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Amblyseius bellatulus Tseng (Acari: Phytoseiidae): neotype designation with first description of a male

Jhih-Rong LIAO[1], Chyi-Chen HO[2] and Chiun-Cheng KO[1*]

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[1] *Department of Entomology, National Taiwan University, Taipei City, 10617 Taiwan. d04632007@ntu.edu.tw, kocc2501@ntu.edu.tw (*Corresponding author)*
[2] *Taiwan Acari Research Laboratory, Taichung City, 41345 Taiwan. mtho2005@yahoo.com.tw*

ABSTRACT — Yi-Hsiung Tseng provided fundamental information of phytoseiid fauna in Taiwan. However, according to an exclusive interview, all specimens included in Tseng's collections were lost after his retirement; therefore, more than 20 holotypes are now lost. To ensure stability in nomenclature, designation of neotypes is thus necessary. In this study, we re-described a known species, *Amblyseius bellatulus* Tseng 1983, by collecting phytoseiid mites from the original type locality and the entirely of Taiwan. Because the morphology of the collected specimens is highly similar to that of specimens used for describing the species, we designated a neotype and redescribed female specimens, as well as male specimens, which have not been described before.

KEYWORDS — Phytoseiids; Taiwan; *Amblyseius bellatulus*; neotype

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INTRODUCTION

Phytoseiid mites have received considerable attention because of their biocontrol potential. Some species can feed on phytophagous mites and small pests (McMurtry *et al.*, 2013). So far, more than 2,700 species included in 91 genera and 3 subfamilies have been recorded worldwide (Chant and McMurtry, 2007; Demite *et al.*, 2015). Fifty-three species are recorded from Taiwan (Ehara, 1970; Lo, 1970; Tseng, 1972; 1973; 1975; 1976; Chang and Tseng, 1978; Tseng, 1983; Ho and Lo, 1989; Ho *et al.*, 2003). Yi-Hsiung Tseng provided the most complete survey of phytoseiid mites in this country from the 1970s to the early 1980s; he recorded 47 species including 20 newly described endemic ones. Collections of Tseng, including type specimens, were deposited at the Tainan Branch of the Bureau of Commodity Inspection and Quarantine (BCIQ) (Tseng, 1983). However, the Tainan Branch of BCIQ no longer possesses Tseng's collections and type specimens. The plant and animal quarantine work was transferred from Bureau of Commodity Inspection and Quarantine to the newly established Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ) since 1998 and BCIQ was renamed to Bureau of Standards, Metrology and Inspection (BSMI). Y. H. Tseng retired from BSMI in 2008. The profile column of BAPHIQ Quarterly, a journal issued by BAPHIQ, had interviewed Yi-Hsiung Tseng in 2009 due to his great contribution to plant quar-

antine and talked about the mite collection of him. Tseng mentioned that he had discarded the whole mite collection of him after his retirement (BAPHIQ, 2009). The present work aims to retrieve specimens collected by Tseng to reconstitute his collection. It is thus the first step of further taxonomical studies.

Some species of *Amblyseius* are considered as generalist predators, they can feed on wide range preys, and can sometimes feed on pollens (McMurtry *et al*., 2013). In Taiwan, Ho and Chen (2001) reported that *A. bellatulus* and *A. maai* Tseng (=*A. tamatavensis* Bloommers) fed on melon thrips from cucumbers in the field. Field observation in Taiwan also reveals other that *Amblyseius* species (e.g., *A. eharai* Amitai & Swirski, *A. herbicolus* (Chant)) feed on spider mites and whiteflies. We consider *Amblyseius* species play an important role in controlling phytophagous mites and small insects. Correct identification and type references are thus essential.

Naming a neotype to ascertain its identity and noting the conditions required by the International Code of Zoological Nomenclature (ICZN) for such designation are necessary. Some examples already exist in the Taxonomy history of the family Phytoseiidae. Duso and Fontana (2001) reported for instance well-known controversy regarding the identity of *Phytoseius plumifer* (Canestrini & Fanzago) resulting from the loss of type materials. After the original description, many Acarologists subsequently provided controversial descriptions for this species on the basis of their specimens. Duso and Fontana (2001) investigated the type locality and designated a neotype for this species to solve the problem. By contrast, Thor (1930) described *Lasioseius* (*Lasioseius*) *magnanalis* Thor from Svalbard but did not designate any type materials. Chant (1959) moved the species "*magnanalis*" into family Phytoseiidae but he considered this species dubious because of the vague original description. Kolodochka and Gwiazdowicz (2014) discussed the fate of Thor's specimens as all specimens were lost after he died. They designated a neotype *Neoseiulus magnanalis* (Thor) to clarify its identity.

To collect the species described by Y. H. Tseng, we conducted a survey in entire Taiwan and surrounding islands. Concurrently, we also tried to collect phytoseiid mites in type localities and type habitat plants. However, we faced some difficulties because of typing errors in the names of the localities of collection, the old vague phonetic English transcription of the localities, and the use of general descriptive terms for plants (e.g., weeds, grasses). In addition, landscape greatly changed in the past 30 years. Nonetheless, we have found specimens that are nearly consistent with description of *A. bellatulus* by Tseng (1983). Tseng (1983) provided a critical description and illustration of *A. bellatullus*, but there is some lacking information regarding the characters and measurements that are currently used in phytoseiid species descriptions. We thus re-described *Amblyseius bellatulus* adding characteristics that were not described in Tseng (1983) and we designated the specimens collected as neotype. These specimens were compared to the elements provided in Tseng (1983). In addition, a description of the male (unknown until now) is provided.

