

Checklist of Phytoseiidae (Acari: Mesostigmata) species from plants bearing leaf domatia, from the Eastern Cape Province, South Africa, with the description of a new species

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ABSTRACT

A new phytoseiid species, *Typhlodromus (Anthoseius) uhoneae* sp.n. is described from plants with domatia. In addition, 8 known phytoseiid species also associated with plants with domatia are discussed. A key to all the South African species of the subgenus *Anthoseius* is given.

Keywords: Predatory mites; *Amblyseius*; *Euseius*; *Typhlodromus (Anthoseius)*

INTRODUCTION

The remarkable variation in South Africa's topography, climate, altitude and latitude has resulted in a diverse vegetation that is exceptionally rich with 11,759 plant taxa and 1,064,100 species on record in the national database (Powrie et al. 2012). As a result, South Africa boasts a wide range of vegetation biomes ranging from deserts to grasslands and forests (Mucina and Rutherford 2006). These biomes have been well-surveyed by botanists, and there is a general understanding of their biodiversity. However, we have a limited understanding of the diversity of mites associated with plants with domatia in South Africa. Therefore, the purpose of this study was to fill this knowledge gap and survey mite communities associated with leaf domatia bearing plants (Situngu 2017).

Leaf domatia are usually inhabited by mites and facilitate a protective mutualism between mites and the host plant (O'Dowd and Pemberton 1998; Norton et al. 2000; Romero and Benson 2005). Many studies have shown that these structures play a significant role in influencing mite assemblages found on plants with leaf domatia (Pemberton and Turner 1989; O'Dowd and Willson 1991; Walter and O'Dowd 1992; Walter 1996; Norton et al., 2000; Romero and Benson 2005; Situngu and Barker 2017). Leaf domatia alter the distribution, abundance, and reproduction of mites and the Phytoseiidae (Acari:

Mesostigmata) are always significantly higher in domatia than on vein axils of plants lacking leaf domatia (O'Dowd and Willson 1991; O'Dowd and Pemberton 1998; Norton et al. 2000).

Members of the family Phytoseiidae are known for their predatory habits on phytophagous mites and small insects on cultivated plants and wild vegetation. Several are used for the control of pest organisms in agricultural open fields and protected crops world-wide (McMurtry and Croft 1997; McMurtry et al. 2013). The Phytoseiidae consists presently of 2,521 valid species of 94 genera belonging to three sub-families (Demite et al. 2020).

McMurtry and Croft (1997) categorise the diversity of life-styles of the Phytoseiidae based on food habits and related biological and morphological traits, and proposed 4 types and revised and updated this classification of lifestyles in 2013 (McMurtry et al. 2013) subdivided some of the 4 types. Types III and IV and their subtypes have bearing on the mites listed in this paper.

The objective of this study is to describe the species of Phytoseiidae collected from the woody species of the Eastern Cape, South Africa including a new species.

Table 1. The study sites visited with sampling dates. Classification of vegetation types based on Mucina and Rutherford (2006)

Vegetation types	Study site	Sampling date (dd/m/yr)
Coastal Thicket	Tolomnga	25/09/14
	Gonubie	26/09/14
	Kwelerha	27/09/14
Great Fish Thicket	Coombs farm	18/04/14
Kowle Thicket	Albany State Forest	12/05/13
	Grahamstown	4/09/14; 25/09/14 and 01/10/14
Northern Coastal Forest	Ntafufu	28/04/14
	Umgazana	02/05/14
Southern Afromontane Forest	Knysna	9/07/14
	Stellenbosch	11/11/14
Southern Afromontane Forest	Bedfort	9/10/14
	Kambi	14/10/14
Southern Coastal Forests	Alexandria	28/08/14
Southern Mistbelt Forests	Tsitsa Falls	05/03/14
	Beggars Bush	02/08/13
	Fort Fordyce	25/04/14 and 9/10/14
	Langeni	13/10/14 and 7/03/13
	Ngcobo	04/03/13
	Baztya	06/03/13 and 09/03/14
	Mount Frere	7/03/14
	Maiden Dam	17/04/13 and 11/10/14
	Pirie Forest	15/04/13 and 10/10/14
	Somerset East	8/10/14
Hogsback	10/10/14	

MATERIALS AND METHODS

Field visits were undertaken to various forest types found in the Eastern and the Western Cape provinces (see Table 1) periodically starting in January 2013 until October 2015. At each site, forest walks were undertaken and trees were examined for the presence and absence of leaf domatia. Herbarium voucher specimens of all the plants sampled were collected to verify the identity of the tree species, and to make sure all host plants were identified to species level. Some of the vouchers are housed at the Schonland Herbarium (GRA) in Grahamstown (now known as Makhanda). From tree species that were found to possess leaf domatia, 20 leaves were collected from each individual tree and placed in a zip

lock bag and stored in a cool backpack while in the field. The leaves were examined for the presence of mites as soon after collection as possible (usually the same day they were collected). The leaves were examined under a dissecting microscope and mites found inside the domatia and the surrounding leaf blade were collected using a pipette and a drop of alcohol. Some were mounted on a stub and viewed under the Scanning Electron Microscope. Others were stored in a vial with alcohol and sent to the Biosystematics division of ARC-Plant Health Protection Research for identification.

