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Review of *Apoplophora* (Acari: Oribatida: Mesoplophoridae), with the description of a new species from China

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Abstract

The oribatid mite genus *Apoplophora* Aoki, 1980 (Mesoplophoridae) is reviewed, and a checklist and key to all known species are provided. Three species of *Apoplophora* including a new species, *Apoplophora dentata* **sp. nov.** from Tibet, and a newly recorded species from China, *Apoplophora heterotricha* Mahunka, 1987, are identified, and their morphological descriptions and illustrations are also given.

Key words: Oribatida, Mesoplophoridae, *Apoplophora*, soil mites, new species, new record, China

Introduction

The oribatid mite genus *Apoplophora* is a small genus occuring in Oriental and Australian regions. At present, the genus is represented by 14 valid species worldwide.

Aoki (1980) proposed the genus *Apoplophora* for the type-species, *Apoplophora remota* from Japan, and he also included *Mesoplophora discreta* in this genus. Niedbała (1984) regarded *A. remota* as a junior synonym of *M. pantotrema*, hence *Mesoplophora pantotrema* Berlese, 1913 is the type-species of *Apoplophora*.

Mesoplophora pantotrema and *M. discreta* were described by Berlese (1913) as new species from Java. Grandjean (1933) treated *M. discreta* as a junior synonym of *M. pantotrema*, and considered that the type specimen of *M. pantotrema* was a tritonymph of *M. discreta*. Hammen (1959) and Niedbała (1993) agreed with Grandjean's view. However, Aoki (1980) did not accept these opinions, and considered that further studies (*i.e.* by rearing) are necessary to ascertain the validity of the species. Hammer (1979) redescribed *M. pantotrema*, and reported two new species from Java, *M. leviseta* and *M. rostrorugosa*, which were transferred to *Apoplophora* by Mahunka (1987), but subsequently Mahunka (1991) reversed his combination of *A. leviseta* back to *Mesoplophora*. Niedbała (1984) revised the genus *Apoplophora* and regarded *M. rostrorugosa* and *A. remota* as synonymous with *A. pantotrema* (Berlese). In the same paper, he proposed the family Apoplophoridae. On the basis of cladistic analysis of Hypochthonioidea, Norton (1984) regarded *Apoplophora* as a genus of Mesoplophoridae. Niedbała (2001) analysed the features of this genus and discussed their taxonomic signification.

Mahunka (1985, 1987, 1988, 1991) described eleven new species of this genus: *M. indica* and *M. striata* from South India, which were transferred to *Apoplophora* by himself in 1987; *A. heterotricha, A. lineata, A. spinosa, A. ornatissima, A. cristata, A. jaccoudi, A. malaya, A. marcuardi* and *A. triseta* from Malaysia. Also, Niedbała (1998, 2000, 2004) described seven new species of *Apoplophora*: *A. solomonensis* from Solomon Islands; *A. ornata* from Indonesia; *A. phalerata* from India and Indonesia; and *A. kapiti, A. sarawaki, A.*

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serrata and *A. triquetra* from Malaysia. In his monograph (Niedbała 2000), *A. triseta* was treated as a junior synonym of *A. marcuardi*; *M. indica*, *M. striata*, *A. lineata*, *A. ornatissima* and *A. jaccoudi* were regarded as synonymous with *A. pantotrema*. Mondal, Kundu and Roy (1999) described one new species, *A. aokii*, from Darjeeling (India). In the checklist compiled by Subías (2004), there are 10 species included in *Apoplophora*.

Chu and Aoki (1997) recorded *A. pantotrema* from Taiwan, which was the first record of *Apoplophora* in China. Since then, no other species of this genus has been reported from China (Wang *et al.* 2002).

In this paper, we focus on three species of *Apoplophora* now known from China. Based on Chinese specimens, we redescribe *A. pantotrema* and *A. heterotricha*, the latter being newly recorded in China. The third species is newly described as *Apoplophora dentata* **sp. nov.**. In addition, we provide a checklist which contains all valid species, distribution information and literatures that treat taxonomic issues involving this genus. Also, a key to all known species is presented herein.

Material and methods

Measurements and descriptions are based on specimens mounted in temporary cavity slides that were studied using a standard light microscope equipped with a drawing attachment.

Terminology generally follows Niedbała (1984, 2000). Explanations and abbreviations for setae of ventral region: *v*: ventral setae; *h*: setae on antero-lateral position of ventral region*; *an*: setae on "ano-adanal" plates**. The unit of measurement is micrometres (μm).

All specimens studied are deposited in the Zoological Museum, Institute of Zoology, Chinese Academy of Sciences, Beijing.

* The setae on antero-lateral position of ventral region are usually regarded as ventral setae (Aoki 1980; Mahunka 1987, 1991; Niedbała 2004) or aggenital setae (Niedbała 2000, 2001; Niedbała & Corpuz-Raros 1998). However, these setae are probably homologous to h_2 and h_3 of the notogaster in the genus *Eniochthonius* (closest to Mesoplophoridae) (Norton 1984, Norton & Behan-Pelletier 2007). So it's better to adopt names setae h_2 and h_3 instead of antero-lateral or aggenital setae. The word "antero-lateral" mentioned in this paper just indicates the position of these setae.

** Aoki (1980) assumed that the valves covering the anal chamber are the anal plates alone. However, Norton (1984) considered that the adanal plate has fused with the anal plate to form a composite paraproctal valve which is discrete in stage of deutonymph and tritonymph. Therefore, the setae on the paraproctal valves are not necessarily all "anal" setae. Here we temporarily use the name "ano-adanal".