MATERIALS AND METHODS

The specimens examined in this study were collected from various plants. Specimens were mounted in Hoyer's medium; also poor condition specimens were soaked with water, bleached by high concentration (50%) H_2O_2 until the cuticle color change back to normal condition, rinsed in ethanol (75%) (Yeh *et al*., 2008), and remounted in Hoyer's medium. Specimens examined under an optical microscope (Olympus BX51), and measured using stage-calibrated ocular micrometers and ImageJ 1.47 (Schneider *et al*., 2012). All measurements provided are in micrometers, neotype measurements are shown in bold type followed by their mean and range (in parentheses). The general terminology used for morphological descriptions in this study follows that of Chant and McMurtry (2007), while for the dorsal and ventral chaetotaxy we followed Rowell *et al*. (1978) and Chant and Yoshida-Shaul (1991, 1992); for adenotaxy and poroidotaxy terminology we followed Beard (2001).

The neotype and voucher specimens were deposited in the following institutions: ESALQ-USP

(Escola Superior de Agricultura Luiz de Queiroz, Piracicaba, State of São Paulo, Brazil) (three females), NCHU (Department of Entomology, National Chung Hsing University, Taichung, Taiwan) (eleven females and one male), NMNS (National Museum of Natural Science, Taichung, Taiwan) (eight females), NTU (Department of Entomology, National Taiwan University, Taipei, Taiwan) (twenty-five females and two males), NPUST (National Pingtung University of Science and Technology, Pintung County, Taiwan) (fifteen females), TARI (Taiwan Agricultural Research Institute, Taichung City, Taiwan) (twenty-eight females), TARL (Taiwan Acari Research Laboratory, Taichung City, Taiwan) (ten females and one male). If necessary, the locality names were translated using the Geographic Name Information System, Department of Land Administration, Ministry of the Interior (Taiwan) (http://gn.moi.gov.tw/geonames/Translation/Translation.aspx). The distribution map was prepared using the SimpleMappr program (Shorthouse, 2010), based on the label data of examined material in this study.

TAXONOMY

Family Phytoseiidae Berlese
Subfamily Amblyseiinae Muma
Tribe Amblyseiini Muma
Subtribe Amblyseiina Muma
Genus *Amblyseius* Berlese

***Amblyseius bellatulus* Tseng, 1983 (Figures 1-4)**

Amblyseius (*Amblyseius*) *bellatulus* Tseng, 1983: 38.

Neotype Designation

Amblyseius bellatulus was described by Y. H. Tseng in 1983 from Mingchien (now Mingjian Township), Nantou Hsien on *Morus alba*. As mentioned in the introduction the mite collection of Y. H. Tseng does not longer exist (BAPHIQ, 2009), according to Article 75.3.4 of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature, 1999), we here designate adult females we collected as neotype of *A. bellatulus* to clarify its taxonomic status and provide a complete description. Additionally, as male specimens were not known, we provide male description for the first time.

Description: **Female** (n= 10). Dorsum (Figure 1A) — Idiosomal setal pattern: 10A:9B/JV-3:ZV. Dorsal shield lightly sclerotized, smooth, with lateral reticulation, **382** 384 (353 – 449) long, **202** 212 (192 – 250) wide at level of *s4*, **228** 228 (212 – 276) wide at level of *S4*; with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), ten pairs of poroids (*id1*, *id1a*, *id2*, *id4*, *is1*, *idl1*, *idl3*, *idl4*, *idm5*, *idm6*); length of dorsal setae: *j1* **23** 28 (23 – 32), *j3* **34** 40 (34 – 46), *j4* **5** 7 (5 – 13), *j5* **4** 5 (4 – 7), *j6* **6** 7 (4 – 8), *J2* **4** 7 (4 – 9), *J5* **5** 6 (4 – 9), *z2* **11** 10 (8 – 11), *z4* **11** 11 (8 – 13), *z5* **5** 6 (4 – 8), *Z1* **8** 8 (7 – 10), *Z4* **52** 52 (47 – 57), *Z5* **119** 136 (117 – 158), *s4* **46** 49 (43 – 61), *S2* **10** 11 (9 – 13), *S4* **5** 8 (5 – 11), *S5* **6** 7 (6 – 9), *r3* **21** 19 (17 – 21), *R1* **13** 10 (8 – 13). All setae smooth, except *Z4* and *Z5* slightly serrate.

Venter (Figure 1B) — Sternal shield smooth, posterior margin almost straight, wider than long, **66** 69 (62 – 73) long, **87** 94 (84 – 114) wide at *st3* level, with three pairs of setae *st1* **25** 27 (24 – 29), *st2* **24** 24 (21 – 26), *st3* **23** 23 (17 – 26) and two pairs of poroids (*pst1*, *pst2*). Metasternal platelets tear-shaped, with a pair metasternal setae, *st4* **22** 19 (14 – 22), and one pair of poroids (*pst3*). Genital shield smooth, *st5* **23** 22 (16 – 26), **77** 78 (73 – 96) wide. Distances between *st1-st1* **59** 58 (53 – 73), *st2- st2* **63** 63 (59 – 75), *st3- st3* **78** 74 (67 – 80), *st1- st3* **63** 64 (61 – 74), *st5- st5* **59** 64 (58 – 73). Ventrianal shield smooth, almost pentagonal, with slightly waist at *JV2* level; **121** 131 (121 – 151) long, **100** 98 (90 – 117) wide at level of *ZV2* and **86** 90 (84 – 103) wide at level of anus; with three pairs of pre-anal setae, solenostome gv3 crescentic, *JV1* **13** 15 (11 – 18), *JV2* **10** 13 (10 – 18), *ZV2* **9** 11 (9 – 14). Setae *JV4* **11** 10 (7 – 11), *JV5* **45** 51 (45 – 61), *ZV1* **15** 16 (12 – 19), *ZV3* **9** 10 (9 – 11) on interscutal membrane. All ventral setae smooth. Two metapodal plates **18** 20 (18 – 23) long, **4** 6 (4 – 7) wide, **12** 15 (12 – 17) long, **2** 2 (1 – 3) wide.

