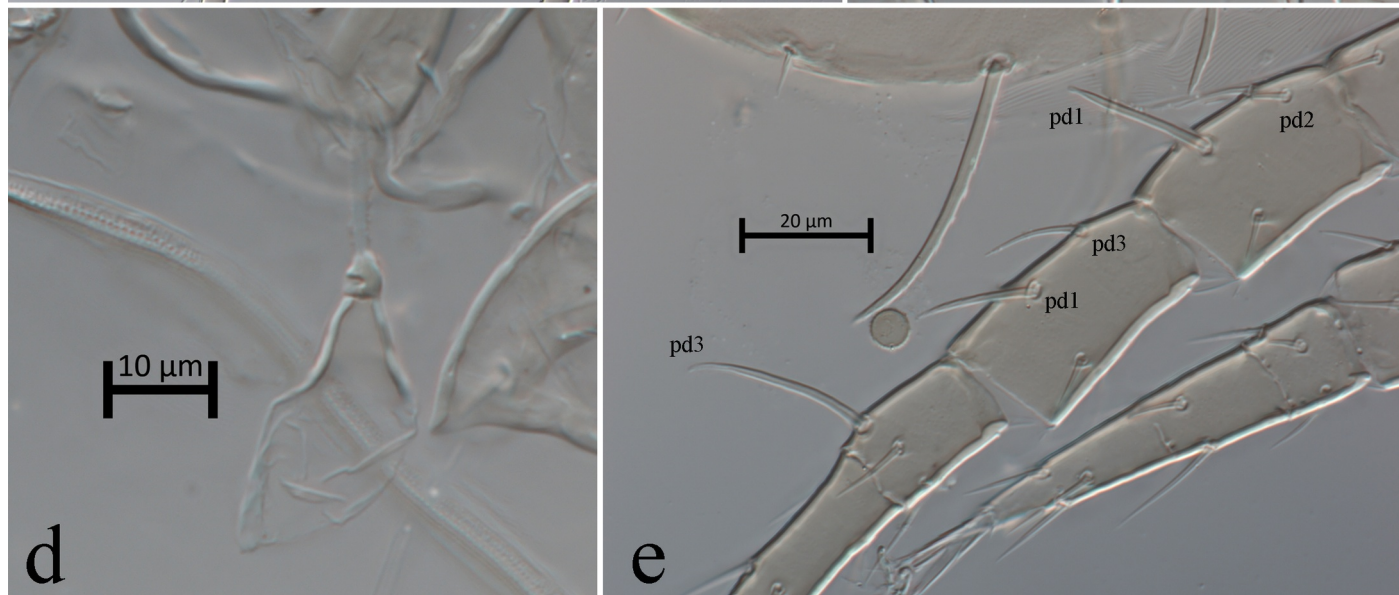


Figure 3 *Neoseiulus houstoni* (Schicha, 1987) female. a – Dorsal shield, b – Ventrianal shield, c – Chelicera, d – Spermatheca, e – Leg IV (genu, tibia and basitarsus).