Taxonomy

Apoplophora Aoki, 1980

Type species: *Mesoplophora pantotrema* Berlese, 1913 (= *Apoplophora remota* Aoki, 1980)

Diagnosis. Sensillus smooth or covered with short barbs; exobothridial seta longer than diameter of bothridium (with exception of *A. ornata*); seta c_3 similar in shape to other notogastral setae or fine, smooth and shorter than them; genital plate triangular, anal and adanal plates fused to form an "ano-adanal" plate, distance between genital and "ano-adanal" plates longer than length of "ano-adanal" plate; five to six pairs ventral setae; one or two pairs of setae present on antero-lateral position of ventral region; two to four pairs of setae on "ano-adanal" plates; six pairs of smooth genital setae present.

Distribution. China, Australia, Fiji, India, Indonesia, Japan, Malaysia, Nepal, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka, Thailand, Vietnam.

Species of the genus *Apoplophora* Aoki, 1980

Apoplophora aokii Mondal, Kundu & Roy, 1999

Apoplophora aokii Mondal, Kundu & Roy, 1999, p. 73, figs. 1–3.
Distribution: India (West Bengal).

Apoplophora cristata Mahunka, 1991

Apoplophora cristata Mahunka, 1991, p. 327, figs. 1–3; Niedbała, 2000, p. 45, figs. 48–50; 2001, p. 363, figs. 1–2; Subías, 2004, p. 41.
Distribution: Malaysia (Pehang).

Apoplophora dentata **sp. nov.**

Distribution: China (Tibet).

Apoplophora heterotricha Mahunka, 1987 **Newly recorded from China**

Apoplophora heterotricha Mahunka, 1987, p. 770, figs. 1–3; Niedbała, 2000, p. 47, figs. 51–54; 2001, p. 365, figs. 3–6; Subías, 2004, p. 41.
Distribution: China (Tibet), India (Meghalaya, Uttar Pradesh, West Bengal), Indonesia (Kalimantan), Malaysia (Sabah), Nepal (Bagmati).

Apoplophora kapiti Niedbała, 2004

Apoplophora kapiti Niedbała, 2004, p. 394, Tab. I, figs. 5–8.
Distribution: Malaysia (Sarawak).

Apoplophora malaya Mahunka, 1991

Apoplophora malaya Mahunka, 1991, p. 329, figs. 8–11; Niedbała, 2000, p. 49, figs. 55–59; 2001, p. 366, figs. 7–9; Subías, 2004, p. 41.
Distribution: Malaysia (Jahor, Pehang).

Apoplophora marcuardi Mahunka, 1991

Apoplophora marcuardi Mahunka, 1991, p. 332, figs. 12–15; Niedbała, 2000, p. 49, figs. 61–63; 2001, p. 366, figs. 10–12; Subías, 2004, p. 41.
Apoplophora triseta Mahunka, 1991, p. 332, figs. 17–19; Subías, 2004, p. 41.
Distribution: Malaysia (Perak).

Apoplophora ornata Niedbała, 2000

Apoplophora ornata Niedbała, 2000, p. 51, figs. 67–70; 2001, p. 369, figs. 13–16; Subías, 2004, p. 41.
Distribution: Indonesia (Borneo).

Apoplophora pantotrema (Berlese, 1913)

Mesoplophora pantotrema Berlese, 1913, p. 10, fig. 94; Hammer, 1979, p. 6, fig. 1.
Mesoplophora discreta Berlese, 1913, p. 101, fig. 95.
Mesophophora rostrorugosa Hammer, 1979, p. 7, fig. 3.
Apoplophora remota Aoki, 1980, p. 13, fig. 4.
Apoplophora pantotrema: Niedbała, 1984, p. 149, figs. 4–6; Chu & Aoki, 1997, p. 174; Niedbała, 1998, p. 441, figs. 4–6; 2000, p. 53, figs. 64–66; 2001, p. 369, figs. 17–35; Niedbała & Corpuz-Raros, 1998, p. 11, figs. 16–18; Wang, Wen & Chen, 2002, p. 109; Subías, 2004, p. 41.
Mesoplophora indica Mahunka, 1985, p. 370, figs. 8–10.
Mesoplophora striata Mahunka, 1985, p. 371, figs. 11–13.

Apoplophora lineata Mahunka, 1987, p. 773, figs. 4–7.
Apoplophora ornatissima Mahunka, 1988, p. 824, figs. 1–4.
Apoplophora jaccoudi Mahunka, 1991, p. 329, figs. 4–6.
Distribution: China (Beijing, Fujian, Hainan, Taiwan), Australia (Queensland), Fiji, India (Kerala, Nandi Hills), Indonesia (Bali, Borneo, Cibodas, Java, Kalimantan, Sarawak, Sulawesi, Sumatra), Japan (Amami Ohshima Is.), Malaysia (Jahor, Kuala Lumpur, Pehang, Sabah), Papua New Guinea, Philippines (Luzon Is., Palawan Is., Polillo Is., Samar Is.), Solomon Islands, Sri Lanka (Central Province), Thailand (Chienamai, Malaya Peninsula), Vietnam (Dalat, Tam Dao).

Apoplophora phalerata Niedbała, 2000
Apoplophora phalerata Niedbała, 2000, p. 59, figs. 71–74; 2001, p. 375, figs. 36–42; Subías, 2004, p. 41.
Distribution: India (Tamil Nadu), Indonesia (Sulawesi, Sumatra), Malaysia (Sabah, Sarawak)

Apoplophora sarawaki Niedbała, 2004
Apoplophora sarawaki Niedbała, 2004, p. 396, Tab. II, figs.1–3.
Distribution: Malaysia (Sarawak).

Apoplophora serrata Niedbała, 2004
Apoplophora serrata Niedbała, 2004, p. 396, Tab. II, figs. 4–6.
Distribution: Malaysia (Sarawak).

