



## Taxonomic study of the *protecta*-group in the genus *Pagaronia* Ball (Hemiptera, Cicadellidae, Evacanthinae) from Japan

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### Abstract

Seven species, including three new species, of the *protecta*-group in the genus *Pagaronia* Ball are recognized from Honshu, Japan. *Pagaronia totoumiensis* **sp. nov.**, *P. dichotoma* **sp. nov.** and *P. lanceolata* **sp. nov.** are described from central Honshu. Some intraspecific morphological variations of *P. protecta* Okada, *P. tridens* M.Hayashi & Arai and *P. spinosa* Y.Hori are analyzed. Additional localities for all the described species of this species-group are also given.

**Key words:** Auchenorrhyncha, Pagaroniini, new species, taxonomy, morphology, intraspecific variation

### Introduction

The evacanthine genus *Pagaronia* Ball was established for *P. tredecimpunctata* Ball from California, USA, and four species from North America and 96 species from East Asia have been described: 74 species from Japan, 23 from Korea, two from the Russian Far East, and one from Northeast China. Furthermore, a great many undescribed species from Japan have been recognized (Metcalf 1963; Huh & Kwon 1994; Anufriev & Emeljanov 1988; Hayashi & Okudera 2007, 2009; Imai 2010; Hayashi *et al.* 2010). Most *Pagaronia* species occurring in East Asia are similar to each other in body hue (yellow to ochraceous) and maculation (four black spots on the head). In contrast, the male genitalia, especially aedeagus and pygofer, are highly diversified. Hayashi *et al.* (2005, 2010) classified these East Asian species into 22 groups. Morphological features used for the species groupings include swelling of the head, black maculation on the head, configuration of the female 7th abdominal sternum, and structure of the male genitalia.

Among the 22 species-groups, the *protecta*-group comprises four species: *P. protecta* Okada, *P. conformata* M.Hayashi & Yoshida, *P. spinosa* Y.Hori and *P. tridens* M.Hayashi & Arai. *Pagaronia protecta* is distributed in western Honshu and the latter three species occur in central Honshu, Japan. Here we describe three new species of the *protecta*-group from central Honshu (Figs. 1–3). Additionally, we describe some morphological intraspecific variations in *P. protecta*, *P. tridens* and *P. spinosa* and report additional new localities for the four described species (Fig. 4).

### Material and methods

Specimens used in this study are deposited in Kyushu University, Fukuoka, Japan (ELKU) and Saitama University, Saitama, Japan (SUU).



FIGURES 1–3. 1, *Pagaronia totoumiensis* sp. nov.; 2, *P. dichotoma* sp. nov.; 3, *P. lanceolata* sp. nov. Scale; 0.5 mm.

For observation of the male genitalia, the terminal segments of the abdomen were placed in 5% solution of KOH with chlorazol black E for staining, and heated for less than 60 to 75 minutes, until the organs became soft. Material was then rinsed in 70% ethanol, and then removed into glycerin. Genitalia (pygofer) were separated from the abdomen and observed under a stereoscopic microscope. After the observation, genitalia and abdomen were kept in glycerin.

### Systematics

The *protecta*-group is distinguishable from other species-groups of *Pagaronia* by having a combination of the following four features: 1) head having three black spots and lacking a fuscous spot at the frontoclypeal tip (except in *P. conformata*); 2) female 7th abdominal sternum pentagonal to rectangular, with caudal margin produced posteriad and slightly emarginate at middle; 3) male pygofer lobe strongly narrowed near base and provided with large inner process. The narrowness of the pygofer lobe was previously described as an “incision” (Okada 1978) or “sinuation” (Hayashi & Arai 1990, Hayashi & Yoshida 1995, Hori 1994). Lastly, the aedeagus has a pair of short apical processes and a large ventral projection near the base. The apical process was previously described as a “subterminal spine” (Okada 1978) or “apical spine” (Hayashi & Arai 1990, Hori 1994), and the ventral projection as a “lamella” (Okada 1978), “projection” (Hayashi & Arai 1990), “basal process” (Hori 1994) or “basal paraphysis” (Hayashi & Yoshida 1995).

### Key to species (males) of the *protecta*-group

1. Pronotum and clavus of fore wing nigrescent; head with obscure fuscous spot on tip of frontoclypeus (see Fig. 40 in Hayashi & Yoshida 1995) ..... *P. conformata*

- Median line of posterior margin of fore wing obscured or sometimes immaculate; pronotum immaculate; head without black spot on tip ..... 2
- 2. Ventral projection of aedeagal shaft long and spinelike (Fig. 55) ..... *P. spinosa*
- Ventral projection tectiform (Figs. 12–13, 23, 35, 41–43, 50) ..... 3
- 3. Inner pygofer process not forked (Fig. 47) ..... *P. lanceolata* **sp. nov.**
- Inner pygofer process bifurcated or trifurcated (Figs. 9–11, 19–20, 31–32, 40) ..... 4
- 4. Inner pygofer process trifurcated (Fig. 40) ..... *P. tridens*
- Inner pygofer process bifurcated (Figs. 9–11, 19–20, 31–32) ..... 5
- 5. Apex of style not exceeding half length of subgenital plate; pygofer lobe narrowed basally with ventral margin strongly sinuate (Fig. 8) ..... *P. protecta*
- Apex of style not exceeding 2/3 times length of subgenital plate; pygofer lobe narrowed basally with ventral margin weakly sinuate (Figs. 18, 30) ..... 6
- 6. Aedeagal shaft narrow in lateral view, and weakly recurved dorsad; ventral projection larger than shaft (Fig. 23) ..... *P. totoumiensis* **sp. nov.**
- Aedeagal shaft wide in lateral view, and almost straight; ventral projection shorter than shaft (Fig. 35) . . . *P. dichotoma* **sp. nov.**

