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Authors: Husband, Robert W., and Kurosa, Kazuyoshi

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Article

Eutarsopolipus asiaticus sp. nov. (Acari: Podapolipidae), subelytral parasite of *Chlaenius costiger* Chaudoir (Coleoptera: Carabidae) from Japan

ROBERT W. HUSBAND[1] & KAZUYOSHI KUROSA[2]

[1]*Biology Department, Adrian College, Adrian, Michigan 49221, U.S.A. e-mail: husbandadrian@aol.com*

[2]*Nishi-Ikebukuro 5-21-15, Tokyo 171-0021, Japan. e-mail: CQW35713@nifty.com*

Abstract

Eutarsopolipus asiaticus **sp. nov.** (Acari: Podapolipidae), subelytral parasite of *Chlaenius costiger* Chaudoir (Coleoptera: Carabidae), is described from Japan. Relationships with 18 previously described species in the *myzus* group of *Eutarsopolipus* are discussed and keys are provided to species in the *myzus* group. This is the first record of *Eutarsopolipus* in the *myzus* group in Japan and represents a subgroup of species in the *myzus* group with cheliceral stylets 90 micrometers or longer.

Key words: Taxonomy, new species, *Chlaenius costiger*, parasite, *myzus* group

Introduction

Mites in the family Podapolipidae (Acari: Tarsonemina) are all specialized parasites of five orders of insects: Blattodea, Heteroptera, Hymenoptera, Orthoptera and especially Coleoptera. Regenfuss (1968) placed 18 species in the genus *Eutarsopolipus*, all parasites of the beetle family Carabidae, in seven groups based on apomorphic and other characters. Of the 64 species of *Eutarsopolipus*, including the species described herein, 18 are in the *myzus* group.

Species in the *myzus* group are divided into three subgroups based on lengths of cheliceral stylets: (1) 90 micrometers or longer, (2) 45–65 and (3) less than 45. Previous studies of *Eutarsopolipus* species in the *myzus* group are: Regenfuss (1968, 1974), Husband and Swihart (1986), Husband (1998, 2000, 2001), Husband and Dastych (1999), Khaustov (2010), Husband and Husband (2012, 2013) and Hajiqanbar and Mortazavi (2012). Species in the *myzus* group of *Eutarsopolipus* with stylets 45–65 from *Chlaenius praesinus* Dejean in the eastern United States are being studied by R. W. Husband and D. O. Husband. Similar species from *Chlaenius costiger* from Japan are under study by Husband and Kurosa. The new species described herein is the first species in the *myzus* group parasitizing the carabid genus *Chlaenius* in Asia and one of the first species from the subgroup with females with stylets exceeding 90 micrometers. We also present a key to the 18 species in the *myzus* group.

Materials and methods

Podapolipid mites were found on ten specimens of *Chlaenius costiger* Chaudoir (Coleoptera: Carabidae) from Nagasaki, Shimane, Okinawa and Yamanashi Prefectures. Mites were cleared with Nesbitt's solution and mounted in Hoyer's medium.

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Measurements were taken with the aid of a Zeiss compound phase contrast microscope with an ocular micrometer. Setae no longer than the diameter of setal acetabulae are listed as microsetae (m). Setae represented by acetabulae without setal remnants are listed as vestigials (v). Terminology follows Lindquist (1986). Long setae are often bent, obscured, broken or at an angle that makes measurement difficult. Setae are at least as long as indicated.

Abbreviations for institutions cited are: National Museum of Nature and Science, Tokyo, Japan (NSMT), National Museum of Natural History, Washington, D.C., U.S.A. (NMNH), Biozentrum Grindel und Zoologisches Museum, Hamburg, Germany (BGZM), University of Michigan Museum of Zoology, Ann Arbor, Michigan, U.S.A. (UMMZ), Nikita Botanical Gardens, National Scientific Center, Yalta, Ukraine (NSCY), and Department of Entomology, Tarbiat Modares University, Tehran, Iran (TMUI).