Apoplophora solomonensis Niedbała, 1998
Apoplophora solomonensis Niedbała, 1998, p. 442, figs. 7–11; 2001, p. 377, figs. 43–46; Subías, 2004, p. 41.
Distribution: Solomon Islands.

Apoplophora spinosa Mahunka, 1987
Apoplophora spinosa Mahunka, 1987, p. 773, figs. 8–11; Niedbała, 2000, p. 61, fig. 60; 2001, p. 377, figs. 47–48; Subías, 2004, p. 41.
Distribution: Indonesia (Borneo), Malaysia (Sabah, Sarawak).

Apoplophora triquetra Niedbała, 2004
Apoplophora triquetra Niedbała, 2004, p. 397, Tab. III, figs. 1–7.
Distribution: Malaysia (Sarawak).

Descriptions of species from China

***Apoplophora dentata* sp. nov.**
(Figs. 1–4)

Material examined: Holotype: Adult (in alcohol), CHINA: Tibet, Mêdog County (29°19'31.08"N, 95°19'59.51"E), from litter, 800M, 9, Jan., 1983, leg. Yin-Heng Han. Paratype: 1 adult (in alcohol), with same data as holotype.

Etymology. The new specific name "*dentata*" is from Latin, and refers to the dentate margin of the rostrum.

Diagnosis: Anterior margin of prodorsum finely dentate; all prodorsal and notogastral setae faintly barbed, except setae c_3 fine, short and smooth; six pairs of ventral setae and setae h_2 and h_3 faintly barbed, nearly uniformly thick, but h_2 and h_3 much longer.

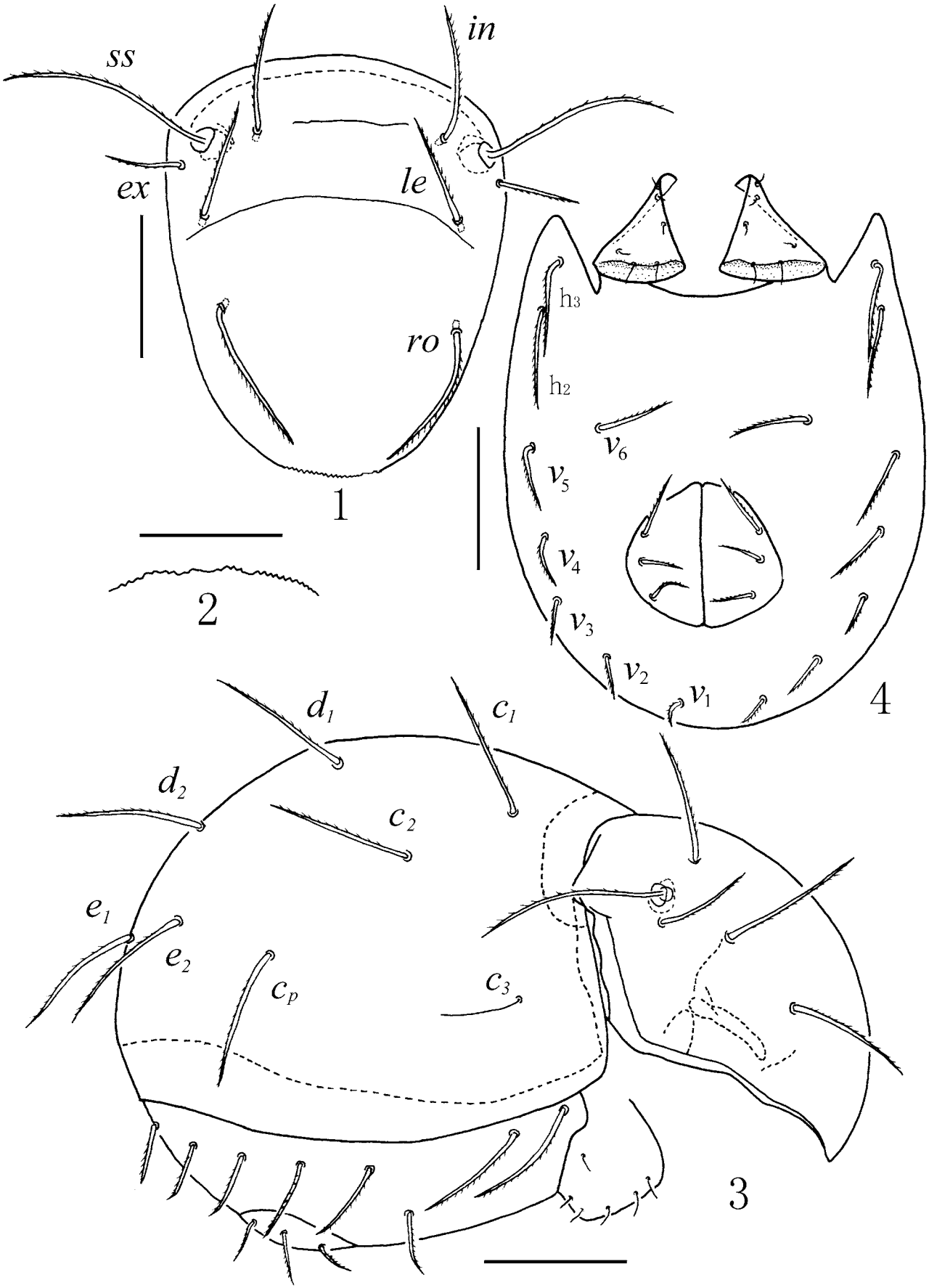

FIGURE 1–4. *Apoplophora dentata* sp. nov.: 1, prodorsum, dorsal view; 2, anterior margin of rostrum, dorsal view; 3, lateral view of body (legs removed); 4, ventral region. Scale bars: 1, 3, 4 = 100μm, 2 =200μm.