The preserved mites were mounted on microscope slides in PVA and dried in an oven at 45–50 degrees Celsius for 24 hours. Line drawings were made from photographs of the specimens taken with a Zeiss Axioskop TM Research microscope equipped with an AxioCam 208 colour camera and a Zen Soft Imaging System with measuring tools. All illustrations were edited using Adobe Illustrator C5. Measurements in microns (μm) of the holotype are provided, followed by that of paratype female in parenthesis. The taxonomic system of Chant and McMurtry (2007) is followed. The setal notations is according to Lindquist and Evans (1965) as adapted by Rowell et al. (1978). The holotype and paratypes will be deposited in the National Collection of Arachnida, ARC-Plant Health and Protection Research (NCA-PPRI), Pretoria, South – Africa

RESULTS

Family Phytoseiidae Berlese

Subfamily Typhlodrominae Wainstein

Tribe Typhlodromini Wainstein

Genus *Typhlodromus* Scheuten

Subgenus *Anthoseius* DeLeon

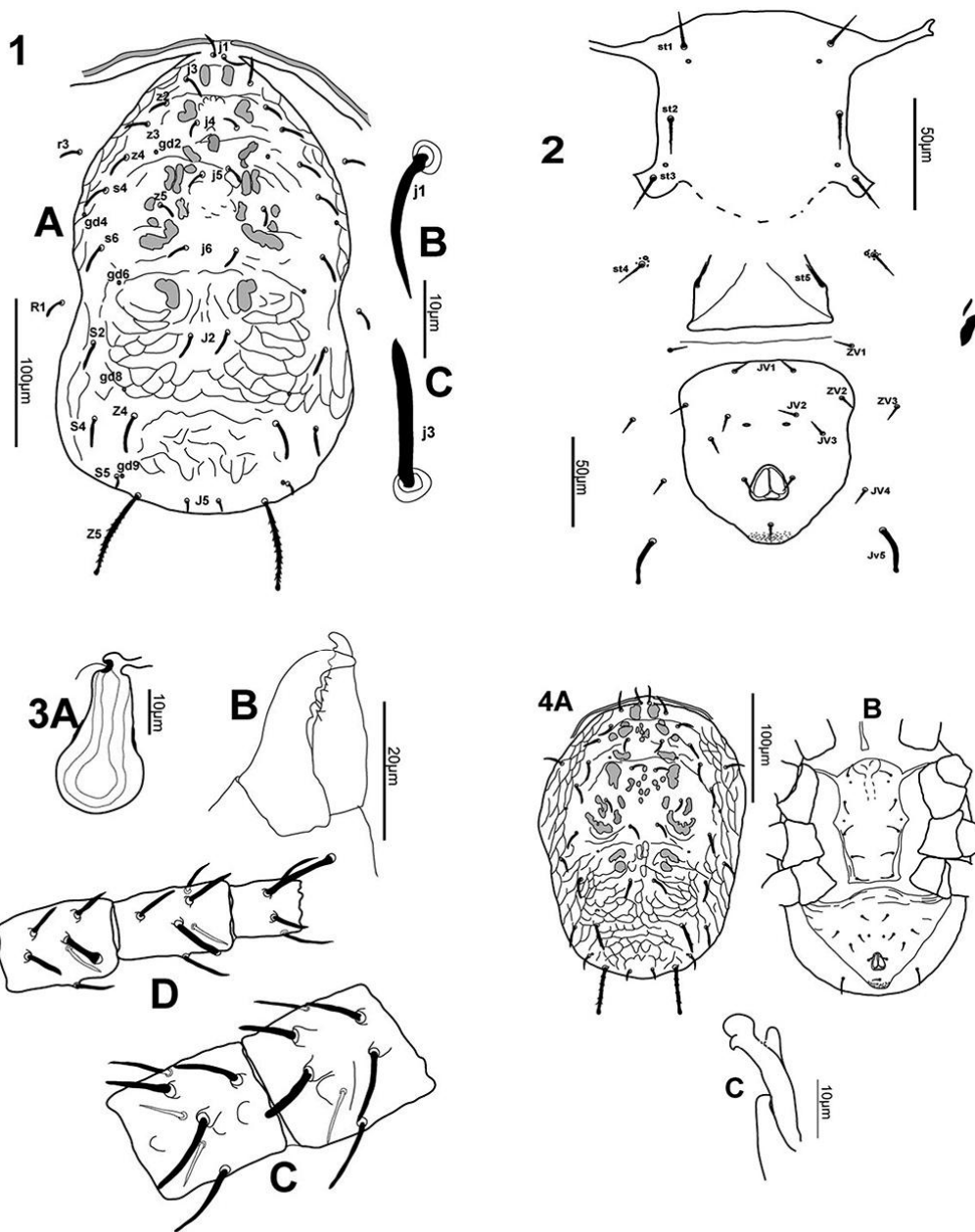
Typhlodromus (Anthoseius) uhoneae sp.n. (Figures 1-4)

Type material

Female holotype and one paratype female, one paratype male from *Gardenia thunbergia* L.f. (Rubiaceae), Kambi Forest, 14 October 2014; one paratype male from *Psychotria capensis* (Eckl.) Vatke (Rubiaceae), Maiden Dam, King-Williamstown, 11 October 2014.