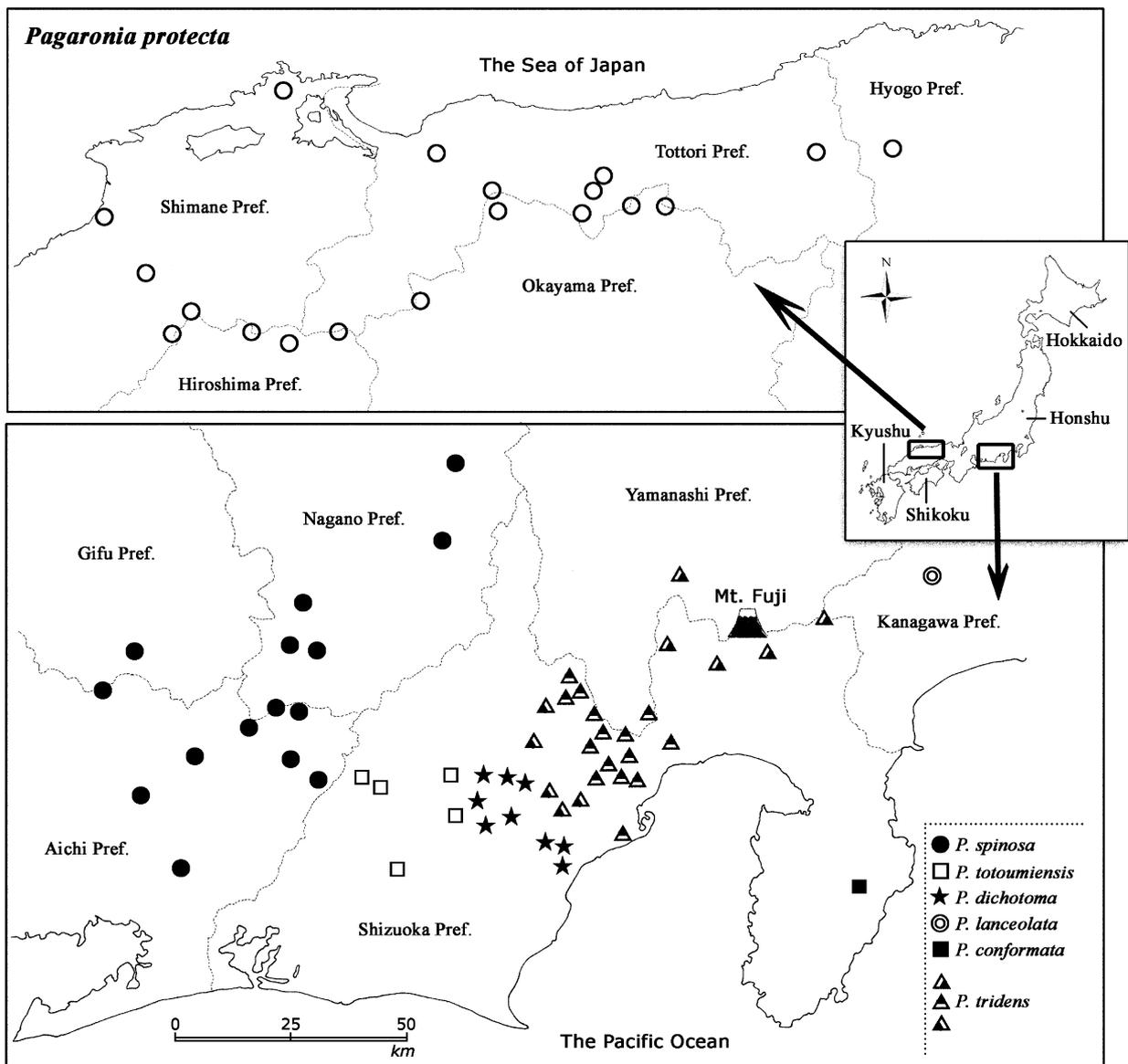


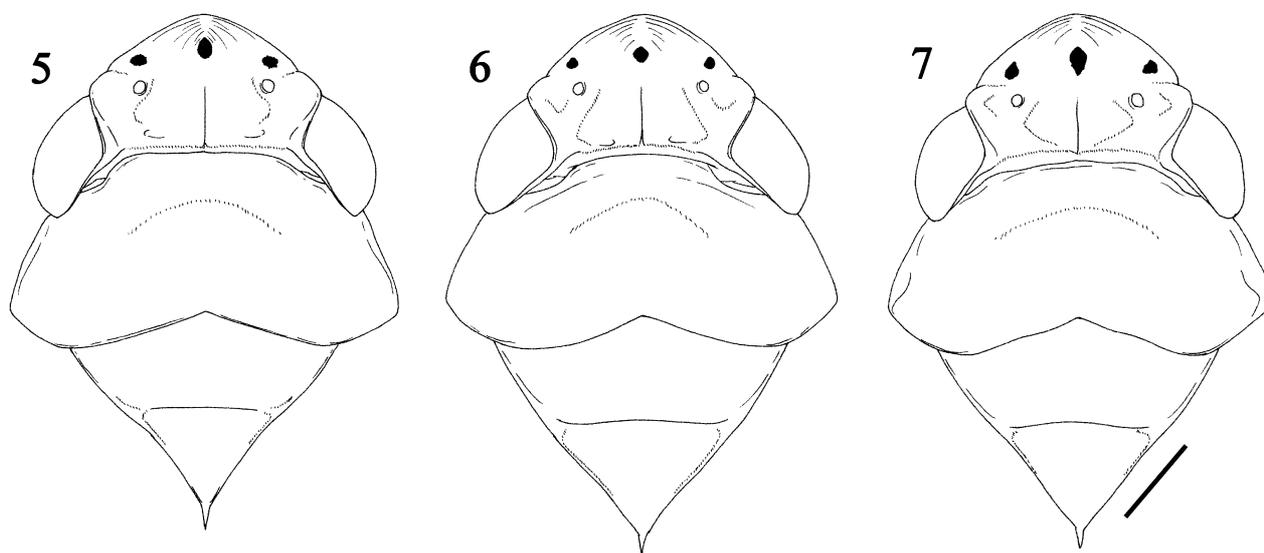
FIGURE 4. Distributional map of the *Pagaronia* species belong to the *protecta*-group.

## *Pagaronia protecta* Okada, 1978

(Figs. 4, 8–15)

*Pagaronia protecta* Okada, 1978: 380, figs. 56–62.

**Taxonomic note.** This species had been known only from the type specimens collected from Mt. Dogoyama, Hiroshima Prefecture, western Honshu. We recognize new localities from five prefectures in western Honshu and some intraspecific morphological variations in the male genitalia. *Pagaronia protecta* has a bifurcated inner process of pygofer lobe and a large ventral projection of aedeagus in the male genitalia. In the material from the type locality and its adjacent area, the dorsal branch of pygofer process is about two times as long as the ventral one (Fig. 9), but in the localities of Tottori and Okayama Prefectures, it is often as long as the latter (Figs. 10, 11). In many localities including the type locality, the ventral projection of aedeagus is about two times as wide as the aedeagal shaft (Fig. 12), but in some eastern localities of its distributional range, in Tottori and Okayama Prefectures, it is about three times as wide as the latter (Fig. 13). In these morphological variations, we observed some intermediate individuals.