Measurements of adult holotype: Prodorsum: length 285, width 240, height 160, sensillus 145, setae: *in* 100, *le* 110, *ro* 110, distance between setae*: in–in* 100, *le–le* 190, *ro–ro* 165, *in–le* 60, *le–ro* 65; notogaster: length 400, width 365, height 290; setae: c_1 95, c_2 100, c_3 60, c_p 100, d_1 100, d_2 100, e_1 105, e_2 110; distance between setae: c_1– d_1 120, d_1–e_1 255; ventral region: ventral setae: v_1 55, v_2 60, v_3 60, v_4 75, v_5 75, v_6 60, h_2 90, h_3 90, an_1 40, an_2 45, an_3 40; "ano-adanal" plate 95×55.

Large species. Colour yellow. Surface of body smooth.

Anterior margin of rostrum finely dentate; sensillus long, thin, setiform, sparsely covered with faint barbs unilaterally; prodorsal setae *in*, *le*, *ro* faintly barbed; exobothridial seta thin, long, several times longer than diameter of bothridium, sparsely covered with small barbs; comparative length: *ro=le>in>ex*; lamellar seta situated between interlamellar and rostral setae, slightly closer to interlamellar seta.

Notogaster with eight pairs of setae, faintly barbed, relatively thick except setae c_3 thin, short and smooth; seta c_2 more remote from anterior margin than setae c_1 and c_3.

Ventral region with six pairs of ventral setae, nearly uniformly thick, faintly barbed as notogastral setae; setae h_2 and h_3 faintly barbed, equally thick with ventral setae, but much longer; genital plates with six pairs of smooth setae; "ano-adanal" plates with three pairs of faintly barbed setae.

Distribution. Known only from type locality.

Remarks. This new species is similar to *A. heterotricha* Mahunka, 1987, *A. malaya* Mahunka, 1991 and *A. solomonensis* Niedbała, 1998 in having short, fine and smooth seta c_3. It differs from them by the following combined characters: prodorsal, notogastral and ventral setae faintly barbed, except setae c_3 and genital setae; all ventral setae nearly uniformly thick; setae h_2 and h_3 longer than ventral setae; anterior margin of rostrum finely dentate. This new species is also similar to *A. phalerata* Niedbała, 2000 in having two barbed long setae on antero-lateral position of ventral region, but differs from the latter by: seta c_3 fine, smooth and shorter than other notogastral setae; all prodorsal setae nearly equally thick, except setae *ex*; rostrum finely dentate anteriorly; all setae, except genital setae and setae c_3, faintly barbed.

Apoplophora heterotricha Mahunka, 1987

(Figs. 5–7)

Apoplophora heterotricha Mahunka, 1987, p. 770, figs. 1–3; Niedbała, 2000, p. 47, figs. 51–54; 2001, p. 365, figs. 3–6.

Material examined: 2 adults (in alcohol, CJ-01-98), CHINA: Tibet, Nyalam County, No.318 national highway in Zham Town (27°59'16.65"N, 85°59'20.76"E), from litter under broadleaf forest and shrub, 2670M, 3, Sep., 2001, leg. Jun Chen. **Newly recorded from China**.

Measurements of adult: Prodorsum: length 285–315, width 210–240, height 125–160, sensillus 150, setae: *in* 115, *le* 135, *ro* 135, distance between setae*: in–in* 145, *le–le* 200, *ro–ro* 170, *in–le* 65, *le–ro* 80; notogaster: length 430–475, width 325–355, height 305–340, setae: c_1 115, c_2 120, c_3 100, c_p 150, d_1 120, d_2 155, e_1 150, e_2 155, distance between setae: c_1– d_1 140, d_1–e_1 260; ventral region: ventral setae: v_1 70, v_2 80, v_3 95, v_4 95, v_5 105, v_6 85, h_2 80, h_3 80, an_1 55, an_2 60, an_3 45; "ano-adanal" plate 120×62.5.

All prodorsal and notogastral setae covered with small barbs, except seta c_3 fine, short and smooth, seta c_2 more remote from anterior margin than setae c_1 and c_3; six pairs of ventral setae thick and barbed; setae h_2 and h_3 thin and smooth; six pairs of smooth genital setae and three pairs of barbed "ano-adanal" setae present.

Distribution. China (Tibet); India; Indonesia; Malaysia; Nepal.

Remarks. Compared with the descriptions of specimens collected from other places, the body of our specimens is relatively bigger. There are three pairs of "ano-adanal" setae in the specimens we examined, which is not consistent with the original description (four pairs of "ano-adanal" setae) of this species. But considering the number of "ano-adanal" seta is a feature subject to individual variation (Niedbała 2001), and

FIGURE 5–7. *Apoplophora heterotricha* Mahunka, 1987 (specimen from Tibet): 5, prodorsum, dorsal view; 6, lateral view of body (legs removed); 7, ventral region. Scale bars: 5–7 = 100μm.

all other morphological features of our specimens are the same as those indicated in the original description of *A. heterotricha* Mahunka, 1987, we identify them as this species.

***Apoplophora pantotrema* (Berlese, 1913)**
(Figs. 8–14)

Mesoplophora pantotrema Berlese, 1913, p. 10, fig. 94.
Apoplophora pantotrema: Chu & Aoki, 1997, p. 174; Wang, Wen & Chen, 2002, p. 109.