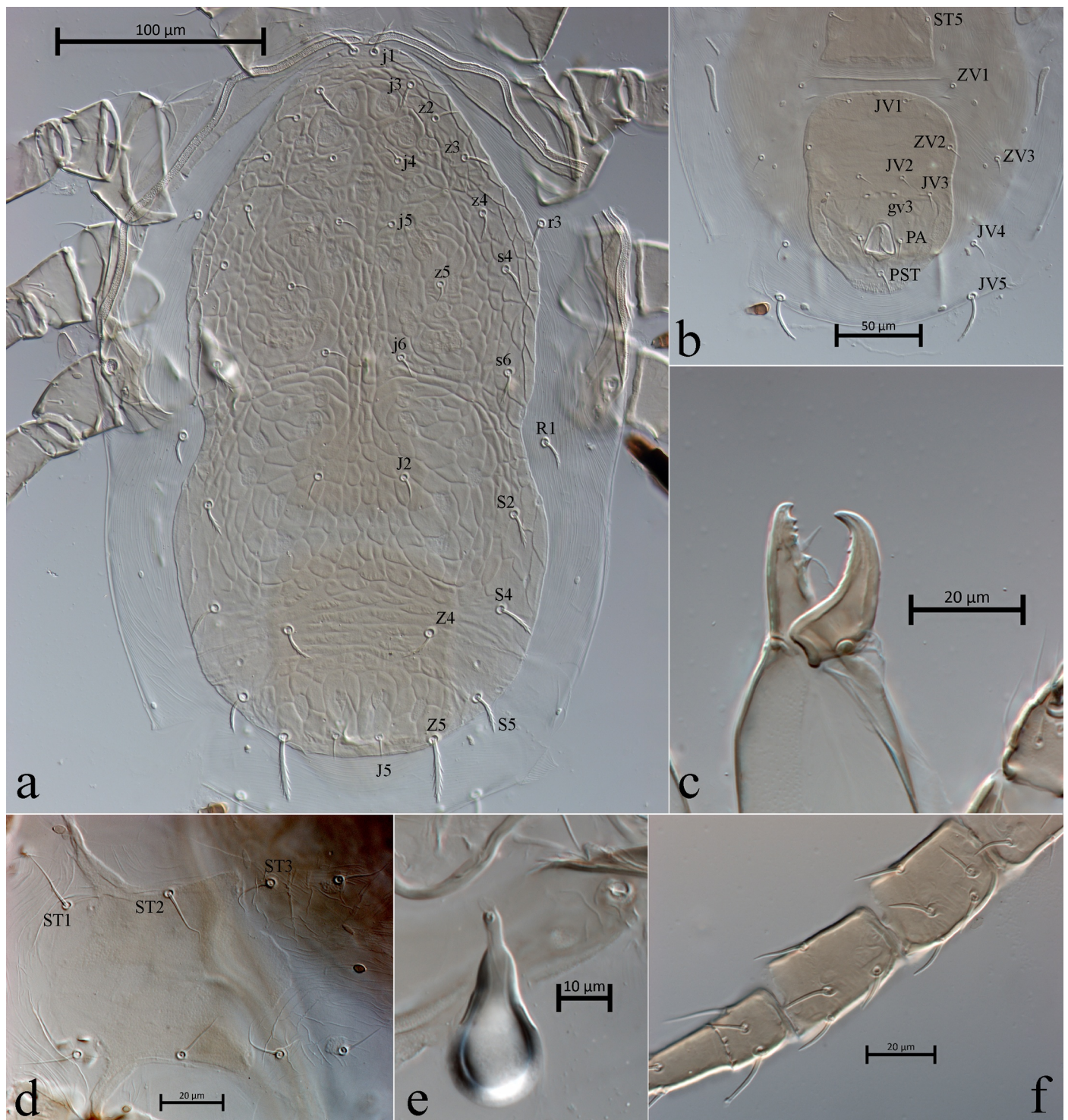


Figure 4 *Typhlodromus (Anthoseius) neobakeri* Prasad, 1968 female. a – Dorsal shield, b – Ventrianal shield, c – Chelicera, d – Sternal shield, e – Spermatheca, f – Leg IV (genu, tibia and basitarsus).

0/2 1, femur 2 3/1 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II: coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/0 2/0 1, tibia 1 2/1 1/1 1. Leg III: coxa 0 0/1 0/1 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/1 1. Leg IV: coxa 0 0/1 0/0 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/0 2/1 1, tibia 1 1/0 2/1 1. Leg IV with

one knobbed macroseta, *StIV* 20 (18–21) in length (Figure 4f).

World Distribution — Australia (Schicha and McMurtry 1986), Brazil (Lofego *et al.* 2009), Hawaii (Pritchard and Baker 1962), Philippines (Schicha and Corpuz-Raros 1992), USA (Denmark and Evans 2011) and Maldives (this study).

Remarks — *Typhlodromus (Anthoseius) neobakeri* was described by Prasad in 1968 based on the material collected from grass in Waimanalo, Oahu, Hawaii. Morphological characters and measurements of the current specimens almost identical to those of the original description and the re-descriptions (Prasad 1968; Schicha and McMurtry 1986; Schicha and Corpuz-Raros 1992). However, measurements of setae *Z4*, *Z5* and *S5* in the Maldivian material are slightly shorter than those provided in the original description, 19 (18–21) versus 24, 34 (31–36) versus 41 and 22 (21–24) versus 26, respectively (Prasad 1968). We considered these differences as intraspecific variations as these measurements fit well with those provided in the redescrptions (Schicha and McMurtry 1986; Lofego *et al.* 2009). In addition, Schicha and McMurtry (1986) and Schicha (1987) illustrated calyx of spermatheca as tube-like with basal part less sclerotized, based on the material collected from Australia. However, our examinations showed that Maldivian specimens have a nodular atrium which connect a bell-shaped calyx with a neck, as illustrated by Schicha and Corpuz-Raros (1992).

***Typhlodromus (Anthoseius) philippinensis* Corpuz**

Typhlodromus philippinensis Corpuz, 1966: 731.