Peritreme (Figure 1A-B) — Peritreme extending beyond to *j1*, peritrematic shield smooth, lightly sclerotized, with one pair of solenostome (*gd3*).

Spermatheca (Figure 1D) — Calyx of spermath-

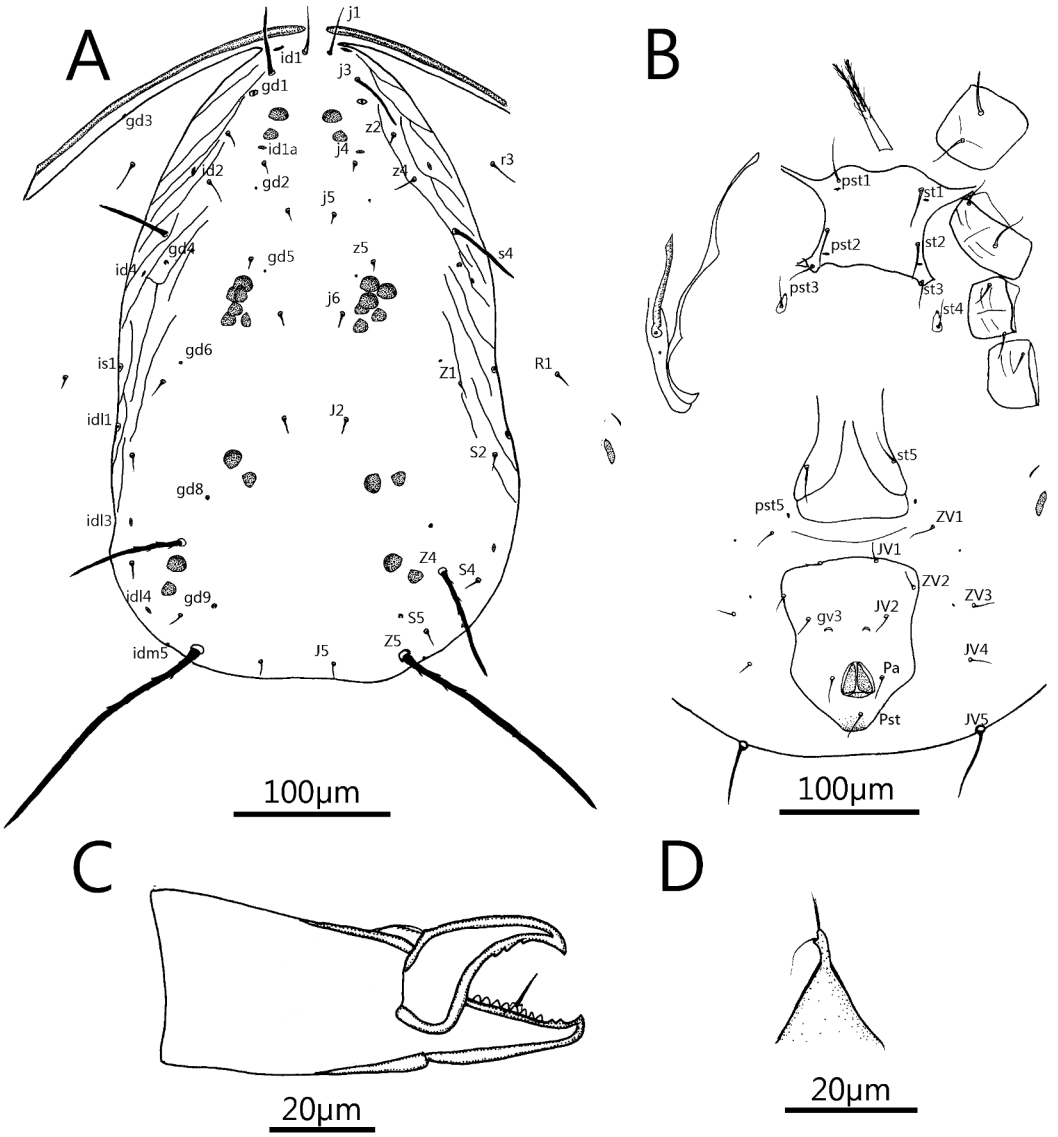


FIGURE 1: *Amblyseius bellatulus* Female: A – Dorsal shield; B – Ventral idiosoma; C – Chelicera; D – Spermatheca.

eca funnel-shaped and atrium well distinct with neck, embolus not visible, with a thin major duct.

Chelicera (Figure 1C) — Movable digit **31** 32 (30 – 36) long, with three teeth; fixed digit **27** 29 (26 – 34), with 10 teeth, pilus dentilis.

Legs (Figure 2) — Coxal formula 2, 2, 2, 1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/2-2/0-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-2/1-1/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (pd2) **27** 29 (26 – 33), *Sge* III (ad2) **30** 31 (27 – 37), *Sge* IV (ad2) **50** 50 (40 – 59), *Sti* IV (ad) **45** 46 (40 – 51), *St* IV (pd) **73** 73 (66 – 84).