Material examined: 5 adults (in alcohol, W-90-117), CHINA: Beijing, Yanqing County (40°31'34.86"N, 116° 9'17.63"E), from litter under trees of persimmon, May, 1990, leg. Hui-Fu Wang; 1 adult (in alcohol, CJ-07-22), Beijing, Fangshan District, Simatai (39°46'55.88"N, 115°37'53.32"E), from litter under deadwood, 2070M, 5, July, 2007, leg. Jun Chen; 12 adults (in alcohol, LD-07-1, LD-07-2, LD-07-4), Hainan Province, Lingao County, Gaoshanling Nature Reserve (19º55'48.4"N, 109º38'18.5"E), from litter, 165M, 27 July, 2007, leg. Dong Liu; 5 adults (in alcohol, LD-07-7), same data as LD-07-1, from litter under shrub; 6 adults (in alcohol, LD-07-21), Hainan Province, Baisha County, Yinggeling Nature Reserve (19º03'0.2"N, 109º33'48.0"E), Yinggezui, from litter under deadwood, 635M, 29 July, 2007, leg. Dong Liu; 4 adults (in alcohol, LD-07-27), Hainan Province, Changjiang Li Autonomous County, Bawangling National Nature Reserve (19º07'0.5"N, 109º05'6.3"E), from litter under rubber forest, 156M, 31 July, 2007, leg. Dong Liu; 1 adult (in alcohol, LD-07-31), same data as LD-07-27, from litter under moss; 9 adults (in alcohol, LD-07-35), Hainan Province, Changjiang Li Autonomous County, Bawangling National Nature Reserve (19º05'0.2"N, 109º07'3.0"E), Yajia, from litter under arbor forest, 516M, 1 Aug., 2007, leg. Dong Liu; 1 adult (in alcohol, LD-07-38), same data as LD-07-35, from litter under roots in a cave; 1 adult (in alcohol, LD-07-39), Hainan Province, Changjiang Li Autonomous County, Bawangling National Nature Reserve (19º01'6.2"N, 109º06'18.4"E), Exianling, from litter under deadwood, 518M, 2 Aug., 2007, leg. Dong Liu; 3 adults (in alcohol, LD-07-46), Hainan Province, Changjiang Li Autonomous County, Bawangling National Nature Reserve (19º05'18.2"N, 109º11'18.4"E), from litter under arbor forest, 1040M, 3 Aug., 2007, leg. Dong Liu; 1 adult (in alcohol, LD-07-47), same data as LD-07-46, from litter under fern; 1 adult (in alcohol, LD-07-48), same data as LD-07-46, from litter under pine forest; 2 adults (in alcohol, LD-07-50, LD-07-51), same data as LD-07-46, from litter under pine forest; 29 adults (in alcohol, LD-07-53, LD-07-54, LD-07-57), Hainan Province, Dongfang City, Datian National Nature Reserve (19º06'36.0"N, 108º47'36.2"E), from litter under arbor forest, 70M, 5 Aug., 2007, leg. Dong Liu; 11 adults (in alcohol, LD-07-55, LD-07-54), same data as LD-07-53, from litter under deadwood; 21 adults (in alcohol, LD-07-56), same data as LD-07-53, from litter under shrub; 2 adults (in alcohol, LD-07-58), Hainan Province, Dongfang City, Datian Village (19º02'54.2"N, 108º49'36.1"E), from litter under arbor forest, 144M, 6 Aug., 2007, leg. Dong Liu; 1 adult (in alcohol, LD-07-59), same data as LD-07-58, from litter under shrub; 1 adult (in alcohol, LD-07-60), same data as LD-07-58, from litter under Banyan; 3 adults (in alcohol, H9403I3), Hainan Province, Ledong Li Autonomous County, Jianfengling National Forest Park (18º41'48.4"N, 108º47'18.0"E), from litter under deadwood, Mar., 1994, leg. Chong-Hui Liao; 5 adults (in alcohol, H94041210, H94041203), same data as H9403I3, Apr., 1994, leg. Chong-Hui Liao; 5 adults (in alcohol, LD-07-64, LD-07-65, LD-07-71), Hainan Province, Ledong Li Autonomous County, Jianfengling National Forest Park (18º41'48.4"N, 108º47'18.0"E), Institute of Subtropical Forestry, from litter under arbor forest, 64M, 7 Aug., 2007, leg. Dong Liu; 3 adults (in alcohol, LD-07-67), same data as LD-07-64, from litter under cycad plant; 2 adults (in alcohol, LD-07-68), Hainan Province, Ledong Li Autonomous County, Jianfengling National Forest Park (18º43'0.1"N,108º52'18.5"E), main peak, from litter under arbor forest, 1357M, 8 Aug., 2007, leg. Dong Liu; 5 adults (in alcohol, LD-07-81), Hainan Province, Wuzhishan City, Wuzhi National Nature Reserve (18º53'48.2"N, 109º41'48.0"E), Hudiegu, from litter under deadwood, 635M, 13 Aug., 2007, leg. Dong Liu; 1 adult (in alcohol, LD-07-96), Hainan Province, Wuzhishan City, Wuzhishan National Nature Reserve (18º53'48.2"N, 109º41'48.0"E), main