(Figures 5–6)

Material examined — Two females collected from Maafushi Island, Maldives, 3°56'40.5"N 73°29'35.2"E, *Terminalia catappa* L. (Combretaceae) in 25 December 2021.

Measurements — *Female* ($n = 2$) – *Dorsum* (Figures 5a, 6a). Dorsal setal pattern 12A:8A (*r3* and *R1* off shield). Dorsal shield smooth except some lateral reticulations or striations, with five pairs of solenostomes (*gd2*, *gd4*, *gd6*, *gd8* and *gd9*), 14 pairs of visible poroids (*id1*, *id2*, *id4*, *id5*, *idm2*, *idm3*, *idm4*, *idm5*, *idm6*, *idx*, *is1*, *idl1*, *idl3* and *idl4*). Length of dorsal shield 276–291, width at level of *s4* 160–170, width at level of *S2* 168–174. Dorsal setae smooth and stout, except *Z5* with some barbs and large apical knob. Measurements as follows: *j1* 18–21, *j3* 20–23, *j4* 14, *j5* 14, *j6* 17–19, *J2* 21, *J5* 9–10, *z2* 12–16, *z3* 15–19, *z4* 19–20, *z5* 15, *Z4* 26–30, *Z5* 40–43, *s4* 18–21, *s6* 21–23, *S2* 22–25, *S4* 20–22, *S5* 10–12, *r3* 15 and *R1* 16–17. Peritremes long, extending to level of setae *j1*. *Venter* (Figures 5b, 6b). Sternal shield smooth, posterior projection present, with three pairs of setae (*st1*, *st2* and *st3*) and two pairs of pores (*iv1* and *iv2*); distance between *st1*–*st3* 56–58, *st2*–*st2* 59–60; metasternal setae *st4* and pair of pores (*iv3*) on soft integument; genital shield smooth, width at level of *st5* 55. Ventrianal shield smooth, pentagonal with four pairs of pre-anal setae (*JV1*, *JV2*, *JV3* and *ZV2*), one pair of paraanal (*Pa*) and one postanal seta (*Pst*) and with large crescentic preanal pores, distance between pores (*gv3*–*gv3*) 16–17. Length of ventrianal shield 86–94, width at level of setae *ZV2* 76–80. Setae *ZV1*, *ZV3*, *JV4*, *JV5* and seven pairs of poroids on integument surrounding ventrianal shield. Setae *JV5* smooth with large apical knob, longer than other ventral setae, 28–30 in length.

Chelicera (Figures 5c, 6c). Fixed digit 24–25 long with five teeth and pilus dentilis; movable digit 24–25 long with three teeth.

Spermatheca (Figures 5d, 6d). Calyx saccular, flaring distally 23–24 in length, atrium bulbous directly connected calyx without neck. Major duct broad, minor duct visible.

Legs (Figures 5e, 6e–f). Length of legs (excluding pretarsus): leg I 236–247; leg II 194–215; leg III 195–206; leg IV 250–265. Chaetotaxy as follows: Leg I; coxa 0 0/1 0/1 0, trochanter 1 1/1 0/2 1, femur 2 3/1 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/0 2/0 1, tibia 1 2/1 1/1 1. Leg III; coxa 0 0/1 0/1 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/1 2/1 1. Leg IV; coxa 0 0/1 0/0 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/0 2/1 1, tibia 1 1/0 2/1 1. Leg III and IV with modified macrosetae all with large knob. *SgeIII* 13–15, *StiIII* 10, *SgeIV* 20–21, *StiIV* 10–11, *StIV* 20 in length. In addition to these setae, leg III and IV have one more modified seta on each segment all blunt-tipped or slightly knobbed.