Male (n= 2). Dorsum (Figure 3A) — Idiosomal setal pattern: 10A:9B/JV-3, 4:ZV-1, 3. Dorsal shield lightly sclerotized, smooth, with lateral reticulation, 264 (248 – 280) long, 178 (161 – 195) wide at level of *s4*, 138 (127 – 149) wide at level of *S4*; with seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), ten pairs of poroids (*id1*, *id1a*, *id2*, *id4*, *is1*, *idl1*, *idl3*, *idl4*, *idm5*, *idm6*); length of dorsal setae: *j1* 20 (20 – 2), *j3* 28 (28 – 29), *j4* 5.4 (5 – 6), *j5* 5 (4 – 5), *j6* 5 (4 – 6), *J2* 5 (5 – 5), *J5* 5 (4 – 6), *z2* 10 (10 – 11), *z4* 9 (8 – 10), *z5* 4 (4 – 4), *Z1* 9 (8 – 9), *Z4* 35 (35 – 35), *Z5* 81 (77 – 85), *s4* 34 (34 – 34), *S2* 9 (9 – 9), *S4* 7 (7 – 7), *S5* 6 (6 – 6), *r3* 15 (15 – 16), *R1* 9 (7 – 11). All setae smooth, except *Z4* and *Z5* slightly serrate.

Venter (Figure 3B) — Sternogenital shield smooth, with slightly lateral reticulation, posterior margin almost straight, longer than wide 116 (110 – 123) long, 64 (55 – 73) wide at level *st2*, with five pairs of setae *st1* 18 (16 – 19), *st2* 18 (16 – 20), *st3* 16 (13 – 19), *st4* 14 (11 – 17), *st5* 14 (13 – 14) and three pairs of poroids (*pst1*, *pst2*, *pst3*); distance between *st1-st1* 42 (40 – 43), *st2-st2* 49 (46 – 52), *st3-st3* 50 (47 – 54), *st4-st4* 38 (36 – 40), *st5-st5* 30 (27 – 33), *st1-st5* 102 (97 – 106). Ventrianal shield subtriangular, with slightly reticulation, 108 (103 – 114) long, 137 (129 – 144) wide at level of anterior corner and 61 (61 – 62) wide at level of anus, fused with peritrematic shield cingulum; with three pairs of pre-anal setae, solenostome gv3 crescentic, *JV1* 9 (9 – 9), *JV2* 10 (10 – 10), *ZV2* 8 (8 – 8); *JV5* 20 (17 – 22) on interscutal membrane. All ventral setae smooth.

Peritreme (Figure 3A-B) — Peritreme extending to seta *j1* level; peritrematic shield lightly sclerotized, with one pair of solenostome (*gd3*).

Chelicera (Figure 3C-D) — Movable digit 21 (21 – 22) long, with one tooth; fixed digit 22 (20 – 24), with 8 teeth, pilus dentilis. Spermatodactyl U-shaped, shaft 34 (30 – 37) long, heel rounded, foot 18 (17 – 19) long, with rounded toe and lateral thorn-like projection.

Legs (Figure 4) — Coxal formula 2, 2, 2, 1. Chaetotaxy (femur to basitarsus): leg I, 2-3/1-2/2-2, 2-2/1-2/1-2, 2-2/1-2/1-2, 1-1/1-1; leg II, 2-3/2-2/0-1, 2-2/0-2/0-1, 1-1/1-2/1-1, 1-1/1-1; leg III, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-2/1-1/1-1, 1-1/1-1; leg IV, 1-2/1-1/0-1, 1-2/1-2/0-1, 1-1/1-2/0-1, 1-1/1-1. Macrosetae: *Sge* II (pd2) 20 (19 – 20), *Sge* III (ad2) 20 (20 – 20) *Sge* IV (ad2) 29 (28 – 30), *Sti* IV (ad) 26 (25 – 26), *St* IV (pd) 56 (56 – 56).

Material examined — Neotype female: TARI, Wufeng District, Taichung, from *Toona sinensis*, 17.xii.2001, C. C. Ho (NTU).

Additional material examined — Hualien County, one female from rice leaf sheath, 2.xi.1977, K. C. Lo (TARL); Wanfeng Village, Wufeng District, Taichung City, one female from *Polygonum perfoliatum*, 3.ii.1978, C. C. Ho (TARI); Wanfeng Village, Wufeng District, Taichung City, one female from *Bothriochloa ischaemum*, 15.ii.1978, C. C. Ho (TARI); Wanfeng Village, Wufeng District, Taichung City, one female from mushroom, 15.xii.1981, K. C. Lo (TARI); TARI, Wufeng District, Taichung City, two females from *Zea mays*, 18.x.1985, C. C. Ho (TARL); TARI, Wufeng District, Taichung City, 17 females 1 male from *Ageratum conyzoides*, 22.xi.1985, C. C. Ho (TARI); NPIA, two females from *Ageratum conyzoide*, 22.xi.1985, C. C. Ho (TARL); Erlin Township, Changhua County, one female from *Vigna unguiculata*, 14.xii.1986, S. M. Yu (NPUST); Mingjian Township, Nantou County, two females from *Ampelopsis brevipedunculata*, 24.xii.1985, C. C. Ho (NTU); TARI, Wufeng District, Taichung City, one female from *Zea mays*, 4.vii.1987, C. C. Ho (TARI); Baihe District, Tainan City, one female from *Sambucus formosana*, 23.vi.1988, S. M. Yu (NMNS); TARI, Wufeng District, Taichung City, one female from *Ageratum houstonianum*, 12.x.1988, S. M. Yu (NMNS); TARI,