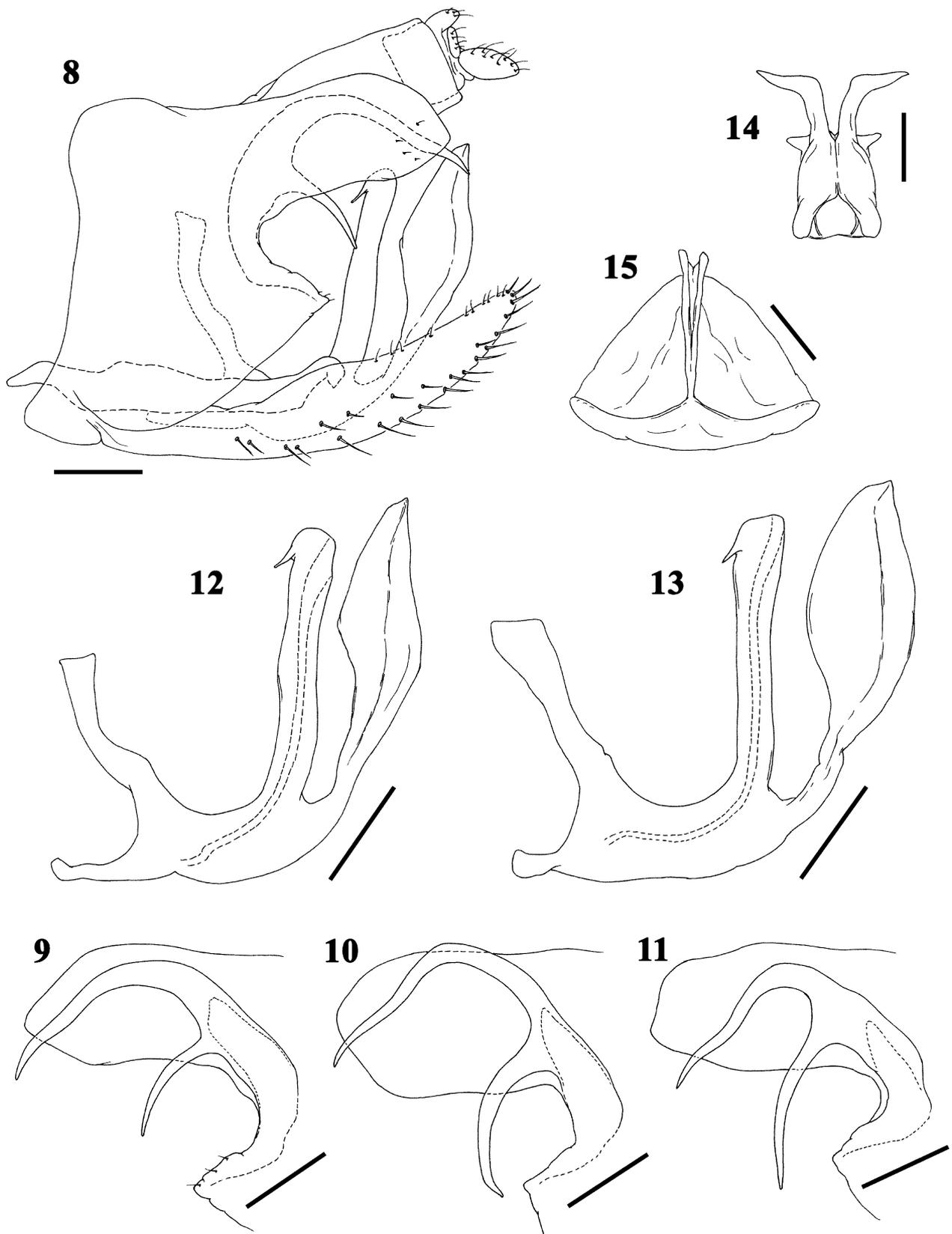


**FIGURES 5–7.** Head and thoracic nota. — 5, *Pagaronia totoumiensis* sp. nov.; 6, *P. dichotoma* sp. nov.; 7, *P. lanceolata* sp. nov. Scale; 0.5 mm.

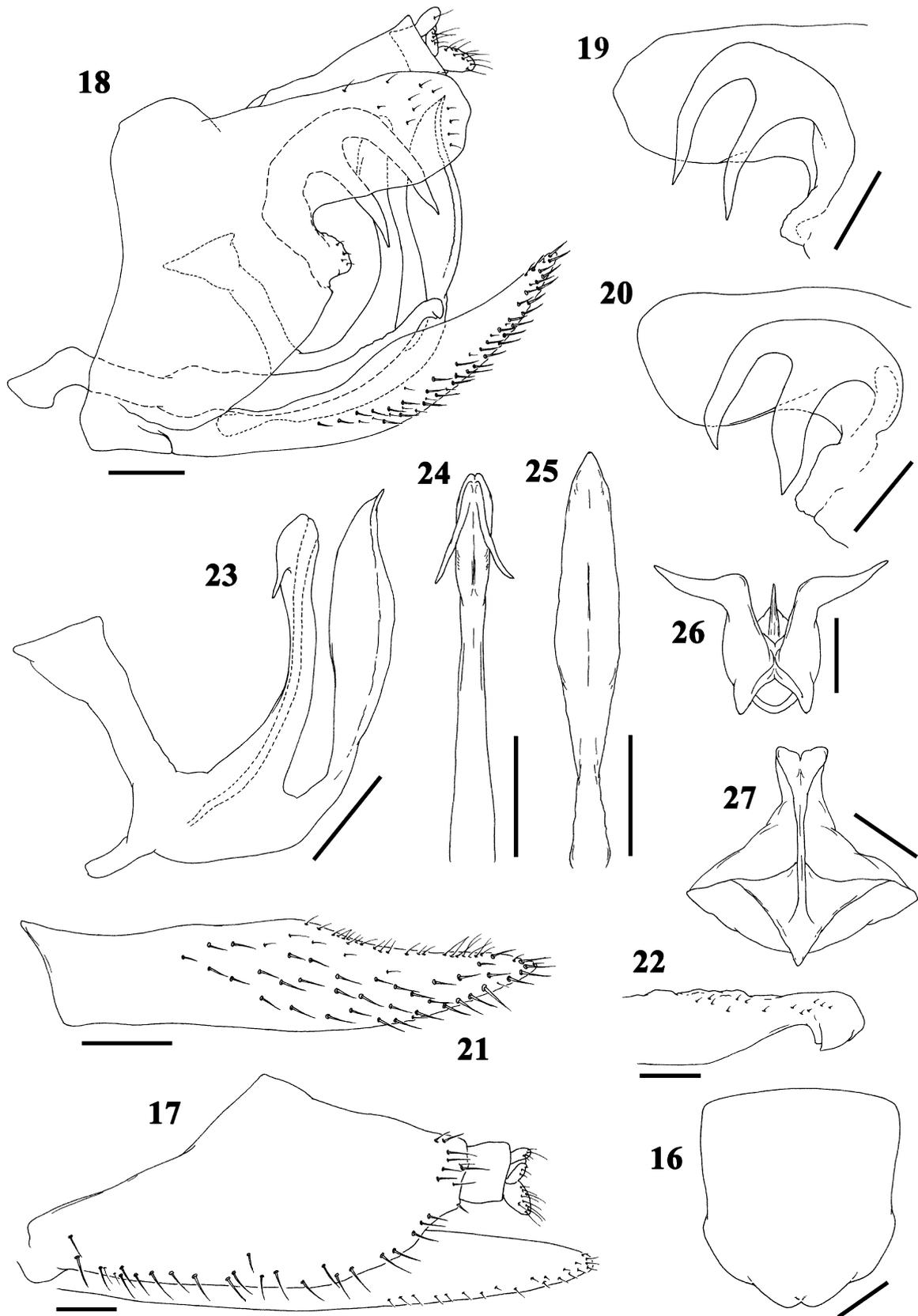
**Body length (mean).** ♂, 8.6–9.6 mm (9.1 mm); ♀, 9.3–10.2 mm (9.7 mm).