Taxonomy

Podapolipidae Ewing 1922

Eutarsopolipus asiaticus Husband & Kurosa sp. nov. (Figs. 1–3)

Differential diagnosis. Cheliceral stylets of adult female, male and larval female *E. asiaticus* longer than those of any other species in the *myzus* group (Table 1). Adult female with prodorsal setae v_1 two times length of setae sc_1 in contrast to less than two times length of setae sc_1 in 16 species of *Eutarsopolipus* in the *myzus* group. Idiosomal setae c_2 and h_1 as well as setae *d* of tibiae I, II, III and tarsus III setae *pl″* distinctly longer than these setae of any previously described species of *Eutarsopolipus* in the *myzus* group.

Description

Female (Fig. 1, n=9): *Gnathosoma* length 65–85, width 70–83. Cheliceral stylets length 95–110, pharynx width 20–23, seta *ch* (dorsal gnathosomal seta) 33–42, subcapitular setae (*su*) 8–12, distance *su–su* 25.

Idiosoma. Stigmata directly anterior to setae v_1, posterolateral to base of gnathosoma. Distance stigmata base-stigmata base 54–62. Idiosoma length 264–580, width 238–330 (Table 1). Prodorsal seta v_1 15–20, v_2 vestigial, sc_1 5–8, sc_2 60–97. Distance v_1–v_1 76–93. Plate C setae c_1 5–8, c_2 10–22, plate D seta *d* 15–20, plate EF seta *e* 10–15, plate H seta h_1 76–93. Cupules *ia* and *im* anterior to setae *d* and *e* respectively. Distance h_1–h_1 25. Venter with apodemes conspicuous, coxal setae *1a* 2–3, *2a* 3–5 *3a* 10–15, seta *3b* 8–12.

Legs. Setation for femur, genu, tibia, tarsus I, II, III 2-0-7-8, 0-0-4-7, 0-0-4-5, respectively. Ambulacrum I with one hooked claw, ambulacra II, III with two claws. Femur I seta *l′* 12–20, tibia I seta *d* 60–68, solenidion φ 8, seta *k* 3, *v′* 30, tarsus I solenidion ω 8, width of base of tarsus I 18. Tibia II seta *d* 45–47, tarsus II solenidion ω 8, *pl″* 47–63. Tibia III seta *d* 70–72, tarsus III setae *pl″* 47–63. Thornlike setae of tarsi II, III not bifid.

Male (Fig. 2, n=9): *Gnathosoma* length 34–41, width 40–45. Cheliceral stylets 28–32, pharynx width 8–10. Setae *ch* 20–25, seta *su* 4–5, distance *su–su* 15–16.

Idiosoma. Length 172–205, width 131–188 (Table 1). Prodorsal plate seta v_1 11–15, v_2 v, sc_1 4–5, sc_2 72–75, distance v_1–v_1 35–38. Plates CD, setae c_1 4–5, c_2 10–12, *d* 9–13, plate EF seta e 7–8. Aedeagus posterior, length 23–28, base width 23–27. Venter with apodemes weakly developed. Coxal setae *1a* 2, *2a* 2–3, *3a* 6–8, *3b* 7–10.

Legs. Setation for femur, genu, tibia, tarsus legs I, II, III 2-0-7-8, 0-0-4-6, 0-0-4-5, respectively. Femur I seta *l′* 0–2, *d* m, tibia I seta *d* 40–48, solenidion φ 6–7, tarsus I solenidion ω 5–6, width of

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base of tarsus I 15. Tibia II seta *d* 23–25, tarsus II solenidion ω 6. Tibia III seta *d* 29–34, tarsus III seta *pl″* 54–58.