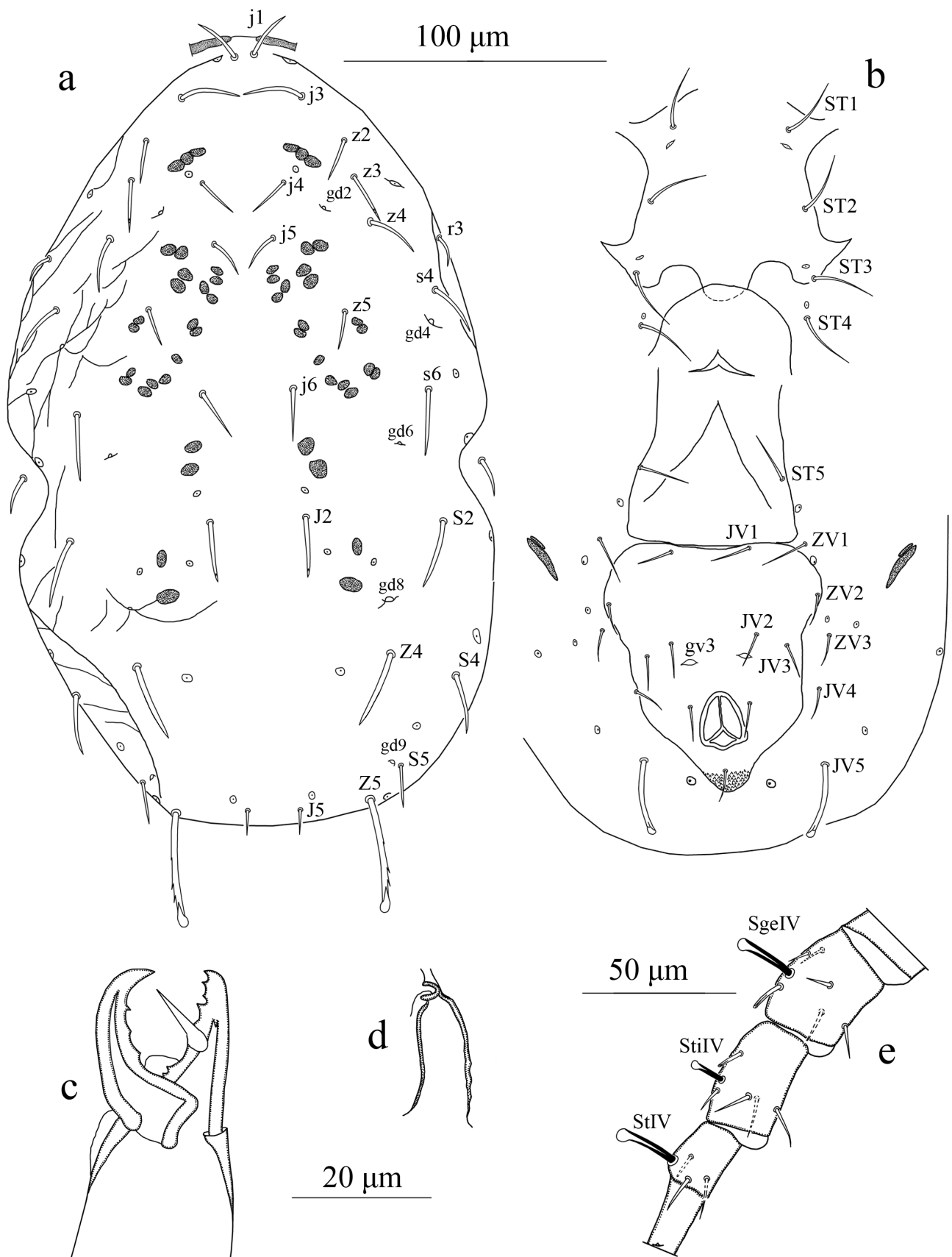


Figure 5 *Typhlodromus (Anthoseius) philippinensis* Corpuz, 1966 female. a – Dorsal shield, b – Ventral idiosoma, c – Chelicera, d – Spermatheca, e – Leg IV (genu, tibia and basitarsus).