**Additional material.** [Hyōgo Pref.] 1♂ (SUU), Mt. Torokawa, Muraoka, Kami, 22. VI. 2005, S. Okudera. [Tottori Pref.] 1♂ (ELKU), Himeji, Kōge, 21. VI. 2005, T. Higuchi; 10♂ 3♀ (ELKU & SUU), Ningyō Pass, Misasa, 19. VI. 2005, T. Higuchi & S. Okudera; 6♂ (SUU), Shimobata, Misasa, 9. VI. 2010, T. Nozaki; 1♂ 1♀ (SUU), Onji, Misasa, 10. VI. 2010, T. Nozaki; 1♂ (SUU), Kubara, Misasa, 11. VI. 2010, T. Nozaki; 6♂ (ELKU & SUU), Mikaeri Pass (alt. 700 m), Mitsukue, Kōfu, 20. VI. 2005, T. Higuchi & S. Okudera; 2♂ 1♀ (ELKU & SUU), Shinkoya Pass (alt. 800 m), Kōfu, 20. VI. 2005, T. Higuchi & S. Okudera; 1♂ (ELKU), Yodochō-Hongū, Yonago, 1. VI. 2007, S. Okudera. [Shimane Pref.] 1♂ (ELKU), Shimanechō-Kaka, Matsue, 1. VI. 2007, S. Okudera; 1♂ 1♀, Takichō-Kumura, Izumo, 27. V. 2010, S. Okudera; 2♂ 1♀ (ELKU), Kakeyachō-anami, Unnan, 26. V. 2010, S. Okudera; 5♂ 5♀ (SUU), Yoshidachō-Yoshida, Unnan, 24. VI. 2010, T. Nozaki; 9♂ 14♀ (SUU), Tombara, Iinan, 24. VI, T. Nozaki. [Okayama Pref.] 2♂ (SUU), Tatsumi Pass, Kagamino, 19. VI. 2005, S. Okudera; 6♂ (SUU), Mt. Hiruzen, Kawakami, 12. VII. 2003, M. Takai; 4♂ 10♀ (SUU), Kawakami (light trap), 11. VII. 2003, M. Takai; 6♂ 2♀ (ELKU & SUU), Kuwahirata Pass (alt. 800 m), Niimi, Kōfu, 20. VI. 2005, T. Higuchi & S. Okudera. [Hiroshima Pref.] 18♂ 4♀ (ELKU), Mt. Dōgo, Shōbara, 16. VI. 2004, T. Higuchi; 4♂ (ELKU), same data except 26. VI. 2009, S. Okudera; 4♂ 8♀ (ELKU), Mt. Azuma, Shōbara, 16. VI. 2004, T. Higuchi; 1♂ 3♀ (SUU), Saijōchō-Yuki, Shōbara, 27. VI. 2010, T. Nozaki.

**Distribution.** Japan (western Honshu: Hyōgo, Tottori, Shimane, Okayama and Hiroshima Prefectures).



**FIGURES 8–15.** *Pagaronia protecta*, ♂ genitalia (8–15). — 8, ♂ pygofer in lateral view; 9–11, left inner pygofer process; 12–13, aedeagus in lateral view; 14–15, apical part of shaft (14) and ventral projection (15) in apical view. Scales; 0.3 mm (8–13), 0.05 mm (14, 15).



**FIGURES 16–27.** *Pagaronia totoumiensis* sp. nov., ♀ abdominal terminalia (16–17) and ♂ genitalia (18–27). — 16, 7th abdominal sternum; 17, ♀ pygofer in lateral view; 18, ♂ pygofer in lateral view; 19–20, left inner pygofer process; 21, left subgenital plate; 22, apical part of left style; 23, aedeagus in lateral view; 24, shaft in dorsal view; 25, ventral projection in caudal view; 26–27, apical part of shaft (26) and ventral projection (27) in apical view. Scales; 0.3 mm (16–21, 23–25), 0.1 mm (22) and 0.05 mm (26, 27).

***Pagaronia totoumiensis* sp. nov.**

(Figs. 1, 4, 5, 16–27)

**Description.** *Coloration & external morphology.* Body pale yellow; head with 3 round black spots on dorsal angle of frontoclypeus (central spot situated slightly anterior) and without black spot at tip; fore wing pale with anterior and posterior margins narrowly infuscate; legs and abdominal sterna entirely pale yellow except for tip of tarsi infuscate. Head weakly swollen anteriorly, with width 2.5 times as wide as long; pronotum 1.2 times as long as head, with posterior margin weakly concave at middle; female 7th abdominal sternum rectangular, 1.1 times as long as wide, with caudal margin produced posteriorly and slightly emarginate at middle; female pygofer (9th tergum) setose along caudal and ventral margins; 3rd valvula (ovipositor) furnished with minute hairs in apical 1/3 and fairly exceeding caudad beyond pygofer.

*Male genitalia.* Pygofer lobe oblong, furnished with about 10 short setae near caudal margin, narrowed near base and roundly sinuate at ventral margin, with inner process bent caudad at apical 2/3 and bifurcated at apical half; branches of inner process almost straight, parallel, as long as each other and immediately tapered at apex; ventral branch protruding beyond center of ventral margin of pygofer lobe. Subgenital plate slender, 4.4 times as long as wide, bearing 3 rows of many macrosetae on distal 2/3. Style almost straight, long, with apex reaching apical 1/3 of subgenital plate. Aedeagus robust with dorsal apodeme large; shaft weakly recurved dorsad, slightly narrowed at middle and widened near base in lateral view, with large ventral projection and pair of apical processes; ventral projection tectiform, twice as wide as base of projection, slightly longer and wider than shaft, parallel to shaft; apical process short, directed ventrad; gonopore apical on ventral surface.

**Body length (mean).** ♂, 8.0–8.9 mm (8.5 mm); ♀, 8.7–9.6 mm (9.2 mm).

**Type material.** *Holotype:* ♂ (ELKU No. 3317), Shimonagao, Kawane-honchô, Shizuoka Pref., Honshu, Japan, 27. V. 2009, S. Okudera. *Paratypes:* [Shizuoka Pref.] 12♂ 6♀ (ELKU), Sakurachô-ôi, Tenryû-ku, Hamamatsu, 27. V. 2009, S. Okudera; 13♂ 8♀ (SUU), Harunochô-toyooka, Tenryû-ku, Hamamatsu, 30. V. 2006, S. Okudera; 9♂ 11♀ (SUU), Mt. Ôfuda, Kawane-honchô, 13. VII. 2004, S. Okudera; 9♂ 6♀ (ELKU), same date as holotype; 2♂ 1♀ (ELKU), Mikura, Mori, 11. VI. 2008, S. Okudera. The holotype is deposited in the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka, Japan.