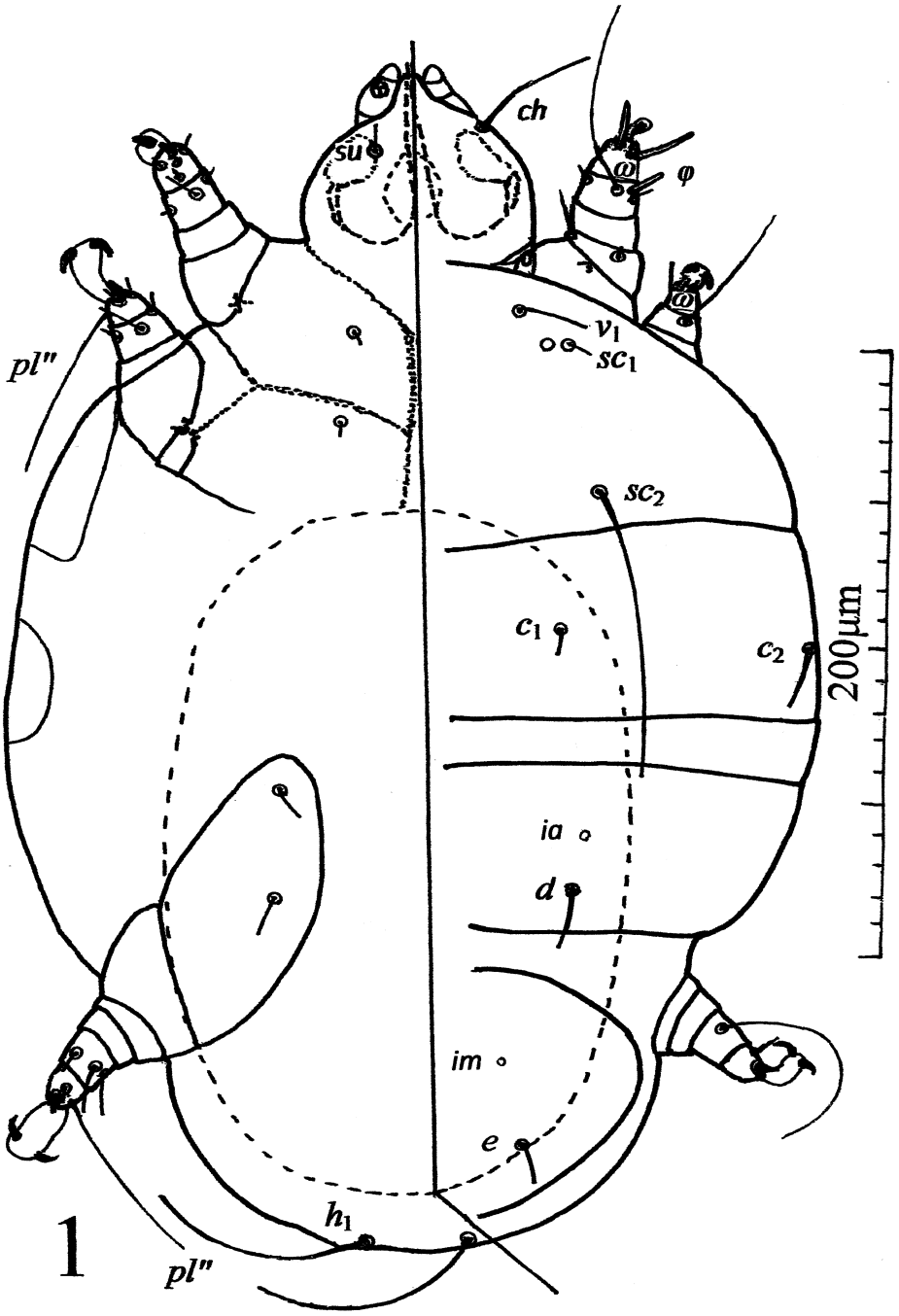


FIGURE 1. *Eutarsopolipus asiaticus* Husband and Kurosa, sp. nov., adult female.