Diagnosis

Dorsal shield partially reticulated; bearing five pairs of rounded solenostomes; dorsal setae stout, smooth and acute to slightly acute, except for setae Z5 which are serrated and knobbed distally, setae S5 clearly shorter than S4 and S2, setae Z4 shorter than distances to setae S5; peritreme extending to level of setae j1; sternal shield with 3 pairs of setae; ventrianal shield with 4 pairs pre-anal setae and a pair of pre-anal pores; fixed cheliceral digit with 5 teeth and movable digit with 3; leg IV with 3 knobbed macrosetae; calyx of spermatheca saccular and atrium nodular; genu II with seven setae.



Figures 1-4. *Typhlodromus (Anthoseius) uhoneae*. Figure 1. (a) Dorsal shield of female. Figure 1. (b) Dorsal seta *j1* of female. Figure 1. (c) Dorsal seta *j3* of female. Figure 2. Ventral view of female. Figure 3. (a) Spermatheca of female. Figure 3. (b) Chelicerae of female. Figure 3. (c) Tibia-Genu of leg III of female. Figure 3. (d) Basitarsus-Tibia-Genu of leg IV of female. Figure 4. (a) Dorsal shield of male. Figure 4. (b) Ventral view of male. Figure 4. (c) Spermatodactyl of male

Description

Female (Figure 1–3) (n = 2)

Dorsum (Figure 1(a-c)). Dorsal setal pattern 12A:8B (Chant and Yoshida-Shaul 1989). Dorsal shield 335(330) long and 195(207) wide, waisted medially with anterolateral margins

reticulate-striate, medially with few striae, opisthosoma irregularly reticulate to reticulate behind setae *j6* (Figure 1(a)). All dorsal setae short, smooth, acute to slightly acute and stout (Figure 1(b-c)) except for setae *Z5* which are much longer, serrate and knobbed distally. Muscle-marks (sigilla) medially on prodorsum. Five pairs of rounded solenostomes (*gd2*, *gd4*, *gd6*, *gd8* and *gd9*) present. Poroids not visible. Setae *r3* and *R1* on cuticle flanking dorsal shield. Lengths of setae: *j1* 16(17), *j3* 19(18), *j4* 15(14), *j5* 16(16), *j6* 17(16), *J2* 20(18), *J5* 11(11), *z2* 16(16), *z3* 18(16), *z4* 18(17), *z5* 16(17), *Z4* 31(30), *Z5* 64(56), *s4* 20(20), *s6* 21(20), *S2* 24(22), *S4* 23(22), *S5* 12(13), *r3* 18(15) and *R1* 18(16). Peritreme reach anterior to setae *j1*.

Venter (Figure 2). Ventral setal pattern 15: JV: ZV (Chant and Yoshida-Shaul 1991). Sternal shield almost squarish with three pairs of setae and two pairs of poroids (*iv1* and *iv2*). Distances *st1-st3* 58(58) and *st2-st2* 61(63). Shield smooth with posterior margin not visible. Setae *st4* and poroids *iv3* on indistinct small metasternal platelets. Genital shield smooth with *st5-st5* 65(65) and two lines, genital sigilla not clearly visible. Ventrianal shield pentagonal, 111(108) long, 89 (84) wide at level of *ZV2* and 83(82) wide at level of anal opening, with four pairs of pre-anal setae and two rounded solenostomes (*gv3*) posteromedially to setae *JV2*. Setae *JV5* 28 (28) long, smooth, stout and slightly knobbed distally. Two pairs of inguinal sigilla with primary one rather broad and elongate oval, 21(22) and secondary one smaller and slender, 12(11).

Spermatheca (Figure 3(a)) – Calyx saccular 16 long with posterior third thick-walled; atrium nodular attached to the calyx without neck.

Chelicerae (Figure 3(b)) – Fixed chela 27(24) long with 5 teeth and a pilus dentilis. Movable chela 24 (25) long with 3 teeth.

Legs (Figure 3(c-d)) – Chaetotaxy of genu II 2–2/0, 2/0-1, genu III 1–2/1, 2/0 – 1, with Sge III stout and blunt distally, 17(16) long. Leg IV with Sge IV knobbed, 16(14) long, Sti IV knobbed, 20(18) long and StIV, knobbed and 26(26) long.