**Distribution.** Japan (central Honshu: Shizuoka Prefecture).

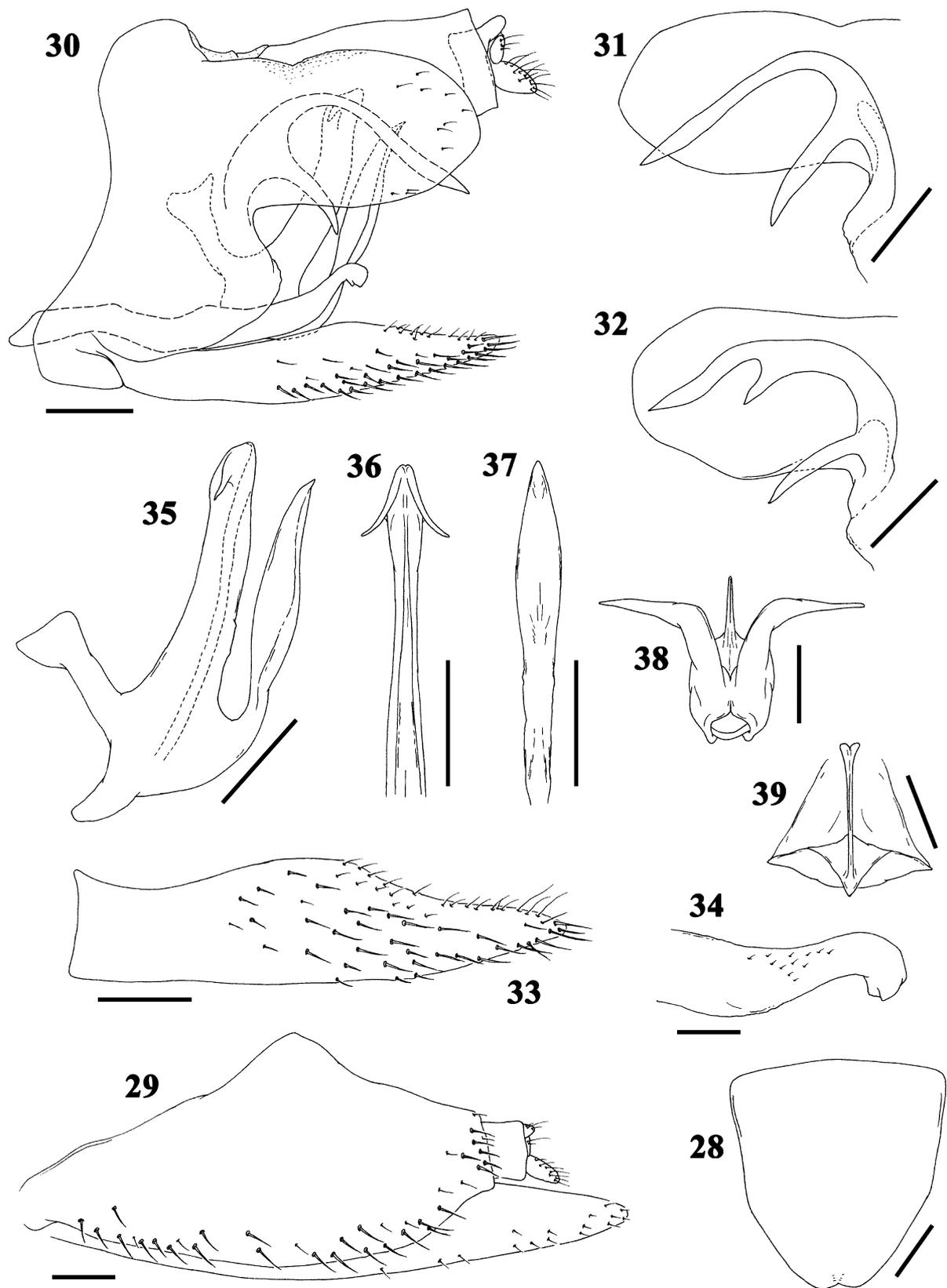
**Remarks.** This species is probably a close ally to *P. protecta* in having the bifurcated inner pygofer process and large ventral projection. But it can be easily distinguished by the following morphological features: apex of style reaching distal 1/3 of subgenital plate; ventral margin of pygofer roundly sinuate; aedeagal shaft weakly recurved dorsad and widened near base. In many localities including the type locality, the pygofer process of the male genitalia is usually slender (Fig. 19), but it is somewhat broadened in the specimens from Sakurachô-ôi, Hamamatsu City (Fig. 20). The species name is based on the ancient district name around the type locality, “Tô-tou-mi”.

***Pagaronia dichotoma* sp. nov.**

(Figs. 2, 4, 6, 28–39)

**Description.** *Coloration & external morphology.* Very similar to preceding species in body hue and infuscation on fore wing. Frontoclypeus with 3 small black spots arranged on line. Head roundly swollen anteriorly, 2.4 times as wide as long; pronotum 1.2 times as long as head, with posterior margin weakly concave at middle; female 7th abdominal sternum oblong, 1.2 times as long as wide, with caudal margin weakly produced posteriorly and slightly emarginate at middle; female pygofer setose along caudal and ventral margins; 3rd valvula sparsely pilose in apical 2/3 and distinctly exceeding beyond pygofer.

*Male genitalia.* Pygofer lobe oblong, furnished with about 10 short setae near caudal margin, narrowed near base and roundly sinuate at ventral margin, with inner process bent caudad at basal 1/4 and bifurcated at apical 2/3; dorsal branch straight and longer than ventral one; ventral branch parallel to dorsal one, protruding beyond center of ventral margin of pygofer lobe. Subgenital plate elongate, 3.8 times as long as wide, bearing about 35 macrosetae on distal half. Style slightly bent dorsad near apex, with tip slightly hooked ventrad; apex of style reaching



**FIGURES 28–39.** *Pagaronia dichotoma* sp. nov., ♀ abdominal terminalia (28–29) and ♂ genitalia (30–39). — 28, 7th abdominal sternum; 29, ♀ pygofer in lateral view; 30, ♂ pygofer in lateral view; 31–32, left inner pygofer process; 33, left subgenital plate; 34, apical part of left style; 35, aedeagus in lateral view; 36, shaft in dorsal view; 37, ventral projection in caudal view; 38–39, apical part of shaft (38) and ventral projection (39) in apical view. Scales; 0.3 mm (28–33, 35–37), 0.1 mm (34) and 0.05 mm (38, 39).

distal 1/3 of subgenital plate. Aedeagus robust; dorsal apodeme robust; shaft wide and almost straight in lateral view, with ventral projection and pair of apical processes; ventral projection tectiform, widened at apical half, shorter than shaft, almost parallel to shaft; apical process short, directed ventrolaterally; gonopore apical on ventral surface. Anal tube (10th segment) cylindrical, almost as long as pygofer lobe.