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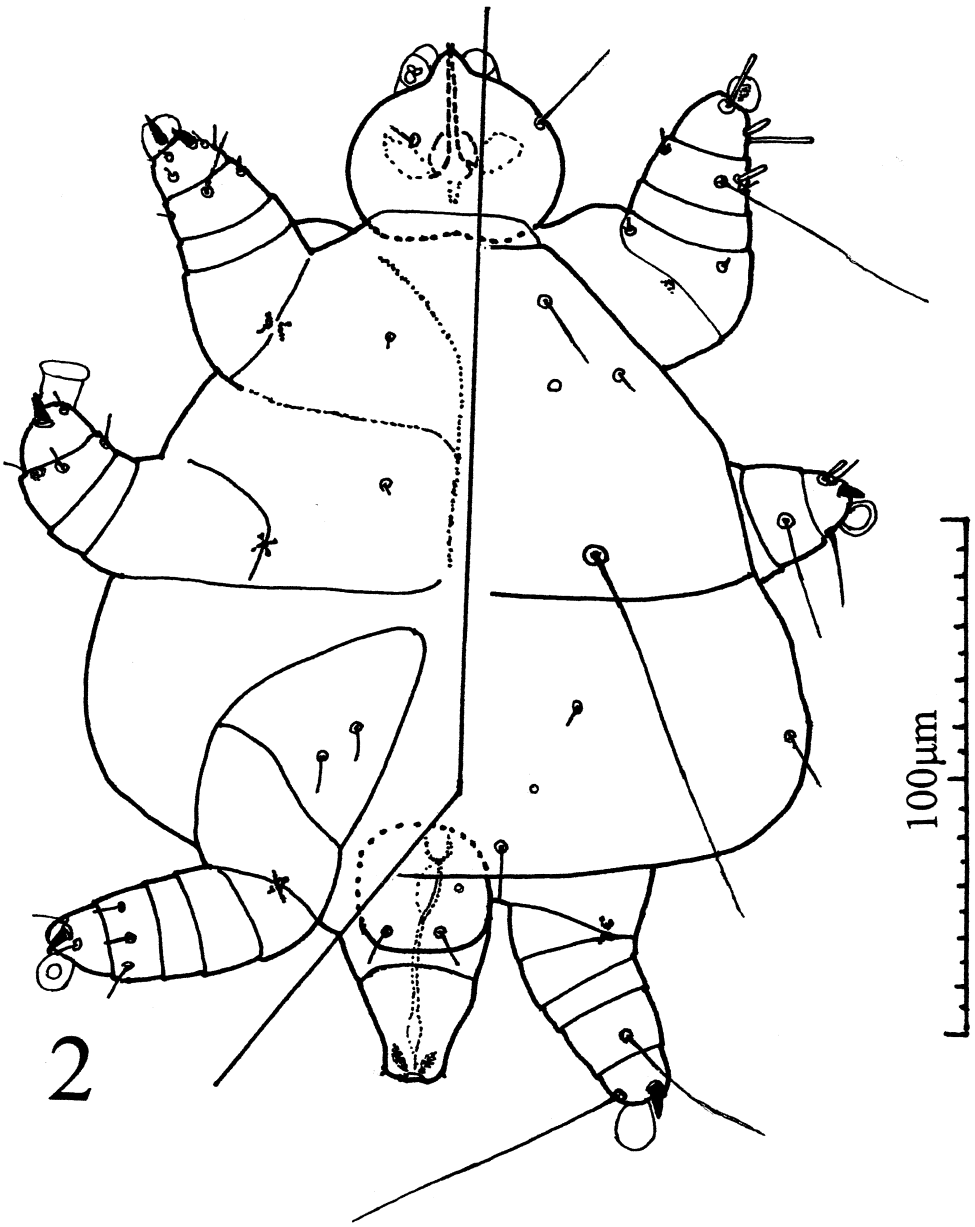


FIGURE 2. *Eutarsopolipus asiaticus* Husband and Kurosa, sp. nov., male.

Larval female (Fig. 3, n=7): *Gnathosoma* length 43–50, width 45–51. Cheliceral stylet length 57–64. Pharynx width 11–15, seta *ch* 18–25, seta *su* 5–6, distance *su–su* 17–18.

Idiosoma. Length 180–330, width 141–250 (Table 1). Prodorsal plate seta v_1 8–10, seta v_2 v, seta sc_1 2–3, sc_2 67–80, distance v_1–v_1 30–38. Plate C seta c_1 3–5, c_2 5–8, plate D seta *d* 4–10, plate EF seta *e* 6–7, plate H seta h_1 90–115, h_2 27–46, distance h_1–h_1 2–3. Venter with apodemes 1, 2 weakly developed. Coxal setae *1a* 2, *2a* 2–3, *3a* 7–9, *3b* 7–10.