Male (Figure 4(a-c))

Dorsum (Figure 4(a)). Dorsal shield 246–279 long and 170–192 wide, broadly oval and reticulated except for centre of prodorsum. All dorsal setae short, smooth, some blunt distally and stout except for setae *Z4* and *Z5* which are longer, serrate and latter knobbed distally. Sigilla medially on prodorsum. Five pairs of solenostomes (*gd2*, *gd4*, *gd6*, *gd8* and *gd9*) present. Setae *r3* and *R1* on dorsal shield. Lengths of setae: *j1* 13–17, *j3* 15–20, *j4* 12, *j5* 11–14, *j6* 12–15, *J2* 14–17, *J5* 10–11, *z2* 13–15, *z3* 12–16, *z4* 12–17, *z5* 12–14, *Z4* 23–24, *Z5* 38–44, *s4* 14–17, *s6* 15–20, *S2* 16–20, *S4* 18–20, *S5* 11–13, *r3* 13–18 and *R1* 13–17. Peritreme reach anterior to setae *j1*.

Venter (Figure 4(b)) – Sternogenital shield, 113–133 long and 70–83 wide, with 5 pairs of setae, two pairs of pores and genital opening on anterior margin. Ventrianal shield triangular, 95–110 long and 137–160 wide, fused with peritremal shields and with four pairs of pre-anal setae and two pre-anal pores. Setae *JV5* (15–17) flanking ventrianal shield and is smooth and pointed.

Spermatodactyl (Figure 4(c)) – Straight, 19–21 long, forked distally into a knobbed process and a short blunt process. Knobbed process with curved claw-like structure at base of knob.

Legs – Same as for female.

Etymology – This species is named after the second author's daughter, Uhone meaning 'arrived' in the Venda language one of 11 languages in South Africa.

Remarks – This new species was compared with all 320 *Typhlodromus (Anthoseius)* spp in the Phytoseiidae Database (Demite et al. 2020) and 8 species not in the database (Chatti et al. 2017; Döker et al. 2017; Ferragut and Navia 2017; Fang et al. 2018; Karmakar and Bhowmik 2018; Ferragut and Baumann 2019) and differs from them all but is closely related to *T. (A.) haramotoi* Prasad (1968) in the shape of the dorsal setae being stout with setae S5 very short, Z4 shorter than distance to setae S5 and Z5 long serrate and knobbed distally, leg IV with 3 knobbed macrosetae and setae JV5 knobbed. However, it differs from *T. (A.) haramotoi* in that setae Z4 are serrate, genu II has 6 setae and in the shape of the spermatheca (Schicha and McMurtry 1986). It is also closely related to *T. (A.) gressitti* McMurtry and de Moraes (1985) in having all dorsal setae smooth except for setae Z5 which are serrate and knobbed, 3 knobbed setae on leg IV and appearance of spermatheca. It differs from *T. (A.) gressitti* in that all dorsal setae (except Z5) are slender but stout in new species, setae JV5 acute but knobbed in new species, pre-anal pores are situated behind setae JV2 but posteromedially to JV2 in the new species and peritreme are slightly bent backwards between setae j1 but not bent in new species. The macrosetae on leg IV are also longer than that of *T. (A.) gressitti* with the one on genu IV twice as long as that of the latter.

The following known species were also found on plants with domatia during this survey:

Amblyseius anomalus Van der Merwe

Amblyseius anomalus Van der Merwe, 1968: 157

Amblyseius (Multiseius) anomalus Denmark & Muma, 1989: 129

Because of its unique spermatheca Denmark and Muma (1989) grouped this species under an Unassigned Species Group together with 5 other *Amblyseius* species with unique spermathecae, but Chant and McMurtry (2004) listed this species in the *andersoni* species-group. All dorsal setae of this species are minute and smooth except for setae s4, Z4 and Z5 which are exceptionally long and also smooth. The major duct of the spermatheca is a broad tube that suddenly narrows before it joins the bulbous atrium, adjacent to the atrium the calyx is a slender stalk that suddenly flares drastically. Fixed digit of chelicerae multidentate.

World distribution: Benin, Cameroon, Ghana, Sierra Leone, South Africa. To give an indication of the abundance of each known species the reported times it was samples are given. Thus this excludes routine samples. This species was sampled 16 times since description, present study included (Ueckermann and Loots 1988; Zannou et al., 2007)

Specimens examined: 2 ♀♀.

Kwelera, East London, on *Grewia occidentalis* L. (Malvaceae), 27 September 2014;
Alexandria Forest, on *Gardenia thunbergia* L.f. (Rubiaceae), 28 August 2014.

Euseius rubicolus (Van der Merwe & Ryke)

Amblyseius (*Typhlodromalus*) *rubicolus* Van der Merwe & Ryke, 1964:266

Amblyseius addoensis rubicolus (Van der Merwe & Ryke), McMurtry 1980: 152

Euseius rubicolus (Van der Merwe & Ryke), De Moraes et al. 2004: 80.

Amblyseius (*Typhlodromalus*) *annecki* Van der Merwe & Ryke, 1964:268

Euseius annecki (Van der Merwe & Ryke), De Moraes et al. 2004: 80.

Amblyseius (*Typhlodromalus*) *raptor* Van der Merwe & Ryke, 1964:270

Euseius raptor (Van der Merwe & Ryke), De Moraes et al. 2004: 80.

Amblyseius (*Typhlodromalus*) *addoensis* Van der Merwe & Ryke, 1964:275

Amblyseius addoensis addoensis (van der Merwe & Ryke), McMurtry 1980: 151

Euseius addoensis (Van der Merwe & Ryke), De Moraes et al. 2004: 80.

