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Two new species of *Typhlodromus* Scheuten (Acari: Phytoseiidae) from Hainan Islands, China

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Abstract

*Typhlodromus* contains the most species in the subfamily Typhlodrominae and 85 species have been recorded in China. Two new species *T. (Anthoseius) bawanglingensis* sp. nov. and *T. (Anthoseius) informibus* sp. nov. were found by examining the specimens collected from Hainan Bawangling National Nature Reserve and Hainan Jianfengling National Nature Reserve in Hainan Islands. Herein, they are described and illustrated based on female specimens.

Key words: Phytoseioidea, taxonomy, description

Introduction

Phytoseiid mites (Acari: Phytoseiidae) are diverse and widespread arthropods, and play an important ecological role (McMurtry *et al*. 2013; Lofego *et al*. 2017; Fang *et al*. 2017). Typhlodrominae Chant & McMurtry is the most primitive group in Phytoseiidae, with the most idiosomal setae as many as 38 pairs, including 22 genera (Chant & McMurtry 1994, 2007; Wu *et al*. 2009; Demite *et al*. 2017). *Typhlodromus* Scheuten is the most diverse, with about 460 nominal species in the world (Demite *et al*. 2017). There are 85 species have been recorded in China, among which 83 species belong to the subgenus *Anthoseius* De Leon and two species belong to the subgenus *Typhlodromus* (Wu *et al*. 2009; Ma *et al*. 2016; Liao *et al*. 2017).

This group widely distributes all over the world and most species are found in the subtropical and tropical areas. Hainan Islands, the most southern province in China, isolated from the mainland by Qiongzhou Straits, belongs to tropical monsoon climate. There are abundant species of phytoseiid mites, with 63 species recorded so far, including 11 *Typhlodromus* species (Wu *et al*. 2009, 2010). This study presents two new species *T. bawanglingensis* sp. nov. and *T. informibus* sp. nov. from Hainan Islands.

Materials and Methods

Mite specimens examined in this study were collected from Hainan Islands in 2017, with a particular focus on Hainan Bawangling National Nature Reserve and Hainan Jianfengling National Nature Reserve. Mites were mounted in Hoyer's medium and examined, measured, illustrated, and
photographed under an optical microscope (Leitz®512836) and picture pick-up system (Ming-Mei®MC-15). Measurements are presented in micrometers (μm). Holotype measurements are shown in bold type for the new species, followed by their mean and range in parentheses. Morphological features of adult mites were measured as follows: dorsal shield length and width were taken from anterior to posterior margins of the shield along midline and from lateral margins at s4 level, respectively; for all ventral shields, lengths were measured along their midlines; sternal shield width between bases of st2; epigynial shield width between setae st5–st5; ventrianal shield width between setae ZV2–ZV2; cheliceral fixed digit length was measured from dorsal poroid to the anterior tip and its movable digit length was measured from basal articulation to the tip. The general terminology used for morphological descriptions in this study follows that of Chant & McMurtry (2007), idiosomal seta terminology follows those by Rowell et al. (1978) and Chant & Yoshida-Shaul (1991, 1992), adenotaxy and poroidotaxy terminology followed that of Beard (2001), and chaetotaxy of legs follows that of Evans (1963).

**Taxonomy**

*Typhlodromus (Anthoseius) bawanglingensis* Fang, Hao & Wu sp. nov.

(Figures 1–6, Plates 1–7)

**Diagnosis**

Dorsal shield surface smooth, with patchy and lateral reticulation. All dorsal shield setae smooth and setiform, except Z5 knobbed apically. With five pairs of solenostomes on dorsal shield (gd2, gd4, gd6, gd8–9). Sternal shield length and width similar, with three pairs of setae. One pair of solenostomes posterior to JV2, almost at level of setae JV3. Peritreme extending to j1 level. Fixed digit of chelicera with three teeth and movable digit with two teeth. Genu, tibia and basitarsus of leg IV each with an apically knobbed macroseta.