**Body length (mean).** ♂, 7.9–9.0 mm (8.6 mm); ♀, 8.9–9.5 mm (9.2 mm).

**Type material.** *Holotype*: ♂ (ELKU No. 3318), Higashi-fujikawa, Kawane-honchô, Shizuoka Pref., Honshu, Japan, 10. VI. 2010, S. Okudera. *Paratypes*: [Shizuoka Pref.] 15♂ 18♀ (ELKU), same date as holotype; 1♂ 1♀ (ELKU), Itchô-gôchi, Kawane-honchô, 10. VI. 2010, S. Okudera; 2♂ 2♀ (ELKU), Sasamashimo, Kawane-honchô, 11. VI. 2008, S. Okudera; 1♂ 3♀ (ELKU), Okabechô-nodasawa, Fujieda, 10. VI. 2010, S. Okudera; 1♂ (ELKU), Okabechô-okabe, Fujieda, 10. VI. 2010, S. Okudera; 3♂ 11♀ (ELKU), Setonoya, Fujieda, 11. VI. 2008, S. Okudera; 2♂ 1♀ (ELKU), Sakanokami, Aoi-ku, 10. VI. 2010, S. Okudera; 4♂ 1♀ (ELKU), Mariko, Suruga-ku, Shizuoka, 10. VI. 2010, S. Okudera. The holotype is deposited in the Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka, Japan.

**Distribution.** Japan (central Honshu: Shizuoka Prefecture).

**Remarks.** This species is similar to *P. protecta* and *P. totoumiensis* **sp. nov.** in general appearance and having the bifurcated inner pygofer process, but it is distinguishable from them by the shape of aedeagal shaft and relative length of the ventral projection. A male paratype from Sakanokami, Shizuoka City shows some differences in the shape of the inner pygofer process: the dorsal branch is bifurcated and not protruding beyond the caudal margin (Fig. 32).

### ***Pagaronia tridens* M.Hayashi & Arai, 1990**

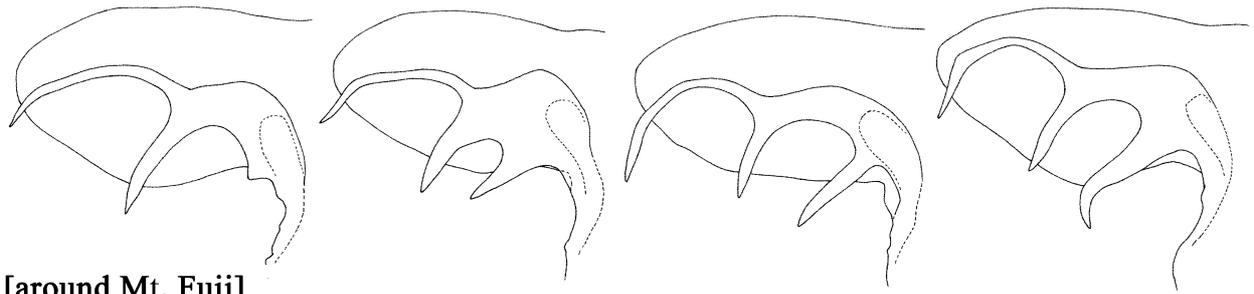
(Figs. 4, 40–43)

*Pagaronia tridens* Hayashi & Arai, 1990: 7, figs. 2, 12, 14–21.

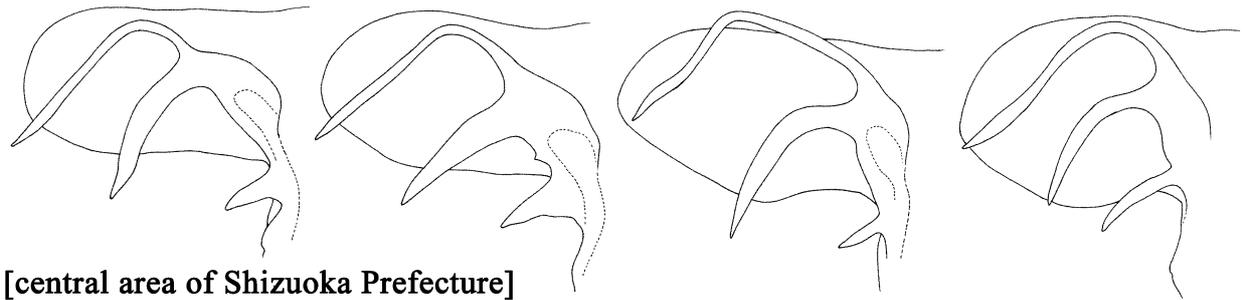
**Taxonomic note.** This leafhopper was described from the male holotype and 50 paratypes collected from two neighboring localities around Mt. Fuji, central Honshu. Through our recent field investigation, we found the species at additional 25 localities in Shizuoka and Yamanashi Prefectures. In the male genitalia, *Pagaronia tridens* has a trifurcated inner process of the pygofer lobe (Fig. 40) and a slender ventral projection of the aedeagus as long as the aedeagal shaft. In these morphological characters, we recognized three regional variations (Fig. 4). In those collected around Mt. Fuji including the type locality, the pygofer has the inner process bifurcate dorsally and centrally in the basal half; the ventral branch is forked near the base of process. The aedeagus usually has no process, but sometimes has a pair of tiny processes near the dorsal base (Fig. 41). In the central area of Shizuoka Prefecture, which is the western area of Mt. Fuji, the pygofer has the inner process bifurcate dorsally and centrally near the basal half of the process; the ventral branch is forked at the base of the process. The aedeagus often has a small process near dorsal base of aedeagus (Fig. 42). In the western part of the distributional range, the dorsal, central and ventral branches fork near the base of process. The pygofer lobe is slightly shorter than those from the other two localities. The aedeagus sometimes has the ventral projection shorter than the aedeagal shaft (Fig. 43). These three regional variations of male genitalia are usually distinguishable from each other, but several specimens show an intermediate condition.