peak, from litter under bamboo forest, 1740M, 16 Aug., 2007, leg. Dong Liu; 6 adults (in alcohol, LD-07-99), same data as LD-07-96, from litter under deadwood; 1 adult (in alcohol, LD-07-103), Hainan Province, Qiongzhong Li and Miao Autonomous County, Limu Mt. (19º10'36.5"N, 109º44'12.2"E), Qumu, from litter under palm forest, 820M, 18 Aug., 2007, leg. Dong Liu; 2 adults (in alcohol, LD-07-106), same data as LD-07-103, from litter under bamboo and arbor forest; 2 adults (in alcohol, LD-07-110), Hainan Province, Qiongzhong Li and Miao Autonomous County, Limu Mt. (19º10'54.2"N, 109º45'6.5"E), from litter under arbor forest, 946M, 19 Aug., 2007, leg. Dong Liu; 3 adults (in alcohol, LD-07-111), same data as LD-07-110, from litter under bamboo forest; 1 adult (in alcohol, LD-07-113), same data as LD-07-110, from litter under trees of *Alsophila spinulosa*; 1 adult (in alcohol, LD-07-118), Hainan Province, Qiongzhong Li and Miao Autonomous County, Limu Mt. (19º10'30.4"N, 109º44'30. 2"E), Limu River, from litter under *Livistona*, 616M, 20 Aug., 2007, leg. Dong Liu; 4 adults (in alcohol, LD-07-120), same data as LD-07-118, from litter under arbor forest; 5 adults (in alcohol, LD-07-124), Hainan Province, Dingan County, Huangzhu (19°28'22.38"N, 110°26'48.29"E), from litter under arbor forest, 136M, 21 Aug., 2007, leg. Dong Liu; 1 adult (in alcohol, LD-07-125), same data as LD-07-124, from litter under trees of pepper; 2 adults (in alcohol, LD-07-133), same data as LD-07-124, from litter under arbor forest; 2 adults (in alcohol, W-89-16), Fujian Province, Wuyi Mt., Sangang (27°44'52.25"N, 117°40'59.28"E), from litter under deadwood, 27 Apr., 1989, leg. Hui-Fu Wang; 9 adults (in alcohol, W-89-23), same data as W-89-16, from litter under deadwood, 28 Apr., 1989, leg. Hui-Fu Wang; 3 adults (in alcohol, W-89-18, W-89-20, W-89-21), Fujian Province, Wuyi Mt. (27°45'23.97"N, 118° 2'7.11"E), Tongmu, from litter under deadwood, 28 Apr., 1989, leg. Hui-Fu Wang; 23 adults, 3 nymphs (in alcohol, W-89-30, W-89-31, W-89-33, W-89-34, W-89-35), Fujian Province, Wuyi Mt. (27°45'23.97"N, 118° 2'7.11"E), Guadun, from litter under deadwood, 30 Apr., 1989, leg. Hui-Fu Wang; 5 adults (in alcohol, W-90-62, W-90-63), Fujian Province, Jiangle County (26°43'42.90"N, 117°28'18.51"E), Longxi Mt., Shejiaping, from litter, 9 Sep., 1990, leg. Hui-Fu Wang; 1 adult (in alcohol, W-90-66), same data as W-90-62, from litter under bamboo forest, 11 Sep., 1990, leg. Hui-Fu Wang; 2 adults (in alcohol, W-90-83, W-90-84), same data as W-90-62, from litter under mixed forest, 21 Sep., 1990, leg. Hui-Fu Wang; 1 adult (in alcohol, W-90-67), Fujian Province: Jiangle County (26°43'42.90"N, 117°28'18.51"E), Longxi Mt., Qingshanao, from litter under bamboo forest, 12 Sep., 1990, leg. Hui-Fu Wang; 10 adults (in alcohol, W-90-69, W-90-70), Fujian Province, Jiangle County (26°43'42.90"N, 117°28'18.51"E), Longxi Mt., Jiangjunding, from litter under bamboo forest, 16 Sep., 1990, leg. Hui-Fu Wang; 8 adults, 2 nymphs (in alcohol, W-91-6), Fujian Province, Jiangle County (26°43'42.90"N, 117°28'18.51"E), Longxi Mt., from litter, 26 June, 1991, leg. Xiao-Mei Zhang; 2 adults (in alcohol, LD-07-140), Guangdong Province, Guangzhou City, South China Agricultural University (23º09'24.5"N, 113º20'48.4"E), from litter under arbor forest, 26 Aug., 2007, leg. Dong Liu.

Measurements of specimens from Beijing: Prodorsum: length 220–285, width 175–195, height 115–155, sensillus 115; setae: *in* 70, *le* 85, *ro* 100; distance between setae*: in–in* 125, *le–le* 165, *ro–ro* 140, *in–le* 40, *le–ro* 60; notogaster: length 240–330, width 270–300, height 190–255, setae: c_1 70, c_2 95, c_3 100, c_p 110, d_1 75, d_2 90, e_1 100, e_2 100; "ano-adanal" plate 90×50. Measurements of specimens from Hainan: Prodorsum: length 185–210, width 145–148, height 110–120, sensillus 90; setae: *in* 50, *le* 60, *ro* 95; distance between setae*: in–in* 95, *le–le* 120, *ro–ro* 105, *in–le* 35, *le–ro* 50; notogaster: length 270–275, width 215–220, height 155–190; setae: c_1 55, c_2 75, c_3 90, c_p 85, d_1 55, d_2 75, e_1 85, e_2 85; "ano-adanal" plate 70×35.

Surface of body smooth or prodorsum with longitudinal striations; all prodorsal and notogastral setae densely barbed, seta c_2 more remote from anterior margin than setae c_1 and c_3; six pairs of ventral setae thick and densely barbed; one or two pairs of setae on antero-lateral position, short, thin and smooth; six pairs of smooth genital setae present; "ano-adanal" setae two, three or four pairs, covered with small barbs.

Distribution. China; Australia; Fiji; India; Indonesia; Japan; Malaysia; Papua New Guinea; Philippines; Solomon Islands; Sri Lanka; Thailand; Vietnam.

Remarks. *Apoplophora pantotrema* is the first record of *Apoplophora* in China, but it was simply listed in the paper concerning soil ecology without any description and comment (Chu & Aoki 1997).