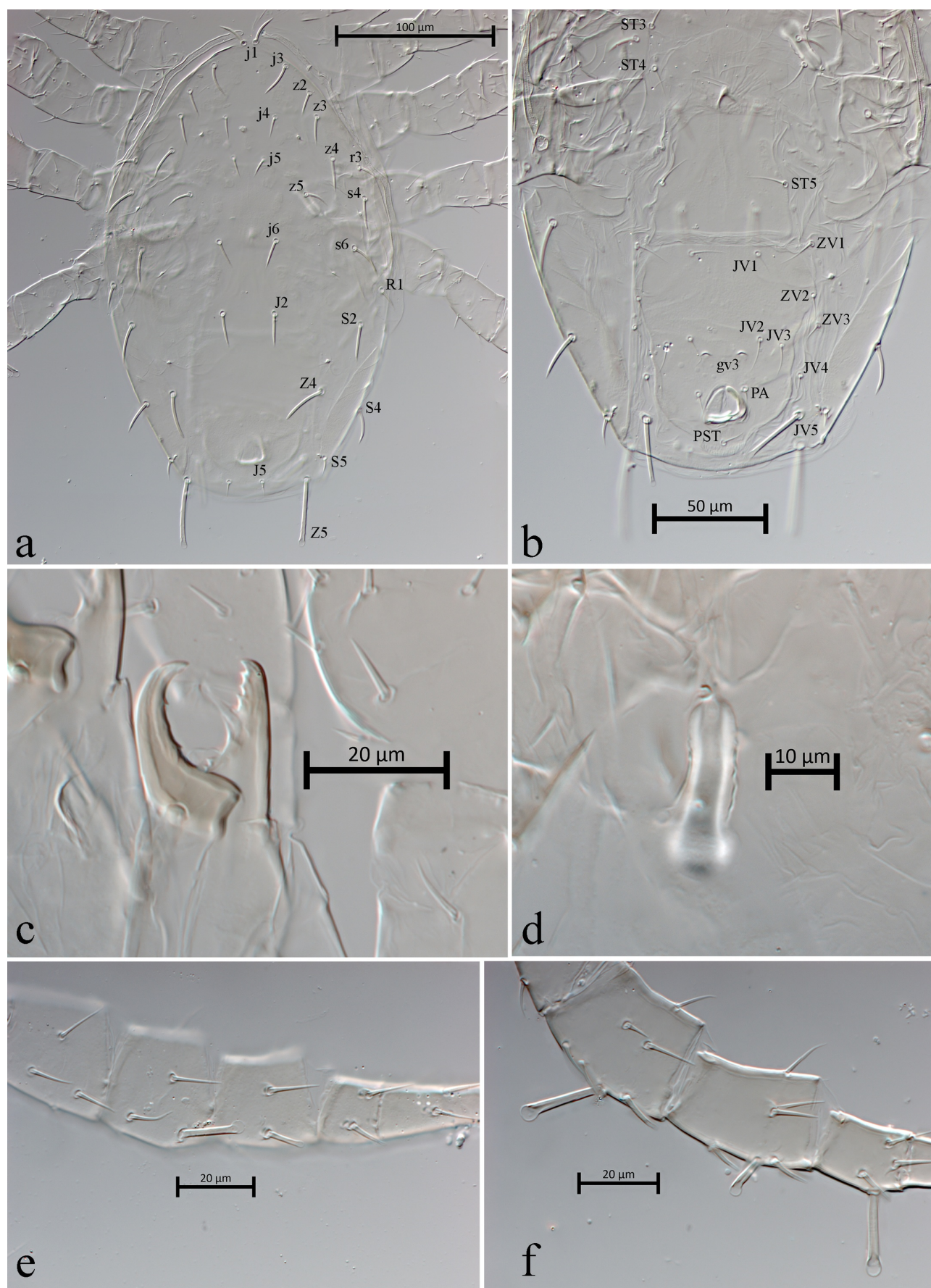


Figure 6 *Typhlodromus (Anthoseius) philippinensis* Corpuz, 1966 female. a – Dorsal shield, b – Ventral idiosoma, c – Chelicera, d – Spermatheca, e – Leg III (genu, tibia and basitarsus), f – Leg IV (genu, tibia and basitarsus).

World Distribution — Philippines (Corpuz 1966) and Maldives (this study).

Remarks — *Typhlodromus (Anthoseius) philippinensis* was described by Corpuz (1966) based on the material collected from *Asparagus plumosus* (Asparagaceae) in Philippines. Morphological characters and measurements of the Maldivian material are identical to those of the original description and the redescription by Schicha and Corpuz-Raros (1992). However, the authors reported that metasternal plates are present in the Philippine material. We are unable to see and confirm the presence of such structures in our material even with high magnifications (1000X). Therefore, we consider presence/absence of metasternal plates maybe variable or it is somewhat challenging to observe them due to poorly sclerotized sternal area in the current material of this species. As reported by the same authors, on the other hand, *T. (A.) philippinensis* shows a close affinity to *T. (A.) fleschneri* Chant, 1960 which was described from Karnataka, India. However, *T. (A.) philippinensis* can be separated from *T. (A.) fleschneri* by three teeth on movable digit of chelicera (two in the latter), by having normal peritreme (curved between setae *j1* in the latter). Moreover, macrosetae *SgeIV* and *StIV* are subequal in length in *T. (A.) philippinensis*, while *StIV* at least two times longer than *SgeIV* in *T. (A.) fleschneri* (Chant 1960; Swirski and Amitai 1967).

***Phytoseius meyeræ* Gupta**

Phytoseius meyeræ Gupta, 1977: 7.

(Figures 7–8)

Material examined — Ten females collected from Maafushi Island, Maldives, 3°56'40.5"N 73°29'35.2"E, *Terminalia catappa* L. (Combretaceae) in 25 December 2021.