Amblyseius (*Typhlodromalus*) *undulatus* Van der Merwe & Ryke, 1964:278

Euseius undulatus (Van der Merwe & Ryke), De Moraes et al. 2004: 80.

Amblyseius (*Typhlodromalus*) *capensis* Van der Merwe & Ryke, 1964:281

Euseius capensis (Van der Merwe & Ryke), De Moraes et al. 2004: 80.

Seven closely related species described by Van der Merwe and Ryke (1964) from Grabouw (Western Cape Province), Addo (Eastern Cape Province) and Rustenburg (North-West Province) were separated into two subspecies, *Amblyseius addoensis rubicolus* (Van der Merwe & Ryke) and *Amblyseius addoensis addoensis* (Van der Merwe & Ryke) and one other species, *Amblyseius citri* (Van der Merwe & Ryke, 1964, p. 273) by McMurtry (1980) based on hybridisation tests. Ueckermann and Loots (1988) ignored the subspecies a status kept since then. Because of page priority de Moraes et al. (2004) changed the name *addoensis* to *rubicolus*, under the genus *Euseius* Wainstein. Only two species are now recognised, namely *E. rubicolus* and *E. citri*. These two species are similar in all respects and can only be distinguished by the length of setae Z4, 14–22 in *E. rubicolus* and 23–30 in *E. citri*. However, this species can be defined by the following combination of characters: All dorsal setae short and smooth, except for setae j1, j3, s4 and Z5 which are longer with the latter serrate, 3 pairs of pre-anal setae (JV1, JV2 and ZV2) on the ventrianal shield are almost

aligned transversely, peritremes are shorter usually not extending to setae *j1*, the teeth on the chelicerae are reduced with only 3 teeth apically on the fixed digit; calyx of spermatheca slightly bulged adjacent to atrium, then narrows to suddenly flares towards vesicle.

World distribution: South Africa. This species can be considered as one of the dominant species in South Africa because it is regularly present in samples from the Eastern- and Western Cape Provinces.

Specimens examined: 15 ♀♀, 5 ♂♂

Alexandria Forest, on *Ehretia rigida* (Thunb.) Druce (Boraginaceae), 28 August 2014; Grahamstown Botanical Garden, on *Gardenia thunbergia* L.f. (Rubiaceae), 4 September 2014; Gonubie, East London, *Grewia occidentalis* L. (Malvaceae), 26 September 2014; Stellenbosch, *Kiggelaria africana* (Thunb.) Spach (Bigoniaceae), 11 November 2014, *Tecoma capensis* (Thunb.) Spach, 11 November 2014; Bedford, on *Grewia occidentalis* L., 9 October 2014, *Canthium ciliatum* (Klotzsch) Kuntze (Rubiaceae), 9 October 2014; Kambi Forest, on *Gardenia thunbergia* L.f. (Rubiaceae), 14 October 2014; Langeni Forest, on *Psychotria capensis* (Eckl.) Vatke (Rubiaceae), 13 October 2014, on *Ocotea* sp. (Lauraceae), 13 October 2014; Pirie Forest, on *Canthium ciliatum* (Klotzsch) Kuntze (Rubiaceae), 10 October 2014, on *Gardein* sp. (Rubiaceae), 10 October 2014; Maidan dam, King-Williams Town, on *Rhoicissus tomentosa* (Lam.) Wild & R.B.Drumm (Vitaceae), 11 October 2014; Hogsback, on *Burchellia bubalina* (L.f.) Sims (Rubiaceae), 10 October 2014; Grahamstown, on *Gardenia thunbergia* L.f. (Rubiaceae), October 2014.

Typhlodromus (Anthoseius) buccalis Van der Merwe

Typhlodromus (Anthoseius) buccalis Van der Merwe, 1968: 55; De Moraes et al. 2004: 314.

Amblydromella buccalis, Moraes et al., 1986: 157

Amblydromella (Amblydromella) buccalis, Denmark & Welbourn, 2002: 307

The species can be recognised by having all dorsal setae short and smooth except for setae *Z4* and *Z5* which are the longest and serrate with latter distally knobbed, setae *S5* much shorter than *S2* and *S4*, ventral setae *JV5* acute distally, spermatheca could not yet be described, macrosetae on leg IV also knobbed distally and genua II and III with 7 setae.

World distribution: South Africa. This species was samples 7 times since description, present study included (Ueckermann and Loots 1988; Ueckermann, et al., 2008)

Specimens examined: 4 ♀♀

Alexandria Forest, on *Gardenia thunbergia* L.f. (Rubiaceae), 28 August 2014; Nr. Grahamstown, on *Canthium inerme* (L.f.) Kuntze (Rubiaceae), 25 September 2014.

Typhlodromus (Anthoseius) vescus Van der Merwe

Typhlodromus (Anthoseius) vescus Van der Merwe, 1968: 48; De Moraes et al. 2004: 357.

Typhlodromus (Anthoseius) anitrae Scultz, 1973: 98.

Typhlodromus (Anthoseius) meyeræ Scultz, 1973: 101

Typhlodromus (Typhlodromus) vesus, Tseng, 1983: 70.