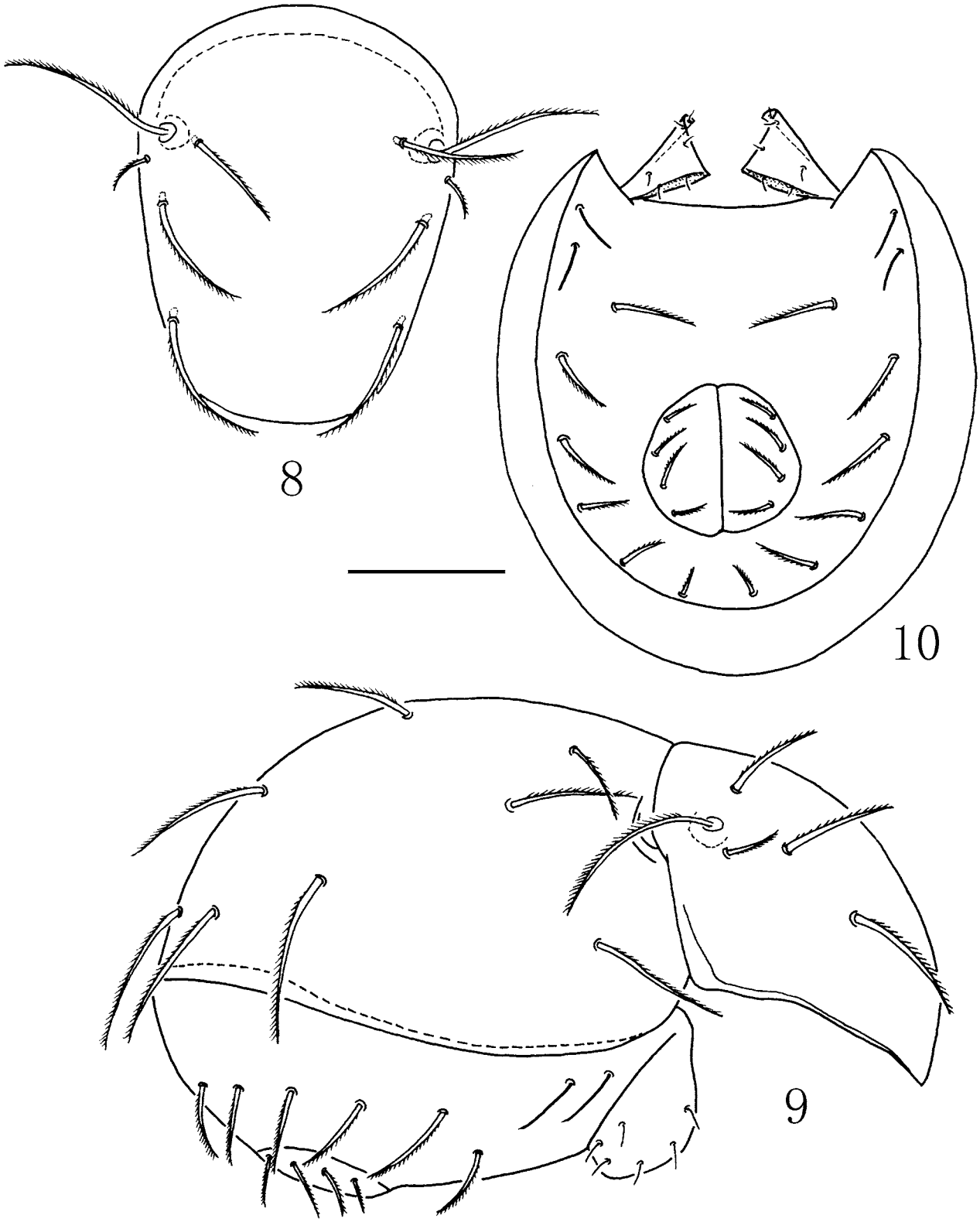

FIGURE 8–10. *Apoplophora pantotrema* (Berlese, 1913) (specimen from Beijing): 8, prodorsum, dorsal view; 9, lateral view of body (legs removed); 10, ventral region. Scale bars: 8–10 = 100μm.

Niedbała (2001) concluded that some morphological features of species in *Apoplophora* show individual variation: the ornamentation of the body and the number of ventral and anal setae. Among the specimens we collected from a single locality, we found their body smooth or ornamented by longitudinal striations, three or