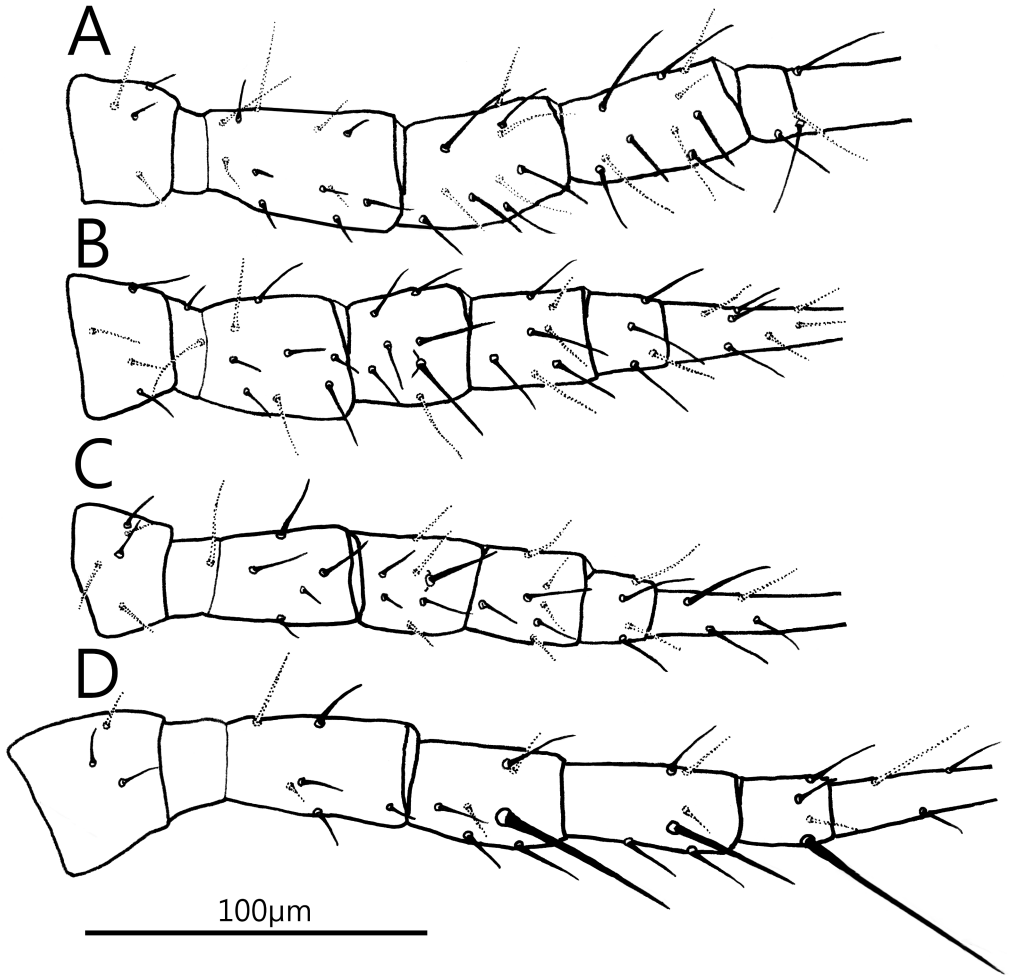


FIGURE 2: *Amblyseius bellatulus* Female: Legs (A – leg I dorso-anterior view; B – leg II dorso-anterior view; C – leg III dorsal view; D – leg IV dorso-anterior view).