Amblydromella vesca, Moraes et al., 1986: 178

Amblydromella (Amblydromella) vesca, Denmark & Welbourn, 2002: 307

This species can be distinguished by all the dorsal setae being short and smooth except for setae Z4 and Z5 which are serrate with latter the longest and knobbed distally, setae S5 much shorter than S2 and S4, ventral setae JV5 knobbed, short broad major duct of spermatheca becomes the cervix, forming a tube which slightly flares towards the vesicle with flared portion sclerotised, macrosetae on leg IV also knobbed distally and genua II and III with 7 setae.

World distribution: South Africa. This species was sampled 36 times since description, present study included (Ueckermann and Loots 1988; Ueckermann, et al., 2008).

Specimens examined: 3 ♀♀

Alexandria Forest, on *Ehretia rigida* (Thunb.) Druce (Boraginaceae), 28 August 2014;
Kwelera, East London, on *Olea faveolata* E. Mey (Oleaceae), 27 September 2014;
Grahamstown, on *Coprosma coprosma repens* A. Rich. (Rubiaceae), October 2014.

Typhlodromus (Anthoseius) incisivus Van der Merwe

Typhlodromus (Anthoseius) incisivus Van der Merwe, 1968: 35; De Moraes et al. 2004: 330.

Amblydromella incisiva, Moraes et al., 1986: 164

Amblydromella (Amblydromella) incisiva, Denmark & Welbourn, 2002: 308.

This species can be recognised by all dorsal setae being short and smooth except for setae Z5 which are the longest and serrate, setae S2, S4 and S5 equally long, ventral setae JV5 smooth and acute, spermatheca with cervix longer (21 µm) and sacculus with proximal half thick-walled, macroseta on leg IV acute and genu II has 8 setae and genu III with 7.

World distribution: South Africa. This species was sampled 24 times since description, present study included (Ueckermann and Loots 1988; Ueckermann, et al., 2008).

Specimens examined: 1 ♀

Gonubie, East London, on *Rhoicissus rhomboidea* (E. Mey x Harv.) Planch (Vitaceae), 26 September 2014.

Typhlodromus (Anthoseius) apoxys Van der Merwe

Typhlodromus (Anthoseius) apoxys Van der Merwe, 1968: 31; De Moraes et al. 2004: 309.

Amblydromella apoxys, Moraes et al., 1986: 154

Amblydromella (Amblydromella) apoxys, Denmark & Welbourn, 2002: 308.

This species exhibits the following combination of characters: all dorsal setae being short and smooth except for setae Z4 and Z5 which are serrate with the latter the longest and knobbed distally, setae S2, S4 and S5 equally long, ventral setae JV5 smooth and acute, cervix of spermatheca short (6 µm), saccular with posterior half thick-walled, leg IV with one or 2 knobbed macrosetae, genu II has 7 setae and genu III with 6 setae.

World distribution: South Africa and Mozambique. This species was sampled 26 times since description, present study included (Ueckermann and Loots 1988; Ueckermann, et al., 2008).

Specimens examined: 2 ♀♀

Kwelera, East London, on *Rhoicissus rhomboidea* (E. Mey x Harv.) Planch (Vitaceae), 27 September 2014; Grahamstown, on *Gardenia thunbergia* L.f. (Rubiaceae), October 2014.

Typhlodromus (Anthoseius) microbullatus Van der Merwe

Typhlodromus (Anthoseius) microbullatus Van der Merwe, 1968: 33; De Moraes et al. 2004: 338.

Amblydromella microbullata, Moraes et al., 1986: 167

Amblydromella (Amblydromella) microbullata, Denmark & Welbourn, 2002: 308.

This species exhibits the following combination of characters: all dorsal setae being smooth except for setae Z4 and Z5 which are serrate with the latter the longest and knobbed distally, setae S2, S4 and S5 equally long, ventral setae JV5 smooth and acute, atrium incorporated in bell-shaped and sclerotised cervix, macroseta on leg IV mostly knobbed and genua II and III with 7 setae.

World distribution: Azores, Madagascar, Mauritius, Mozambique and South Africa. This species was sampled 35 times since description, present study included (Ueckermann and Loots 1988; Ueckermann, et al., 2008)

Specimens examined: 1 ♀

Somerset East, on *Rhoicissus digitata* (L.f.) Gilg & M. Brandt (Vitaceae), 8 October 2014.

Typhlodromus (Anthoseius) celastrus Ueckermann & Loots

Typhlodromus (Anthoseius) celastrus Ueckermann & Loots, 1988: 23; De Moraes et al. 2004: 217.

Amblydromella (Amblydromella) celastra, Denmark & Welbourn, 2002: 308.

This species can be defined as having all dorsal setae being short and smooth except for setae Z4 and Z5 which are serrate and knobbed distally, setae S2, S4 and S5 equally long, ventral setae JV5 smooth and knobbed, spermatheca with cervix a long tube which slightly flares towards vesicle, macroseta on leg IV knobbed and genua II and III with 7 setae.