**Female** (n=5)

**Dorsal idiosoma** (Figure 1, Plate 1). Dorsal setal pattern 12A:8A. Dorsal shield 275 286 (275–299) long and 196 193 (189–196) wide, distances between setae j1–j5 263 275 (261–287) and s4–s4 146 150 (146–153), shield nearly oval, slightly constricted at level of R1; shield surface smooth, with patchy and lateral reticulation, r3 and R1 on soft membranous cuticle lateral of dorsal shield, r3 at level of z4, R1 at level of shield incisions. Dorsal setae j1, j3, Z4 and Z5 relatively longer (> 15), other setae shorter. All dorsal shield setae smooth and setiform, except Z5 knobbed apically. With five pairs of solenostomes on dorsal shield (gd2, gd4, gd6, gd8–9), 14 pairs of lyrifissures (idl1, id1a, id2, id4, id6, idx, idl2–4, idm2–6). Length of setae: j1 15 16 (13–19), j3 17 17 (15–19), j4 10 10 (8–12), j5 10 10 (8–12), j6 10 10 (9–10), j2 12 10 (10–14), j5 7 7 (7–9), z2 10 8 (7–10), z3 14 10 (7–11), z4 11 10 (9–12), z5 9 9 (7–10), Z4 17 17 (17–21), Z5 52 52 (48–55), s4 14 14 (12–15), s6 15 14 (12–15), s2 14 13 (11–15), S4 11 10 (9–12), S5 9 9 (7–10), r3 10 10 (10–12), R1 10 10 (8–11).

**Ventral idiosoma** (Figure 2, Plate 2). Ventral setal pattern JV: ZV. All ventral setae smooth. Sternal shield smooth, anterior margin convex, posterior margin of shield with rounded median lobe, 58 58 (56–61) long, 57 57 (57–60) wide, length and width similar, with three pairs of setae st1 18 18 (15–20), st2 14 15 (14–17), st3 17 17 (14–17), and two pairs of lyrifissures (pst1–2). Metasternal platelets drop-shaped, with one pair of metasternal setae, s4 15 14 (12–16) and one pair of lyrifissures (pst3). Genital shield smooth, with one pair of thin genital setae st5 17 16 (14–17), 53 57 (53–57) wide, trailing edge flat; one pair of associated poroids on soft cuticle near posterior corners of shield. Ventrianal shield smooth, pentagonal, 96 96 (94–97) long, 79 79 (76–80) wide at level of
ZV2, with four pairs of thin pre-anal setae JV1 9 10 (7–10), JV2 10 10 (9–10), JV3 11 11 (10–12), ZV2 10 9 (7–10); Pa 12 11 (10–13), Pst 9 8 (7–10) long. Pre-anal pores round-shaped, posteromesad JV2, almost at level of setae JV3, distance between pores 22 24 (22–24). On soft cuticle laterad of dorsal shield: four pairs of setae, ZV1 9 9 (7–10), JV2 10 10 (7–11), JV3 34 34 (33–37) long. All ventral setae thin, except JV5, thick. Two pairs of metapodal plates, primary plate 17 17 (17–17) long, 6 6 (5–7) wide, secondary plate 9 8 (7–10) long, 1 1 (1–1) wide.

Peritreme. Peritreme extending to j1 level. Peritrematal shields (Figure 3, Plate 3) with one pair of solenostomes (gd3) and one pair of lyrifissures (id3).

Chelicera (Figure 4, Plate 4). Fixed digit 22 21 (19–22) long, with three teeth and pilus dentilis; movable digit 24 23 (21–24) long, with two teeth.
**Spermatheca** (Figure 5, Plates 5–6). Calyx of spermathecal apparatus 9 10 (9–11) long, 8 7 (6–8) wide at opening, bell-shaped; atrium 3 3 (3–3) wide, small, knot-like, incorporated with calyx; major duct narrow, without neck, and minor duct not visible.

**Legs.** Genu formula leg I 2–2/1, 2/1–2, leg II 2–2/0, 2/0–1, leg III 1–2/1, 2/0–1, leg IV 1–2/1, 2/0–1. Legs II–I without macrosetae. Leg III with one macrosetae on genu 19 18 (17–20) long. Leg IV with three apically knobbed macrosetae on genu, tibia and basitarsus (Figure 6, Plate 7), Sge IV 26 26 (25–27), Sti IV 16 14 (13–16) and St IV 26 26 (24–28), St IV = Sge IV > Sti IV.

**Male.** Unknown.


**Etymology.** The name *bawanglingensis* refers to the type locality bawangling, from where the type specimens were collected.