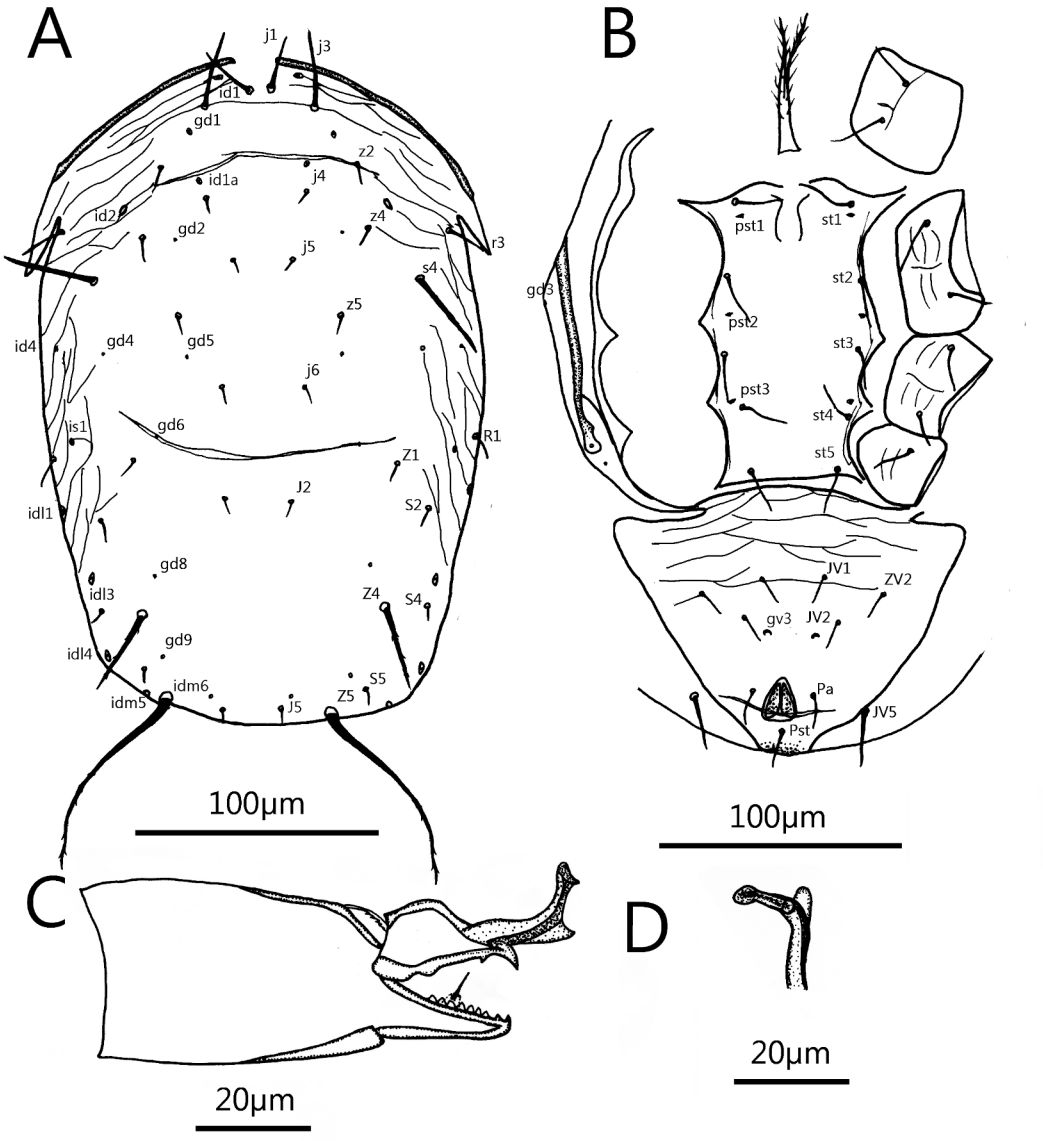


FIGURE 3: *Amblyseius bellatulus* Male: A – Dorsal shield; B – Ventral idiosoma; C – Chelicera; D – Ventral view of spermatodactyl.

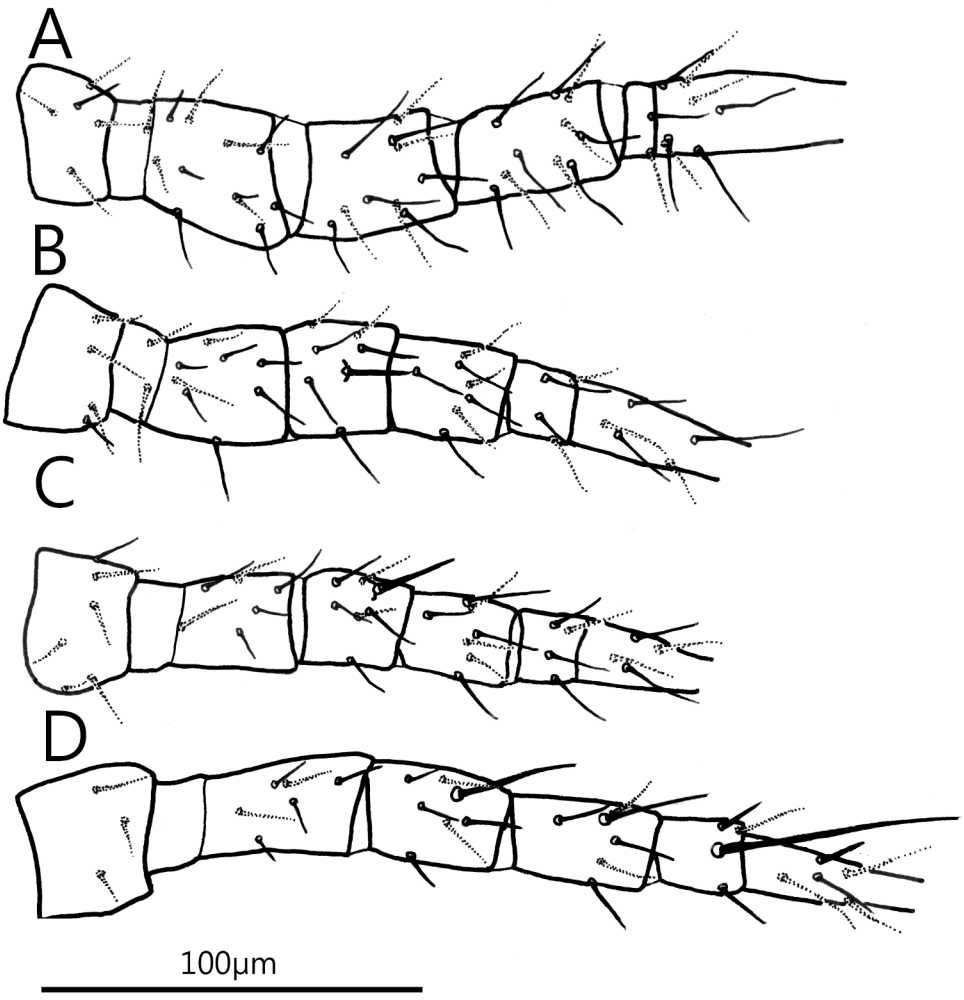


FIGURE 4: *Amblyseius bellatulus* Male: Legs (A – leg I dorso-anterior view; B – leg II dorso-posterior view; C – leg III dorso-posterior view; D – leg IV dorso-posterior view).