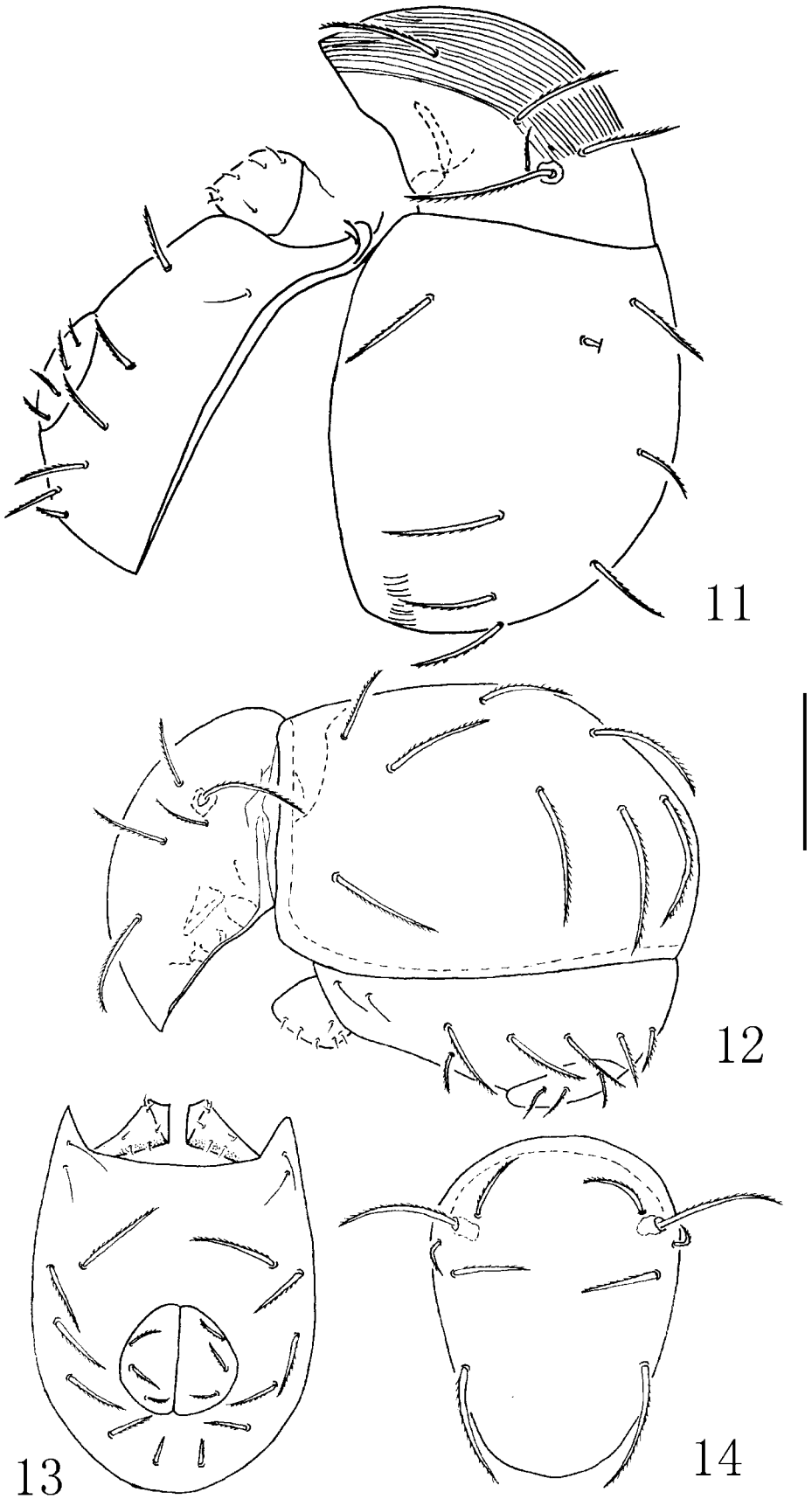

FIGURE 11–14. *Apoplophora pantotrema* (Berlese, 1913) (11. specimen from Beijing, 12–14, specimens from Hainan): 11, lateral view of body (broken, legs removed); 12, lateral view of body (legs removed); 13, ventral region; 14, prodorsum, dorsal view. Scale bars: 11–14 = 100μm.

four pairs of “ano-adanal” setae present, and one or two pairs of setae on antero-lateral position of ventral region. It further confirms the view of Niedbała (2001) that these features are of little use in diagnosis and taxonomy in this genus.

Key to species of *Apoplophora*

1 Prodorsal setae smooth, exobothridial seta shorter than diameter of bothridium ..... *A. ornata* Niedbała
- Prodorsal setae barbed, exobothridial seta longer than diameter of bothridium 2
2 Lateral carinae of prodorsum present 3
- Lateral carinae of prodorsum absent 4
3 Seta c_3 fine, smooth and shorter than other notogastral setae ..... *A. malaya* Mahunka
- Seta c_3 covered with barbs and similar in shape to other notogastral setae ..... *A. cristata* Mahunka
4 Sensillus smooth 5
- Sensillus barbed 6
5 Seta c_3 fine, smooth and shorter than other notogastral setae ..... *A. solomonensis* Niedbała
- Seta c_3 covered with barbs and similar in shape to other notogastral setae ..... *A. serrata* Niedbała
6 Setae series *h* rough or barbed 7
- Setae series *h* smooth or only posterior pair barbed 9
7 Seta c_3 fine, smooth and shorter than other notogastral setae ..... *A. dentata* **sp. nov.**
- Seta c_3 covered with barbs and similar in shape to other notogastral setae 8
8 Rostral seta thicker than other prodorsal setae, six pairs of ventral setae present ..... *A. phalerata* Niedbała
- Interlamellar seta thicker than other prodorsal setae, five pairs of ventral setae present ..... *A. kapiti* Niedbała
9 All dorsal setae short, distance between prodorsal setae always greater than their length ..... *A. spinosa* Mahunka
- All dorsal setae long, distance between prodorsal setae smaller than their length 10
10 Seta c_3 fine, smooth and shorter than other notogastral setae 11
- Seta c_3 covered with barbs and similar in shape to other notogastral setae 12
11 Prodorsum with distinct longitudinal striations; ventral plate with densely punctate region ..... *A. aokii* Mondal, Kundu & Roy
- Prodorsum without longitudinal striations, and ventral plate without densely punctate region ..... *A. heterotricha* Mahunka
12 “Ano-adanal” seta smooth ..... *A. sarawaki* Niedbała
- “Ano-adanal” seta barbed or rough 13
13 Setae series *h* smooth 14
- Posterior pair of setae series *h* barbed ..... *A. marcuardi* Mahunka
14 Surface of notogaster with arrangement of triangular elements; tritonymph with two pairs of ventral setae and two pairs of genital setae ..... *A. triquetra* Niedbała
- Surface of notogaster without arrangement of triangular elements; tritonymph with three pairs of ventral setae and three pairs of genital setae ..... *A. pantotrema* (Berlese)

Remarks. On the basis of the view of Niedbała (2001) and the specimens we studied, we avoided using the features that show individual variation, except for two species, *A. aokii* and *A. triquetra*. According to the original description, *A. aokii* can be distinguished from *A. heterotricha* only by the presence of striations on prodorsum and the number of setae on antero-lateral position of ventral region which are all subject to individual variation. So, we are not fully convinced that these two species are distinct. Similarly, adults of *A. triquetra* differ from those of *A. pantotrema* only by the ornamentation of body, but there are important differences in the tritonymph. Therefore, we use combined characters of adult and tritonymph to distinguish these two species.

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