**Remarks.** By having noticeably longer Z5 relative to setae Z4 on dorsal shield, shove-shaped setae Z5, and a distinctly shove-shaped macrosetae on genu, tibia and basitarsus of leg IV, respectively, this new species is similar to *T. admirabilis* Wainstein, 1978, *T. tridentiger* Tseng, 1975 and *T. qianshanensis* Wu, 1988. By having similar shaped of spermatheca, dorsal plate, ventrianal shield and pre-anal pore, and three apically knobbed macrosetae on leg IV, this new species is similar to *T. miyarai* Ehara, 1967. Differences between *T. bawanglingensis* and related species are given in Table 1.

**TABLE 1.** Differences in diagnostic characters between Typhlodromus bawanglingensis Fang, Hao & Wu sp. nov. and similar species.

<table>
<thead>
<tr>
<th>Character</th>
<th>bawanglingensis</th>
<th>miyarai</th>
<th>admirabilis</th>
<th>tridentiger</th>
<th>qianshanensis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body size</td>
<td>275–299 long, 189–196 wide</td>
<td>330 long, 230 wide</td>
<td>370 long, 205 wide</td>
<td>375 long, 196 wide</td>
<td>300–310 long, 181 wide</td>
</tr>
<tr>
<td>Dorsal shield</td>
<td>reticulate laterally</td>
<td>reticulate throughout</td>
<td>reticulate laterally</td>
<td>smooth</td>
<td>reticulate throughout</td>
</tr>
<tr>
<td>Relative length of Z4, Z5</td>
<td>Z5 = Z4</td>
<td>Z5 = Z4</td>
<td>Z5 = Z4</td>
<td>Z5 = Z4</td>
<td>Z5 = Z4</td>
</tr>
<tr>
<td>Posterior margin of sternal Shield</td>
<td>with rounded median lobe</td>
<td>Scherontization weak</td>
<td>flat</td>
<td>Scherontization weak</td>
<td>flat and concave on both ends</td>
</tr>
<tr>
<td>Calyx of spermatheca</td>
<td>bell-shaped</td>
<td>bell-shaped</td>
<td>sacular</td>
<td>sublyriform</td>
<td>triangle</td>
</tr>
<tr>
<td>Pre-anal pore</td>
<td>round-shaped</td>
<td>round-shaped</td>
<td>crescent-shaped</td>
<td>crescent-shaped</td>
<td>crescent-shaped</td>
</tr>
<tr>
<td>Macrosetae</td>
<td>St IV &gt; Sge IV &gt; Sti IV</td>
<td>St IV &gt; Sge IV &gt; Sti IV</td>
<td>St IV &gt; Sge IV &gt; Sti IV</td>
<td>St IV &gt; Sge IV &gt; Sti IV</td>
<td>St IV &gt; Sge IV &gt; Sti IV</td>
</tr>
</tbody>
</table>

*a* from five specimens, *b* from Ehara, 1967, *c* from Wainstein, 1978, *d* from Wu et al., 2009

**Typhlodromus (Anthoseius) informibus** Fang, Hao & Wu sp. nov.

(Figures 7–12, Plates 8–15)

**Diagnosis**

Dorsal shield reticulate to colliculate throughout. All setae smooth, except Z4–5 thick, serrate. With six pairs of solenostomes on dorsal shield (*gd2, gd4–6, gd8–9*), Sternal shield length and width similar, with three pairs of setae. One pair of solenostomes between and behind JV2, slightly anterior to level of JV3. Peritreme extending to j1 level. Fixed digit of chelicera with two teeth and movable digit with three teeth. Leg IV with one macrosetae on basitarsus.
Female (n=7)