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Legs. Setation for femur, genu, tibia, tarsus legs I, II, III 2-0-7-8, 0-0-4-6, 0-0-4-5. Ambulacra I each with two claws (5–6), ambulacra II, III without claws. Femur I seta *l′* 2–3, *d* m, tibia I seta *d* 27–32, solenidion φ 6–7, setae *k* 2, tarsus I solenidion ω 5, width of base of tarsus I 13. Tibia II seta *d* 12–15, tarsus II solenidion ω 6–7. Tibia III seta *d* 15–25, tarsus III seta *pl″* 35–53.

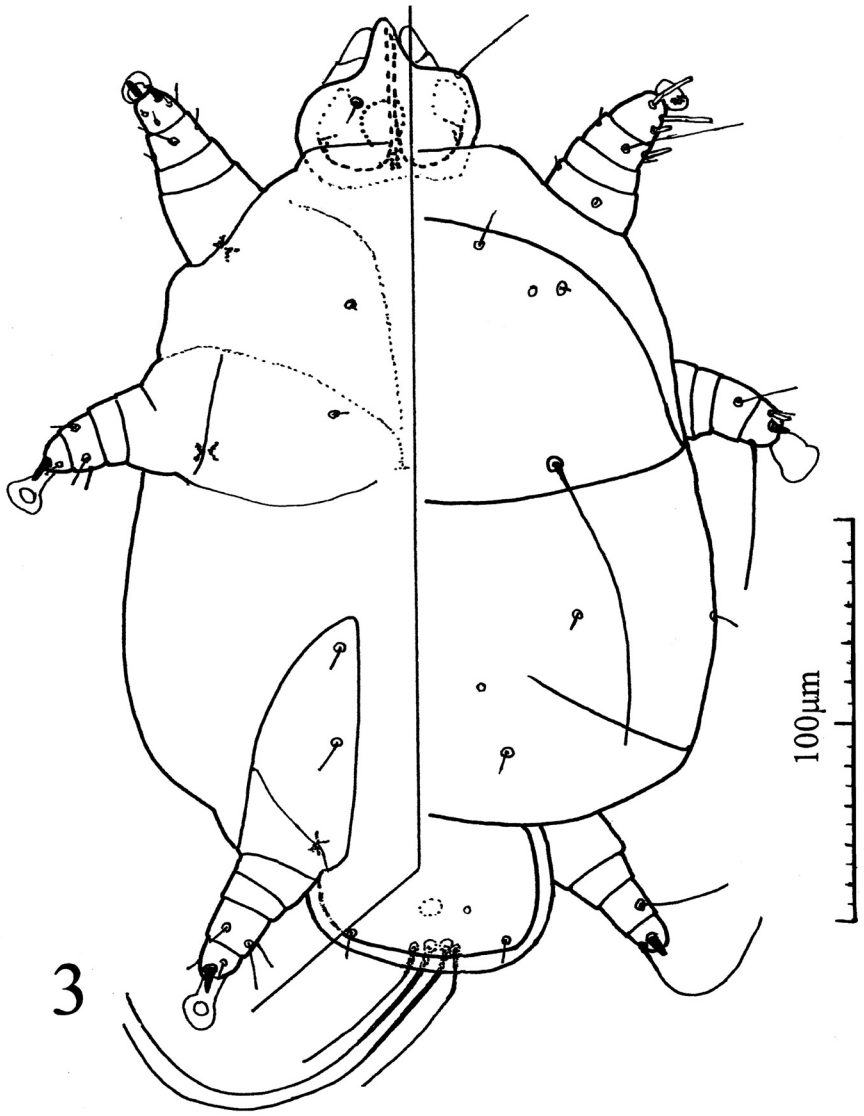


FIGURE 3. *Eutarsopolipus asiaticus* Husband and Kurosa, sp. nov., larval female.

Egg (n=10): Length 191–242, width 110–170.