**Body length (mean).** ♂, 8.0–9.0 mm (8.6 mm); ♀, 8.8–9.7 mm (9.2 mm).

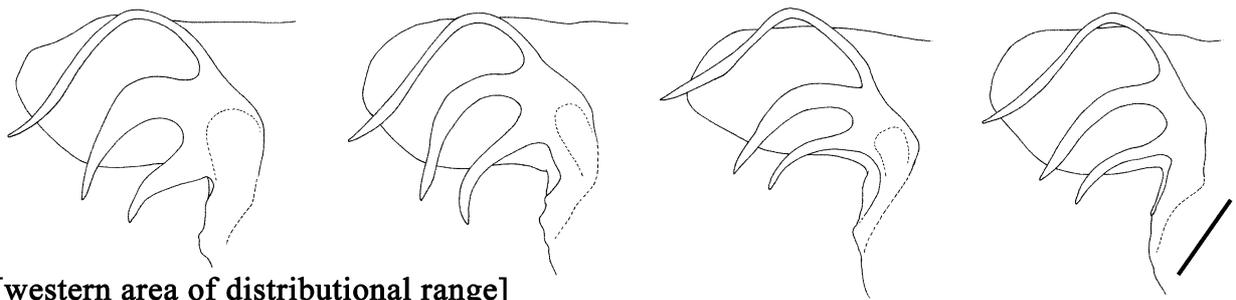
**Additional material.** [Shizuoka Pref.] 1♂ 1♀ (SUU), Myôjin-tôge Pass (alt. 900 m), Oyama, 23. VI. 1988, M. Hayashi; 3♂ 4♀ (SUU), same data except 19. VI. 2008, M. Hayashi *et al.*; 1♂ (SUU), same data except 12. VII. 2008; 2♂ 1♀ (SUU), Tarôbô (alt. 1,240 m), Gotenba, Mt. Fuji, 1. VIII. 1979, M. Hayashi; 2♂ 1♀ (SUU), same data except 30. VIII. 1990, M. Hayashi *et al.*; 3♂ 2♀ (SUU), Awakura (alt. 1,030 m), Fujinomiya, Mt. Fuji, 1. VII. 1991, M. Hayashi *et al.*; 1♂ 2♀ (SUU), same data except 17. VII. 1991; 2♂ (ELKU), Tanuki-ko, Inokashira, Fujinomiya, 12. VI. 2010, S. Okudera; 3♂ 5♀ (SUU), Kitamatsuno, Fuji, 30. V. 2006, S. Okudera; 1♂ (ELKU), Hikagezawa, Umegashima, Aoi-ku, Shizuoka, 8. VI. 2008, S. Okudera; 5♂ 7♀ (ELKU), Magosajima, Aoi-ku, Shizuoka, 9. VI. 2010, S. Okudera; 1♂ 5♀ (ELKU), Umegashima-Ôshiro, Aoi-ku, Shizuoka, 9. VI. 2010, S. Okudera; 2♂ (ELKU), Utogi, Aoi-ku, Shizuoka, 9. VI. 2010, S. Okudera; 1♂ 4♀ (ELKU), Hirano, Aoi-ku, Shizuoka, 8. VI. 2008, S. Okudera; 29♂ 8♀ (ELKU), Hirayama, Aoi-ku, Shizuoka, 8. VI. 2008, S. Okudera; 17♂ 16♀ (SUU),



[around Mt. Fuji]

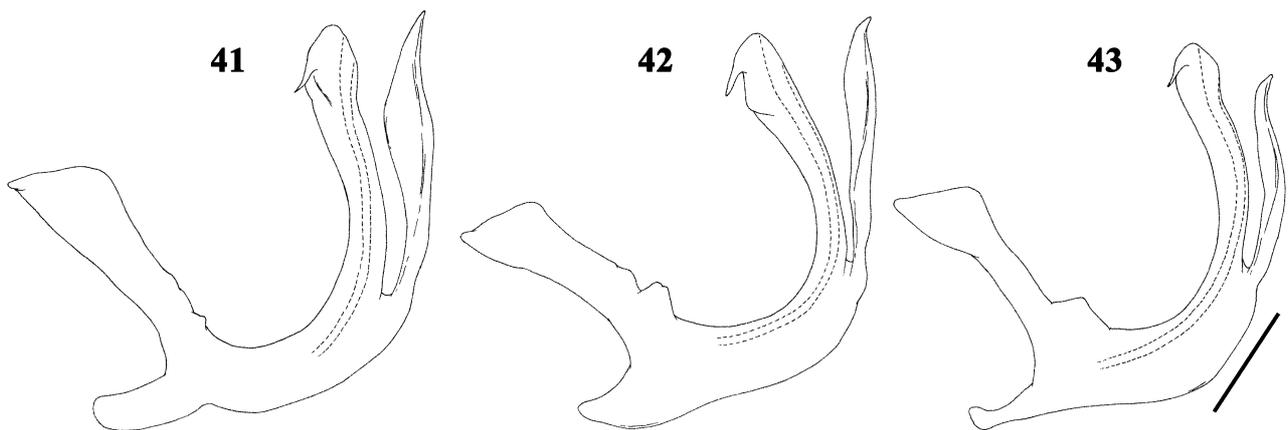


[central area of Shizuoka Prefecture]



[western area of distributional range]

FIGURE 40. Left inner pygofer process of *Pagaronia tridens*. Scale; 0.3 mm



FIGURES 41–43. Aedeagus of *Pagaronia tridens* in lateral view. Scale; 0.3 mm

Mt. Monju-dake, Aoi-ku, Shizuoka, 14. VI. 2004, S. Okudera; 1♂ (SUU), Okusenmata, Aoi-ku, Shizuoka, 12. VI. 2004, S. Okudera; 2♂ (ELKU), Yokosawa, Aoi-ku, Shizuoka, 9. VI. 2008, S. Okudera; 2♂ 7♀ (ELKU), Sakamoto, Aoi-ku, Shizuoka, 10. VI. 2010, S. Okudera; 4♂ 5♀ (ELKU), Ashikubo-kuchigumi, Aoi-ku, Shizuoka, 8. VI. 2008,

S. Okudera; 5♂ 4♀ (ELKU), Shinma, Aoi-ku, Shizuoka, 10. VI. 2010, S. Okudera; 9♂ 7♀ (ELKU), Ôhira, Shimizu-ku, Shizuoka, 25. V. 2009, S. Okudera; 1♂ 1♀ (ELKU), Taru Pass, Nakagôchi, Shimizu-ku, Shizuoka, 25. V. 2009, S. Okudera; 4♂ 2♀ (ELKU), Nakagôchi, Shimizu-ku, Shizuoka, 25. V. 2009, S. Okudera; 4♂ 2♀ (SUU), Nishizato, Shimizu-ku, Shizuoka, 14. VII. 2004, S. Okudera; 4♂ 3♀ (ELKU), Yoshiwara, Shimizu-ku, Shizuoka, 25. V. 2009, S. Okudera; 2♂ 2♀ (SUU), Tokura, Shimizu-ku, Shizuoka, 28–29. V. 1990; 2♀ (SUU), same data except 18–19. VI. 1990 (collector unknown); 2♂ 1♀ (ELKU), Nihondaira, Shimizu-ku, Shizuoka, 22. V. 2008, S. Okudera. [Yamanashi Pref.] 1♂ (SUU), Manzawa, Nanbu, 29. V. 2006, S. Okudera.

**Distribution.** Japan (central Honshu: Shizuoka and Yamanashi Prefectures).

### *Pagaronia conformata* M.Hayashi & Yoshida, 1995

(Fig. 4)

*Pagaronia conformata* Hayashi & Yoshida, 1995: 82, figs. 39, 43, 54–62.

**Remarks.** This species is characterized by the remarkable nigrescent areas on the pronotum and clavus of fore wing, and it has been known only from Mt. Amagi of the Izu Peninsula, central Honshu (Hayashi & Yoshida, 1995). A new locality near Mt. Amagi is here recorded.