World distribution: South Africa. This species was sampled only 4 times since description, present study included; Ueckermann et al. 2008).

Specimens examined: 1 ♀

Kwelera, East London, on *Ehretia rigida* (Thunb.) Druce (Boraginaceae), 27 September 2014

Key to South African species of *Typhlodromus (Anthoseius)* – Females. (Based on Ueckermann et al. 2008)

1. Ventrianal shield with 3 pairs of pre-anal setae 2
 - Ventrianal with 4 pairs of pre-anal setae 3
2. Dorsal shield with a pair of profound incisions at level of R1; all dorsal setae very short and smooth; JV5 very short, smooth, sharp tipped.....
 - *T.(A.) eremicus* Smith Meyer & Ueckermann
 - Dorsal shield without a pair of profound incisions at level of R1; all dorsal setae and JV5 long, serrate, knobbed, except for setae S5 and J5 which are very short and smooth....
 - *T.(A.) transvaalensis* (Nesbitt)
3. Dorsal shield with more than 10 pairs of serrated setae..... 4
 - Dorsal shield with at most 5 pairs of serrate setae 5
4. Dorsal shield with all pairs of setae serrate, except for setae j4–j6, J2–J5 and z5 which are smooth, setae Z4, S4 and S5 knobbed; setae St3 off sternal shield.....
 - *T.(A.) grastis* Ueckermann & Loots
 - Dorsal shield with all pairs of setae serrate, setae Z4, S4 and S5 acute only Z5 knobbed; setae St3 on sternal shield *T.(A.) michaeli* Ueckermann & Loots
5. Both setae S4 and S5 smooth 6
 - Setae S4 and S5 serrate, setae Z4 and Z5 also serrate but knobbed
 - *T.(A.) terrulentis* Van der Merwe
6. Most dorsal setae distinctly blunt; setae Z4 and Z5 spatulate; anal orifice located at centre of ventrianal shield *T.(A.) religiosus* Ueckermann & Loots
 - Most dorsal setae sharp-tipped or blunt or slightly tipped; setae Z4 and Z5 not spatulate; anal orifice located at posterior region of ventrianal shield..... 7
7. Setae S4, S5 and r3, knobbed *T.(A.) bullatus* van der Merwe
 - Setae S4, S5 and r3 sharp-tipped or stout, blunt or slightly tipped 8
8. Setae S4, S5 and r3 sharp-tipped 9
 - All dorsal setae smooth, stout, blunt or slightly tipped, except for setae Z5 which are the longest, serrate and knobbed *T.(A.) uhoneae* sp.n.
9. Setae Z4 as long as or longer than distance to setae S5 10
 - Setae Z4 clearly shorter than distance to setae S5 14
10. Genu of leg II with 7 setae..... 11
 - Genu of leg II with 8 setae 12

11. Seta Z5 knobbed, setae Z4 extending to or pass Z5, both serrate; leg IV with 3 knobbed macrosetae..... *T.(A.) buccalis* Van der Merwe
- Seta Z5 sharp-tipped, seta Z4 distinctly shorter than distance between its base and base of Z5, both serrate; leg IV with one knobbed macroseta..... *T.(A.) capparidis* Van der Merwe
12. Seta S5 much shorter than S4, all dorsal setae smooth except setae Z4 and Z5 which are serrate and also the longest setae *T.(A.) praeacutus* Van der Merwe
- Seta S5 equal to or slightly shorter than S4; only setae Z5 serrate..... 13
13. Calyx of spermatheca bulged next to atrium, followed by aslender tube that flares toward the vesicle; preanal pores present; macroseta on leg IV knobbed..... *T.(A.) astibus* Ueckermann & Loots
- Calyx of spermatheca bell-shaped, short, broad, atrium incorporated in calyx; pre-anal pores absent; macroseta on leg IV acute *T.(A.) lootsi* Schultz
14. Pre-anal pores absent 15
- Pre-anal pores present 16
15. All dorsal setae short and smooth, only setae Z5 long, serrate and knobbed; proximal half of calyx of spermatheca slightly bulged and thick walled, posterior half thin walled slightly flared towards vesicle; leg IV with 3 knobbed macrosetae.. *T.(A.) argyronamus* Ueckermann & Loots
- All dorsal setae short and smooth, except for setae Z5 which are serrate and acute; calyx of spermatheca bell-shaped with posterior half thick-walled; leg IV with one knobbed macroseta..... *T.(A.) namaquaensis* Ueckermann & Loot
16. Calyx of spermatheca more than 50 times as long as width at its mid-length..... *T.(A.) muliebris* Van der Merwe
- Calyx of spermatheca less than 10 times as long as width at its mid-length 17
17. Setae S5 clearly shorter than S4 18
- Setae S5 and S4 equal or subequal in length 27
18. Legs III and IV with extra knobbed setae in addition to macrosetae..... *T.(A.) crassus* Van der Merwe
- Legs without extra knobbed setae in addition to macrosetae..... 19
19. Leg IV with 1-3 knobbed macrosetae; Z5 sharp-tipped or knobbed 20
- Leg IV with one sharp-tipped macroseta; Z5 sharp-tipped..... *T.(A.) galpinii* Ueckermann, Zannou & Moraes
20. Leg IV with one or 3 knobbed macrosetae..... 21
- Leg IV with 2 knobbed macrosetae, Sti IV absent..... *T.(A.) rasilis* Van der Merwe
21. Leg IV with 3 knobbed macrosetae..... 22
- Leg IV with one knobbed macroseta 24
22. Sternal shield with 3 pairs of setae; setae JV5 knobbed 23
- Sternal shield with 2 pairs of setae; setae JV5 blunt *T.(A.) drymis* Ueckermann & Loots
23. Calyx of spermatheca about 4 times as long as width at its mid-length; with 5 teeth about equally spaced along internal margin of fixed digit..... *T.(A.) vescus* Van der Merwe
- Calyx of spermatheca about 10 times as long as width at its mid-length; fixed digit of chelicera with 6 teeth, all distal..... *T.(A.) acaciae* Schultz
24. Setae Z4 serrate, shorter than distance to S5; setae JV5 knobbed..... 25
- Setae Z4 serrate as long as distance to S5; setae JV5 sharp-tipped..... 26
25. Calyx of spermatheca tubular; sternal shield with 3 pairs of setae..... *T.(A.) paganus* Van der Merwe
- Calyx of spermatheca bell-shaped; sternal shield with 2 pairs of setae..... *T.(A.) wrenschae* Ueckermann & Loots