Etymology. *Eutarsopolipus asiaticus* is derived from the Asiatic distribution of the host carabid beetle, *Chlaenius costiger*.

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TABLE 1. Comparison of selected maximum measurements for species of the *myzus* group of the genus *Eutarsopolipus*: *E. asiaticus* (*Eas*), *E. americanus* (*Eam*), *E. regenfussi* (*Er*), *E. tomentosi* (*Et*), *E. mirifici* (*Emi*), *E. caudatus* (*Eca*), *E. myzus* (*Emy*), *E. jacobi* (*Ej*). All measurements are in micrometers. Although illustrated and described by Regenfuss (1968), there are no male or larval female instars of *E. myzus* in the Regenfuss Collection at the University of Hamburg. Male and larval female instars of *E. abdominis*, *E. squamorum*, *E. thoracis* and *E. poecili* are not described or illustrated and no specimens of these instars are in the Regenfuss Collection. Species of *Eutarsopolipus* in the *myzus* group with adult females with cheliceral stylets less than 40 micrometers are not included in this table.

	Subgroup 1		Subgroup 2					
Character	*Eas*	*Eam*	*Er*	*Et*	*Emi*	*Eca*	*Emy*	*Ej*
			ADULT FEMALES					
Idiosoma length	580	727	605	233	600	500	480	600
Idiosoma width	330	620	398	170	280	360	530	480
Gnathosoma width	83	108	43	53	75	48	67	57
Cheliceral stylets	110	100	48	46	49	54	40	52
Gnathosomal setae *ch*	42	30	23	7	20	25	23	15
Idiosomal setae v_1	20	10	6	4	8	8	8	7
sc_1	8	20	7	4	9	11	7	6
h_1	93	29	16	8	12	56	10	15
Femur I setae *l′*	20	22	12	3	16	18	13	17
Tibia I setae *d*	68	50	41	24	27	39	32	34
Tarsus I solenidion ω	8	7	5	6	4	3	3	5
Tibia III setae *d*	72	10	10	8	9	8	9	8
Tarsus III setae *pl″*	63	38	22	11	12	17	m	17
			MALES					
Idiosoma length	205	232	140	162	208	178	175	205
Idiosoma width	188	172	190	115	140	180	125	122
Gnathosoma width	45	48	27	32	40	30	30	33
Cheliceral stylets	32	38	18	23	17	20	25	21
Gnathosomal setae *ch*	25	8	6	9	4	7	20	6
Aedeagus length	28	31	22	23	30	20	25	30
Aedeagus width	27	31	22	25	35	20	25	30
Femur I setae *l′*	2	5	m	m	m	m	–	2
Tibia I setae *d*	48	30	28	25	12	31	–	25
Tibia III setae *d*	34	5	8	4	2	3	–	7
Tarsus III setae *pl″*	58	12	22	16	7	10	–	15
			LARVAL FEMALES					
Idiosoma length	330	360	230	290	150	152	220	235
Idiosoma width	250	231	130	190	120	130	150	190
Gnathosoma width	51	65	33	37	31	38	42	40
Cheliceral stylets	64	60	30	37	23	38	36	35
Gnathosomal setae *ch*	25	20	12	17	12	18		10
Idiosomal setae v_1	10	3	3	4	6	4		8
Plate H, setae h_2	46	50	27	28	18	32		31
Femur I setae *l′*	3	10	5	m		2		6
Tibia I setae *d*	32	50	26	23		33		28
Tibia III setae *d*	25	10	7	8		6		5
Tarsus III setae *pl″*	53	26	14	14		12		14

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Host. All of the mites from the host specimens were found under the elytra on the metanotum, the basal portion of the metathoracic wings, and the abdominal dorsum, but rarely also on the membrane between the pro- and mesothoraces, and the basal portion of the underside of the elytra of nine specimens of *Chlaenius* (*Haplochlaenius*) *costiger* Chaudoir (Coleoptera: Carabidae). Beetles collected in six localities in Japan are stored in UMMZ.