Measurements — *Female* (*n* = 5) – *Dorsum* (Figures 7a, 8a). Dorsal setal pattern 12A:3A (*r3* on shield). Dorsal shield sclerotized and sculptured, with two pairs of visible solenostomes (anterolaterad *z5* = *gd5*) and posteromesad *s6* = *gd6*), nine pairs of visible poroids (*id1*, *id2*, *id5*, *id6*, *idm2*, *idm4*, *idx*, *idl1*, and *isl1*). Length of dorsal shield 281 (274–287), width at level of *s4* 149 (145–151). Dorsal setae thick, and distinctly serrated except *j4*, *j5*, *j6*, *z4* and *z5* smooth. Measurements of setae as follows: *j1* 22 (21–22), *j3* 22 (20–24), *j4* 8 (7–8), *j5* 7 (6–8), *j6* 8 (7–9), *J5* 9 (8–10), *z2* 14 (12–15), *z3* 27 (26–28), *z4* 11 (11–12), *z5* 9 (8–9), *Z4* 47 (44–48), *Z5* 54 (51–57), *s4* 63 (59–68), *s6* 64 (58–68) and *r3* 32 (31–33). Peritreme long, extending to level of setae *j1*. *Venter* (Figures 7b, 8b). Sternal shield smooth, lightly sclerotized, with three pairs of setae (*st1*, *st2* and *st3*) and two pairs of poroids (*iv1* and *iv2*); distance between *st1*–*st3* 56 (54–57), *st2*–*st3* 55 (52–58); metasternal shields not visible, metasternal setae *st4* and pair of poroids (*iv3*) on soft integument; genital shield smooth, width at level of *st5* 66 (62–68). Ventrianal shield smooth, elongated, with three pairs of pre-anal setae (*JV1*, *JV2* and *ZV2*), one pair of paraanal (*Pa*) and one postanal seta (*Pst*), preanal pores *gv3* visible in some specimens. Length of ventrianal shield 94 (87–97), width at level of setae *ZV2* 48 (44–50), width at level of anus 48 (46–51). Setae *ZV1*, *ZV3*, *JV5* and five pairs of poroids on integument surrounding ventrianal shield. Setae *JV5* thick, and strongly serrated, 41 (38–43) in length.

Chelicera (Figures 7c, 8c). Fixed digit 21 (20–22) long with four teeth and pilus dentilis; movable digit 22 (21–22) long with one tooth.

Spermatheca (Figures 7d, 8d). Calyx short, v-shaped 10 (10–11) in length, atrium large, bulbous. Major duct broad, minor duct not visible.

Legs (Figures 7e, 8e). Length of legs (excluding pretarsus): leg I 260 (252–268); leg II 220 (215–225); leg III 224 (218–228); leg IV 388 (376–397). Chaetotaxy as follows: Leg I; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II; coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/0 2/0 1, tibia 1 2/1 1/1 1. Leg III; coxa 0 0/1 0/1 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/0 2/0 1, tibia 1 1/1 2/1 1. Leg IV; coxa 0 0/1 0/0 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/0 2/1 1, tibia 1 1/0 2/1 1. Leg IV with four macrosetae; *SgeIV*, *StiIV* and *StIV* with membranous large knobs 9 (9–10), 35 (32–39) and 21 (20–22) in length, respectively, and that on telotarsus thicker than other setae on the same segment with blunt tip, 19 (18–19) in length.