26. Seta Z5 knobbed, seta S5 about 0.7 times as long as S4.....	<i>T.(A.) persianus</i> McMurtry	
- Seta Z5 sharp-tipped, seta S5 about 0.5 times as long as S4.....		
.....	<i>T.(A.) theroni</i> Ueckermann & Loots	
27. Genu II with 8 setae.....		28
- Genu II with 7 setae.....		30
28. Setae Z4 serrate and as long as distance to S5.....		29
- Setae Z4 smooth and shorter than distance to S5.....	<i>T.(A.) incisivus</i> Van der Merwe	
29. Seta JV5 knobbed; tibia of leg IV with 6 or 7 setae.....		
.....	<i>T.(A.) johanna</i> e Ueckermann & Loots	
- Seta JV5 sharp-tipped; tibia of leg IV with 6 setae.....		
.....	<i>T.(A.) auratus</i> Ueckermann & Loots	
30. Genu of leg III with 6 setae.....	<i>T.(A.) apoxys</i> Van der Merwe	
- Genu of leg III with 7 setae.....		31
31. Leg IV with one knobbed or sharp-tipped macroseta.....		32
- Leg IV with 3 knobbed macrosetae.....	<i>T.(A.) umbraculus</i> Ueckermann & Loots	
32. Setae JV5 knobbed.....		33
- Setae JV5 sharp-tipped.....		34
33. Seta Z4 knobbed.....	<i>T.(A.) celastrus</i> Ueckermann & Loots	
- Seta Z4 sharp-tipped.....	<i>T.(A.) gardeniae</i> Schultz	
34. Setae Z5 knobbed distally; calyx of spermatheca bell-shaped.....		35
- Setae Z5 narrow distally ending blunt; calyx of spermatheca abroad tube.....		
.....	<i>T.(A.) februs</i> Van der Merwe	
35. Seta Z4 serrate; St IV knobbed.....	<i>T.(A.) microbullatus</i> Van der Merwe	
- Seta Z4 smooth; St IV sharp-tipped.....	<i>T.(A.) saevus</i> Van der Merwe	

DISCUSSION

All 23 host plant species surveyed for mites had domatia on their leaves and are dicotyledonous plants. Based only on this all the phytoseiids species discussed here can be considered to present lifestyle subtype III-c; generalist predators living in confined spaces (domatia) on dicotyledonous plants. Representatives of all 3 the genera mentioned here have been noted to occur in domatia (McMurtry et al. 2013). *Euseius rubicolus* (= *E. addoensis*) most probably has a Type IV lifestyle as members of this genus are pollen feeding generalist predators. Keetch (1972) evaluated this predator for controlling the citrus red mite, *Panonychus citri* (McGregor) in citrus orchards in the Sundays River Valley, Eastern Cape Province as it was the dominant predator in these orchards. He found that it was able to keep the populations of the pest low. In one year, it kept the red mite populations substantially reduced throughout the winter with no subsequent increase in *P. citri* numbers but in the following year the predator kept the numbers low throughout the summer with a peak in *P. citri* numbers in autumn. As citrus can blossom more than once a year depending on ambient temperatures and humidity, the presence of pollen could have influenced these population fluctuations as the population increases of members of this genus often follow blossoming periods (McMurtry et al. 2013). Members of this lifestyle type also prefers plants with glabrous leaves as in citrus and most of the plants *E. rubicolus* was found on during this study. Unfortunately, the biology of the other phytoseiids mentioned here are not known. However, *A. anomalus* may also have a subtype III-b lifestyle, generalist

predators living on glabrous leaves, as it was originally and now collected from plants with glabrous leaves namely, *Gardenia thunbergia* and members of this genus seems to prefer this habitat.

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