Type material. Holotype, adult female (Kurosa No. 21453-5), from *Chlaenius costiger* Chaudoir (Coleoptera: Carabidae), Sato, Mikura-jima Is., Izu Iss., Tokyo, Japan, 23 July 1975, J. Okuma leg., deposited in the National Museum of Nature and Science, Tokyo, Japan (NSMT).

Paratypes, four adult females, nine males, five larval females, eight slides with eggs, with same data as holotype; two adult females, two males, three larval females, six eggs and one vial with mites, Ôhara, Iriomote Is., Okinawa Pref., Japan, 29 April 1979, Y. Kurosa leg.; one male, one female, one larval female, one vial with mites, Mt. Yahiro-dake, Sasebo-shi, Nagasaki Pref., 1 March 1976, J. Okuma leg.; one male, two females, five larval females, one vial with mites, Mt. Yahiro-dake, Sasebo-shi, Nagasaki Pref., Japan, 24 February 1978, J. Okuma leg.; one male, one female, one vial with mites, Mt. Yahiro-dake, Sasebo-shi, Nagasaki Pref., Japan, 17 December 1981, J. Okuma, leg.; one male, one adult female, one female larva, one vial with mites, Mt. Yahiro-dake, Sasebo-shi, Nagasaki Pref., Japan, 13 February 1982, J. Okuma, leg.; two males, one female, one larval female, one vial with mites, Tomane, Oki Islands, Shimane Pref., Japan, 4 December 1972, T. Okumura leg.; one female, one larval female, Manzawa-mura, Fuji-gun, Yamanashi Pref., Japan, 12 May 1974, M. & K. Murata leg.; two males, one female, one vial with mites, Mt. Miyatsuka-yama, Toshima Is., Tokyo, Japan, 19 July 1978, J. Okuma leg.; one adult female, one male and one larval female are deposited in each of the following museums: NSMT, NMNH, BGZM, UMMZ, NSCY and TMUI.

Discussion

Regenfuss (1968) placed five species of *Eutarsopolipus* in the *myzus* group based on two apomorphic characters: adult females with bare genua III and trochanter I of larval females with a lobe. He did not assign apomorphic or plesiomorphic status to three additional characters: adult females with femur I setae l' long, larval females with setae h_1 adjacent or nearly so and males with aedeagi as long as wide with lateral margins concave. All species, including *E. asiaticus*, meet criteria for males and adult females. Husband and Husband (2012) were unable to find trochanteral I lobes in North American larval *Eutarsopolipus* in the *myzus* group and we have not been able to find trochanteral I lobes in larval *E. asiaticus*. The significance of idiosomal lobes in adult females and possible trochanteral lobes in larval females is still under investigation.

Plesiomorphic characters found in species in the *myzus* group include: adult females with stigmata, ambulacra II, III with strong claws, ambulacrum I with a claw (except *E. poecili* Regenfuss, 1968), prodorsal setae v_1, sc_1 present and epimeres III well developed. Unassigned characters include adult females with femur I setae l' setae long (except *E. latus* Regenfuss and *E. tomentosi* Husband and Dastych) and setae h_1 less than 30 (except *E. caudatus* Regenfuss and *E. asiaticus* herein), male with aedeagus with lateral margins concave and larval female with plate H setae h_1 adjacent or nearly so.

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Key to adult females of the *myzus* group of *Eutarsopolipus* (Podapolipidae) that parasitize beetles of the genera *Chlaenius, Poecilus, Scarites* and *Diplocheila*