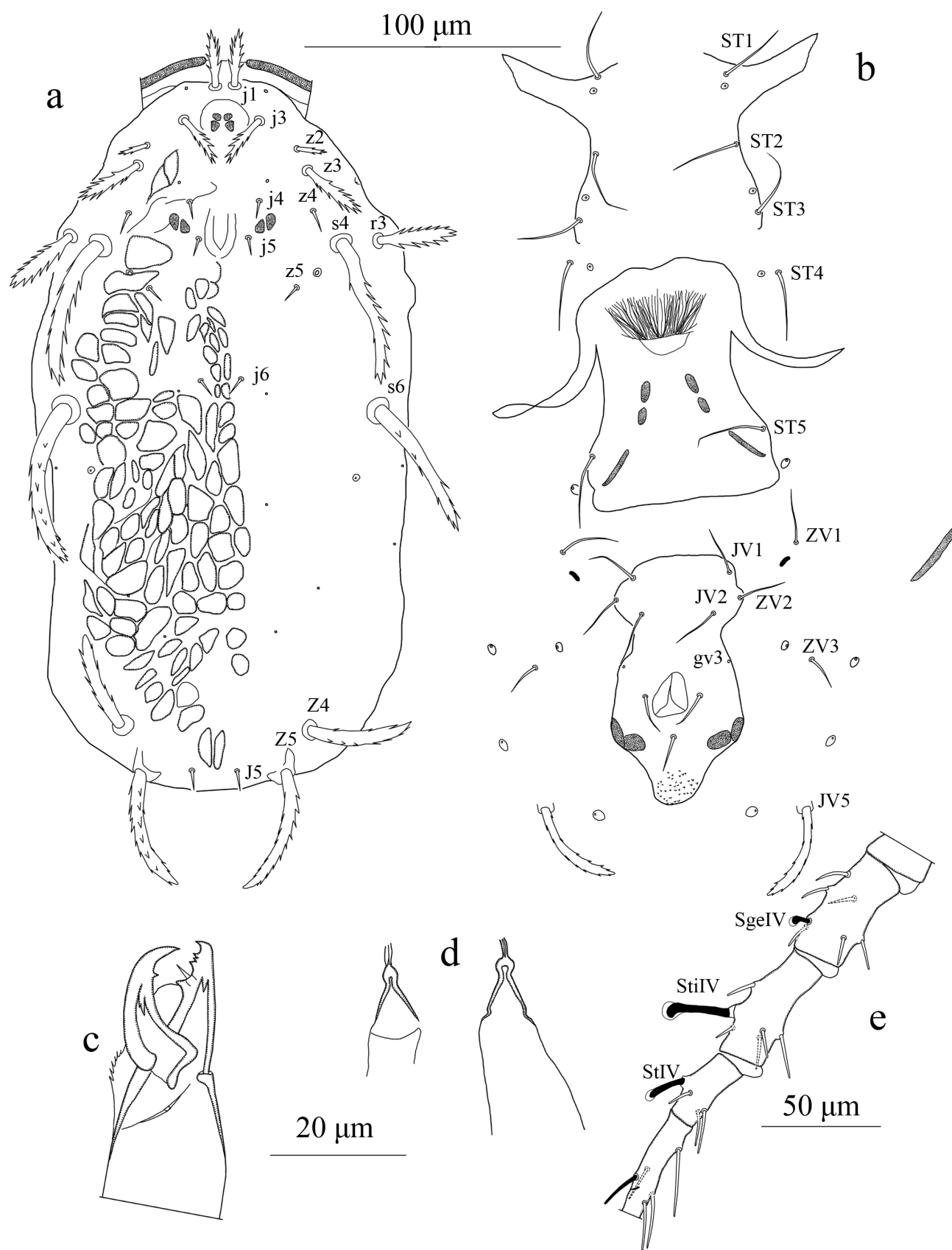


Figure 7 *Phytoseius meyeri* Gupta, 1977 female. a – Dorsal shield, b – Ventral idiosoma, c – Chelicera, d – Spermathecae, e – Leg IV (genu, tibia and basitarsus).