Wufeng District, Taichung City, two females from *Alternanthera sessilis*, 17.x.1988, S. M. Yu (NPUST); TARI, Wufeng District, Taichung City, one female from *Eclipta prostrata*, 17.x.1988, S. M. Yu (NMNS); TARI, Wufeng District, Taichung City, nine females from *Polygonum perfoliatum*, 17.x.1988, S. M. Yu (NCHU); TARI, Wufeng District, Taichung City, two females (MZLQ-7644, 7645) from *Arachis hypogaea*, 17.x.1988, S. M. Yu (ESALQ-USP); TARI, Wufeng District, Taichung City, one female (MZLQ-7643) from unknown plant, 18.x.1988, S. M. Yu (ESALQ-USP); Caotun Township, Nantou County, three females from *Psidium guajava*, 27.x.1988, S. M. Yu (NTU); TARI, Wufeng District, Taichung City, two females from *Ipomoea acuminata*, 27.x.1988, S. M. Yu (NTU); TARI, Wufeng District, Taichung City, three females from *Zingiber officinale*, 2.xi.1988, S. M. Yu (TARL); TARI, Wufeng District, Taichung City, one female from *Monorfiae choartiae*, 2.xi.1988, S. M. Yu (TARL); Caotun Township, Nantou County, 11 females from *Psidium guajava*, 2.xi.1988, S. M. Yu (NPUST); TARI, Wufeng District, Taichung City, two females from *Ageratum houstonianum*, 16.xi.1988, S. M. Yu (NTU); TARI, Wufeng District, Taichung City, two females from *Ipomoea acuminata*, 24.xi.1988, S. M. Yu (NTU); TARI, Wufeng District, Taichung City, one female from *Rorippa indica*, 30.xi.1988, S. M. Yu (TARL); TARI, Wufeng District, Taichung City, two females one male from *Oryza sativa*, 2.xii.1988, S. M. Yu (NCHU); TARI, Wufeng District, Taichung City, one female from *Ziziphus mauritiana*, 7.xii.1988, C. C. Ho (TARI); Sanxiantai, Chenggong Township, Taitung County, one male from *Calophyllum inophyllum*, 4.iv.1989, C. C. Ho (TARL); TARI, Wufeng District, Taichung City, one female from *Solanum melongena* 25.vi.1991, C. C. Ho (NMNS); TARI, Wufeng District, Taichung City, two females from *Solanum melongena* 4.vi.1991, C. C. Ho (TARI); TARI, Wufeng District, Taichung City, one female from *Solanum melongena* 11.vi.1991, C. C. Ho (NMNS); TARI, Wufeng District, Taichung City, three females rear from unknown plant, 3.vii.1991, C. C. Ho (TARI); TARI, Wufeng District, Taichung City, one female from *Solanum melongena* 4.vii.1991, C. C. Ho (NPUST); TARI, Wufeng District, Taichung City, three females from *Solanum melongena* 6.vii.1991, C. C. Ho (NMNS); TARI, Wufeng District, Taichung City, nine females two males from *Solanum melongena*, 16.vii.1991, C. C. Ho (NTU); TARI, Wufeng District, Taichung City, one female from *Solanum melongena*, 23.vii.1991, C. C. Ho (NTU); TARI, Wufeng District, Taichung City, one female rear from unknown plant, 6.xi.1993, C. C. Ho (NTU); Lucao Township, Chiayi County, one female from *Lagenaria siceraria* soil, 14.viii.2001, C. C. Ho (NTU); Dayuan District, Taoyuan City, one female from *Allium fistulosum* soil, 25.x.2001, C. C. Ho (NTU).

Remarks — Tseng (1983) described this species by using a single female specimen collected from Mingchien (now Mingjian Township), Nantou Hsien, on *Morus alba*. We collected two female specimens from the type locality on *Ampelopsis brevipedunculata*, but they were in poor condition. Consequently, the neotype specimen was selected from among the entire collection depending on the slide condition. The neotype locality is Wufeng District, Taichung, which is not far from the type locality (Figure 5).

The females of this species are unique among the known *Amblyseius* species from Taiwan because of the following characters: dorsal shield with lateral reticulation, ventrianal shield pentagonal with slightly lateral concaved, calyx of spermatheca funnel-shaped. A comparison of different body measurements among the holotype, neotype, and remaining specimens of *A. bellatulus* is provided in Table 1. Most specimens were similar to the neotype, with little morphological differences. We observed only one specimen with a larger body size and longer idiosomal setae (e.g. dorsal shield 449 long, 250 wide). Tseng (1983) reported the chaetotaxy of genu I-IV: 2-2/1-2/1-2, 1-2/1-2/0-1, 1-2/1-2/0-1, 1-2/1-2/0-1". We observed the chaetotaxy of leg I-IV and found that the chaetotaxy of genu I-IV differs from the original description: 2-2/1-2/1-2, 2-2/0-2/0-1, 1-2/1-2/0-1, 1-2/1-2/0-1. With regard to adenotaxy and poroidotaxy, Tseng (1983) reported "at least five pairs of pores on the dorsal shield". On the basis of his illustration, we observed three pairs of solenostomes (*gd6*, *gd8*, *gd9*). In the present study, we observed seven pairs of solenostomes (*gd1*, *gd2*, *gd4*, *gd5*, *gd6*, *gd8*, *gd9*), and ten pairs of poroids (*id1*,