Dorsal idiosoma (Figure 7, Plate 8). Dorsal setal pattern 12A:7B. Dorsal shield reticulate to colliculate throughout, relatively weaker caudally and middle posterior. Dorsal shield 282 (275–286) long and 162 (150–162) wide, distances between setae j1-J5 275 (265–278) and s4-s4 133 (122–133), shield nearly oval, slightly constricted at level of R1. Setae r3 and R1 on soft membranous cuticle laterad of dorsal shield, r3 at level of z4, R1 at level of shield incisions. All setae smooth, except Z4, Z5 thick, serrate. With six pairs of solenostomes on dorsal shield (gd2, gd4–6, gd8–9), 14 pairs of lyrifissures (id1, id1a, id2, id4, id6, idx, idm2–6, idl2–4). Length of setae: j1 19 (15–19), j3 17 (13–17), j4 12 (12–15), j5 14 (12–15), j6 14 (13–16), J2 14 (14–
Ventral idiosoma (Figure 8, Plate 9). Ventral setal pattern JV: ZV. All ventral setae smooth. Sternal shield smooth, anterior margin convex, posterior margin with a faint median projection, 58 (56–60) long, 57 (57–60) wide, length and width similar, with three pairs of setae st 1 17 (16–19), st 2 14 (13–16), st 3 17 (14–18), and two pairs of lyrifissures (pst 1–2). Metasternal platelets drop-shaped, with one pair of metasternal setae, st 4 15 (13–15) and one pair of lyrifissures (pst 3). Genital shield smooth, with one pair of thin genital setae st 5 17 (16–17), 53 (53–58) wide, trailing edge flat; one pair of associated poroids on soft cuticle near posterior corners of shield. Ventrianal shield smooth, pentagon, 96 (93–98) long, 79 (76–81) wide at level of ZV 2, with four pairs of thin pre-anal setae JV 1 9 (7–10), JV 2 10 (9–10), JV 3 11 (10–14), ZV 2 10 9 (7–10); Pa 12 11 (10–14), Pst 9 8 (7–10) long. Pre-anal pores round-shaped, between and behind JV 2, slightly anterior to level of JV 3, distance between pores 22 (22–24). On soft cuticle lateral of dorsal shield: four pairs of setae, ZV 1 9 9 (7–10), ZV 3 9 9 (7–10), JV 4 10 (9–12), JV 5 36 34 (31–36) long. All ventral setae thin, except JV 5, thick. Two pairs of metapodal plates, primary plate 17 17 (17–17) long, 6 6 (5–7) wide, secondary plate 9 8 (7–10) long, 1 1 (1–1) wide.

Peritreme. Peritreme extending to j1 level. Peritrematal shields (Figure 9, Plate 10) lightly sclerotised, with one pair of solenostomes (gd 3) and one pair of lyrifissures (id 3).

Chelicera (Figure 10, Plates 11–12). Fixed digit 19 19 (18–22) long, with two teeth and pilus dentilis, movable digit 19 21 (18–22) long, with three teeth.

Spermatheca (Figure 11, Plates 13–14). Calyx of spermathecal apparatus 10 10 (10–10) long, shallowly funnel-shaped; atrium 2 2 (1–2) wide, small, knot-like; major duct narrow, very short, without neck, and minor duct invisible.

Legs. Genus formula leg I 2–1/1, 2/1–1, leg II 2–2/0, 2/0–1, leg III 1–2/1, 2/0–1, leg IV 1–2/0, 2/1–1. Legs I–III without macrosetae. Leg IV with one macrosetae (Figure 12, Plate 15) on basitarsus, Sti IV 17 17 (16–20).

Male. Unknown.

Material examined. Holotype: ♀, Hainan, Bawangling National Nature Reserve (accession no. HN-0733), Rourea minor (Gaerm.) Leenh. 21-VII-2017, Fang X. D. coll. Paratypes: 3 ♀ (accession no. HN-0701, HN-0731, HN-0732), same locality, host and date as holotype; Paratypes: 3 ♀, Hainan, Main top, Jianfengling National Nature Reserve (accession no. HN-0031, HN-0081, HN-0082), Fang X. D., Mussaenda hirsutula Miq. same collector and date as holotype.

Etymology. The species name informibus, latin for “funnel”, refers to the distinctive shape of the spermathecal apparatus in this species.

Remarks. By having reticulation throughout on dorsal shield, absence of S4 dorsal seta, round-shaped pre-anal pore between and behind JV 2, T. informibus sp. nov, is similar to T. arizonicus (Tuttle & Mumu, 1973) and T. demoraesi Lofego & Feres, 2007. But there are obvious differences in the shape of ventrianal shield among the three species: pentagonal (T. informibus), triangular (T. arizonicus) and rectangular (T. demoraesi). Additionally, the new species has setae JV 4 and also one macroseta on basitarsus IV, but the other two species do not have them.

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Reference


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Appendix