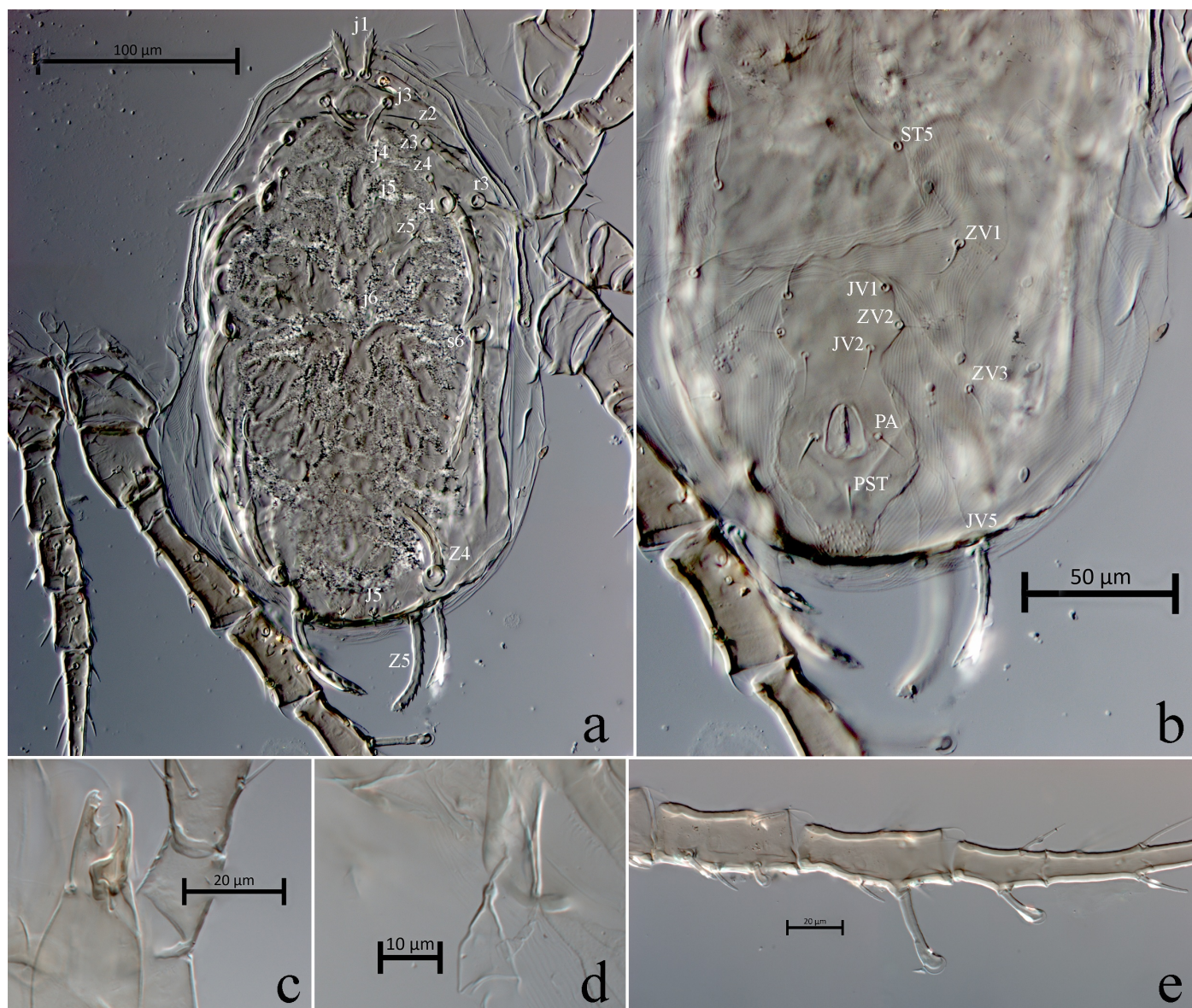


Figure 8 *Phytoseius meyeri* Gupta, 1977 female. a – Dorsal shield, b – Genital and ventrianal shields, c – Chelicera, d – Spermatheca, e – Leg IV (genu, tibia and basitarsus).

World Distribution — India (Gupta 1977) and Maldives (this study).

Remarks — *Phytoseius meyeri* was described by Gupta (1977) from Tura, Meghalaya, India. Morphological characters and measurements of the Maldivian material are almost identical to that of the original description and the redescrptions (Gupta 1985, 1986, 2003). However, seta *s4* in the Maldivian material is slightly longer compared to those of the original and the redescrptions [(63 (59–68) vs 44–45)]. We consider this difference as a flaw of the descriptions by Gupta (1985, 1986, 2003), as the seta *s4* almost reaching the base of setae *s6* in Indian material, similar to the Maldivian material.

In addition, measurements of seta *Z5* appear to be longer [54 (51–57)] in Maldivian material when compared to that provided in the original description (37). However, measurements of this seta fall into range provided in the subsequent redescrptions by the same author (Gupta 1985, 1986, 2003). This species appears to be close to the several other *Phytoseius* such as *P. coheni* Swirski & Shechter, 1961, *P. brevicrinis* Swirski & Shechter, 1961, *P. taiyushani*

Swirski & Shechter, 1961 and *P. rimandoi* Corpuz, 1966, all has priority over *P. meyeræ*. However, it can be separated from the aforementioned species by the combination of following characters, lengths of dorsal setae and macrosetae on genu IV, the length and the shape of ventral seta *JV5*, the shape of distal macroseta on telotarsus IV.

Discussion

Phytoseiid mites are considered to be one of the most important groups of predators for biological control of spider mites, and small soft bodied insects such as thrips, and whiteflies (McMurtry *et al.* 2013). Although previous studies have been documented a rich phytoseiid mite fauna including series of endemic species in its neighbouring countries such as India and Sri Lanka, nothing was known about native phytoseiid fauna in Maldives, an archipelagic country located in the Indian Ocean (Gupta 2003; Moraes *et al.* 2004; Khaustov *et al.* 2021; Kar and Karmakar 2022).

In this study, we reported six species belongs to four genera for the first time in Maldives. When its volcanic origin and isolated geographic position along with previous records of phytoseiids in its neighbouring countries as well as findings of the current work are considered together, it is clear that Maldives hold a special interest for further discoveries of phytoseiid mites.

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