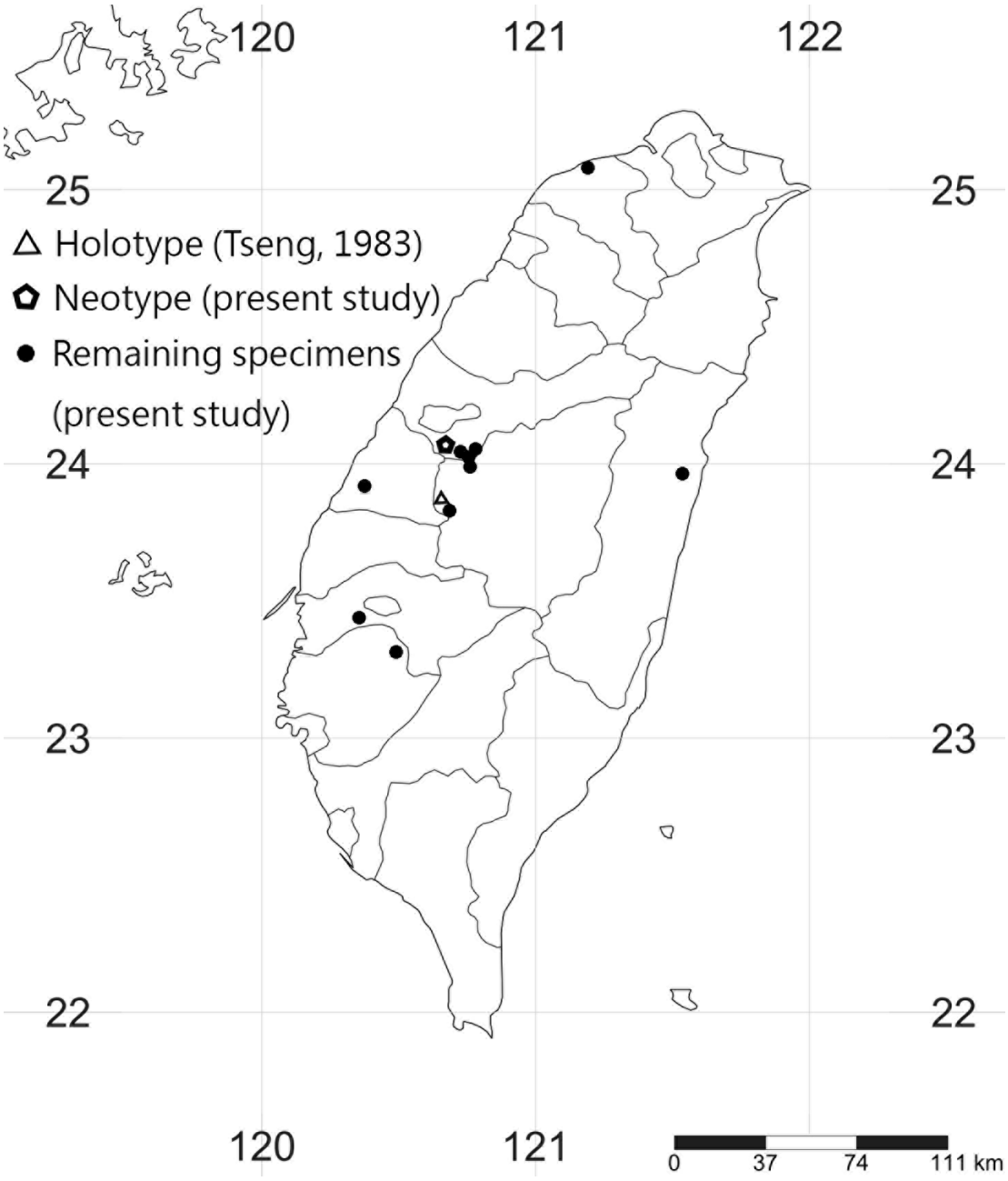


FIGURE 5: The distribution map of *Amblyseius bellatulus* from Taiwan.

TABLE 1: Comparisons on measurements[1] (μm) of *Amblyseius bellatulus* between (1) holotype (in Tseng 1983), (2) presently studied neotype and (3) ten females including neotype

	1	2	3
Dorsal shield length	331	382	384 (353 – 449)
Dorsal shield width	178	202	212 (192 – 250)
j1	24	23	28 (23– 32)
j3	36	34	40 (34 – 46)
j4	5	5	7 (5 – 13)
j5	5	4	5 (4 – 7)
j6	6	6	7 (4 – 8)
J2	6	4	7 (4 – 9)
J5	8	5	6 (4 – 9)
z2	10	11	10 (8 – 11)
z4	10	11	11 (8 – 13)
z5	5	5	6 (4 – 8)
Z1	6	8	8 (7 – 10)
Z4	42	52	52 (47 – 57)
Z5	110	119	136 (117 – 157)
s4	42	46	49 (43 – 61)
S2	11	10	11 (9 – 13)
S4	7	5	8 (5 – 11)
S5	5	6	7 (6 – 9)
r3	18	21	19 (17 – 21)
R1	10	13	10 (8 – 13)
Ventrianal shield length	106	121	131 (121 – 151)
Ventrianal shield width	81	100	98 (90 – 117)
metapodal shield (primary plate)	21	18	20 (18 – 23)
metapodal shield (accessory plate)	–	12	15 (12 – 17)
Sge IV	43	50	50 (40 – 59)
Sti IV	38	45	46 (40 – 51)
St IV	60	73	73 (66 – 84)

[1] Only dorsal setae were compared as Tseng (1983) only measured dorsal setae.

id1a, *id2*, *id4*, *is1*, *idl1*, *idl3*, *idl4*, *idm5*, *idm6*). The differences between the reported and observed adenotaxy and poroidotaxy may be due to the quality of microscopes.

By comparing the collection records of this *A. bellatulus*, we observed that this species was mostly collected from central Taiwan; however, one specimen was collected from northern Taiwan and another from eastern Taiwan. Therefore, this species may be more widely distributed than is evident from the collection. We also observed *A. bellatulus* occurred on various plants, although these mites mostly inhabit weeds, they also inhabit some economically valuable plants (e.g., corn plants, egg-

plants, and guava). Ho and Chen (2001) reported that *A. bellatulus* could prey on melon thrips (*Thrips palmi*) in the field. Therefore, we consider *A. bellatulus* need further experiments for confirmation of the biocontrol potential.

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