1. Cheliceral stylets length 90–115 2
- Cheliceral stylets shorter than 70 3
2. Setae h_1 93, setae *ch 42*, Nagasaki, Okinawa, Shimane, Yamanashi Prefectures and Toshima Is., Tokyo, Japan, host *Chlaenius costiger* . . . . . *E. asiaticus* **sp. nov.** Husband and Kurosa
- Setae h_1 22–29, setae *ch* 30, Oceana County, Michigan, Adair and St. Louis Counties, Missouri, USA, host *Chlaenius praesinus* . . . . . *E. americanus* Husband and Husband
3. Plate C or D divided 4
- Plate C or D not divided 5
4. Idiosoma elongate, slightly broader posterior to plate D, setae h_1 3–4, Michigan, USA, host *Chlaenius sericeus* . . . . . *E. davidsoni* Husband
- Idiosoma pear-shaped, broader anterior to plate C, setae h_1 m, Georgia, USA, host *Chlaenius aestivus* . . . . . *E. latus* Regenfuss
5. Propodosoma not covering gnathosoma, strong ambulacra I claws 6
- Propodosoma covering gnathosoma, no ambulacra I claws, Germany, host *Poecilus lepidus* . . . . . *E. poecili* Regenfuss
6. Idiosoma tear-drop shaped or with wrinkled posterior lobes 7
- Idiosoma not tear-drop shaped and not with wrinkled posterior lobes 8
7. Idiosoma tear-drop shaped, posterior idiosoma smooth, Germany, host *Poecilus cupreus*. . . . . *E thoracis* Regenfuss
- Idiosoma not tear-drop shaped, with posterior idiosomal lobes wrinkled, Quebec, Canada, host *Poecilus lucublandus* . . . . . *.E. quebecensis* Husband
8. Femur I setae *l'* longer than 10 9
- Femur I setae *l'* shorter than 5, Rome, Georgia, USA, host *Chlaenius tomentosus* . . . *E. tomentosi* Husband
9. Idiosoma length two times width 10
- Idiosoma length not two times width 11
10. Plate H evident dorsally, setae *3a* longer than 10, Entebbe, Uganda, host *Chlaenius mirificus* . . . . . *E. mirifici* Husband
- Plate H not evident dorsally, setae *3a* shorter than 5, Cheboygan Co., Michigan, USA host *Chlaenius pennsylvanicus* . . . . . *E. regenfussi* Husband and Swihart
11. Idiosoma with lateral bulges. 12
- Idiosoma without lateral bulges 14
12. Without posterior lobes 13
- With posterior lobes, lateral bulges broadest at plane of plates C and D, Germany, Ukraine, host *Poecilus lepidus, P. sericeus*. . . . . *E. myzus* Regenfuss
13. Lateral lobes broadest at plane of plates D and EF, Ebermannstadt, Germany, host *Poecilus cupreus* . . . . *E. squamorum* Regenfuss
- Lateral lobes broadest at plane of plate C, Ebermannstadt, Germany, host *Poecilus cupreus* . . . . . *E. abdominis* Regenfuss
14. Cheliceral stylets 25–35. 15
- Cheliceral stylets 45–55 16
15. Setae h_1 shorter than 5, Kerman Province, Iran, host *Poecilus* sp. . . . . *.E. anichtchenkoi* Hajiqanbar and Mortazavi
- Setae h_1 longer than 20, Abkhasia, Western Caucasus, host *Chlaenius coeruleus* . . . . *E. steveni* Khaustov
16. Gnathosomal setae *ch* 20–25 17
- Gnathosomal setae *ch* 10–15, Washtenaw Co., Michigan, USA, host *Diplocheila impressicollis*. . . . . *.E. jacobi* Husband and Husband
17. Setae h_1 56, setae *3a* 12, Illmitz am Neusiedlersee, Austria, Moldavia. . . . . *E. caudatus* Regenfuss
- Setae h_1 7, setae *3a* 3–5, Jiroft City, Kerman Prov., Iran, host *Scarites terricola* . . . . . *E. terricolae* Hajiqanbar and Mortazavi

With a majority of the 34,275 species of Carabidae (Lorenz, 2005) not yet examined for podapolipid mites, we anticipate additional reorganizations of groups of Podapolipidae from Carabidae as more

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potential host species are examined and relationships of their parasitic podapolipid mites are studied. Including *E. asiaticus* described herein, eight of 15 species in the *myzus* group and two species in the *desani* group have hosts in the carabid genus *Chlaenius* in Eurasia, North America and Africa. Most of the 864 species of *Chlaenius* distributed worldwide (Ball and Bousquet 2001) have not been examined for podapolipid mites in the *myzus* or *desani* groups. We anticipate many future discoveries of mites in these groups.

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