**Body length (mean).** ♂, 8.7–9.0 mm (8.9 mm); ♀, 9.2–9.7 mm (9.5 mm).

**Additional material.** [Shizuoka Pref.] 3♂ 4♀ (SUU), Fujimidai, Hiekawa, Izu, 4. VI. 2007, M. Hayashi *et al.*

**Distribution.** Japan (central Honshu: Shizuoka Prefecture).

### *Pagaronia lanceolata* sp. nov.

(Figs. 3, 4, 7, 44–54)

**Description.** *Coloration & external morphology.* Head and thorax ochraceous with fuscous markings; frontoclypeus with 3 small black spots on dorsal angle (central spot often slightly larger); fore wing pale ochraceous, widely infuscate at apical and posterior margins. Head swollen anteriorly, 2.2 times as wide as long; pronotum weakly obscured near posterior margin, 1.2 times as long as head; female 7th abdominal sternum pentagonal, 0.9 times as long as wide, with caudal margin produced posteriorly and slightly emarginate at middle.

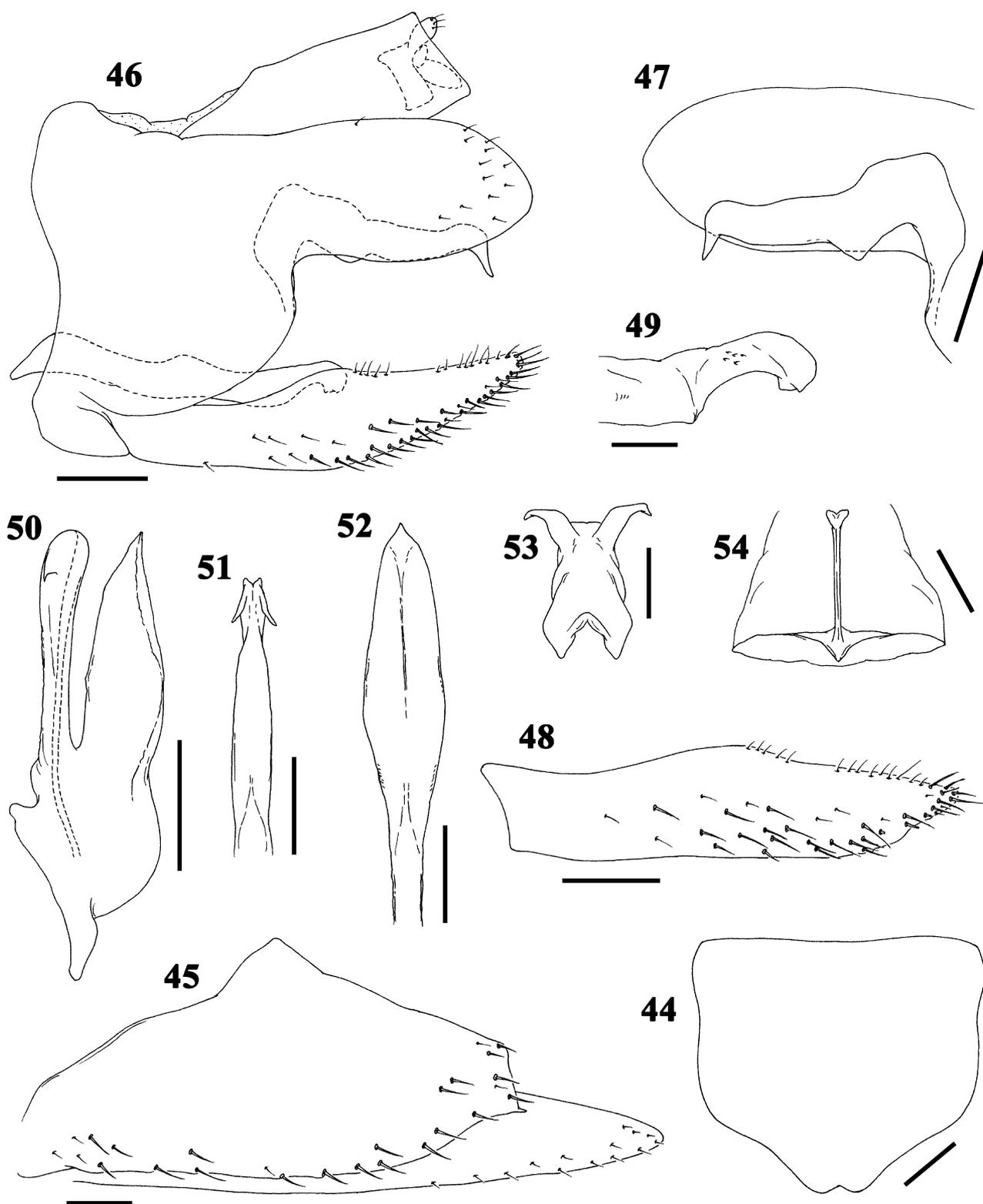
*Male genitalia.* Pygofer lobe slender, furnished with about 10 short setae near caudal margin, narrowed near base and weakly sinuate at ventral margin, with inner process not forked; inner process long and robust, almost straight but bent at apical 1/6, parallel to ventral margin of pygofer lobe, protruding beyond caudal margin. Subgenital plate oblong, 4.2 times as long as wide, bearing many macrosetae on distal 2/3. Style slightly bent dorsad near apex, with tip slightly hooked ventrad; apex of style reaching about half length of subgenital plate. Aedeagus robust; dorsal apodeme very small; shaft slightly widened at apex in lateral view, with widened ventral projection and pair of apical processes; ventral projection tectiform, as long as shaft, distinctly wider than shaft and 3 times as wide as shaft; apical process very short; gonopore apical on ventral surface.

**Body length.** ♂, 9.0 mm; ♀, 9.6 mm.

**Type material.** *Holotype:* ♂ (SUU), Dôdaira, Tennoji-one, Tanzawa Mts., Kanagawa Pref., Honshu, Japan, 17. VII. 1993, K. Takahashi. *Paratype:* [Kanagawa Pref.] 1♀ (SUU), Mt. Ôyama, Tanzawa Mts., 14. VII. 1980, M. Hayashi. The holotype is deposited in the Department of Biology, Faculty of Education, Saitama University, Saitama, Japan.

**Distribution.** Japan (central Honshu: Kanagawa Prefecture).

**Remarks.** This species is similar to *Pagaronia conformata* in habitus, but differs in the shape of the inner pygofer process and ventral projection of the aedeagus. Furthermore, it is also somewhat similar to *P. spinosa* in the situation of the inner pygofer process, but differs in having the inner pygofer process wider, the dorsal apodeme of aedeagus very small, and the ventral projection of the aedeagus short and much widened. This condition of the aedeagus is unique within the *protecta*-group.



**FIGURES 44–54.** *Pagaronia lanceolata* sp. nov., ♀ abdominal terminalia (44–45) and ♂ genitalia (46–54). — 44, 7th abdominal sternum; 45, ♀ pygofer in lateral view; 46, ♂ pygofer in lateral view; 47, left inner pygofer process; 48, left subgenital plate; 49, apical part of left style; 50, aedeagus in lateral view; 51, shaft in dorsal view; 52, ventral projection in caudal view; 53–54, apical part of shaft (53) and ventral projection (54) in apical view. Scales; 0.3 mm (44–48, 50), 0.2 mm (51, 52), 0.1 mm (49) and 0.05 mm (53, 54).

***Pagaronia spinosa* Y.Hori, 1994**

(Figs. 4, 55–57)

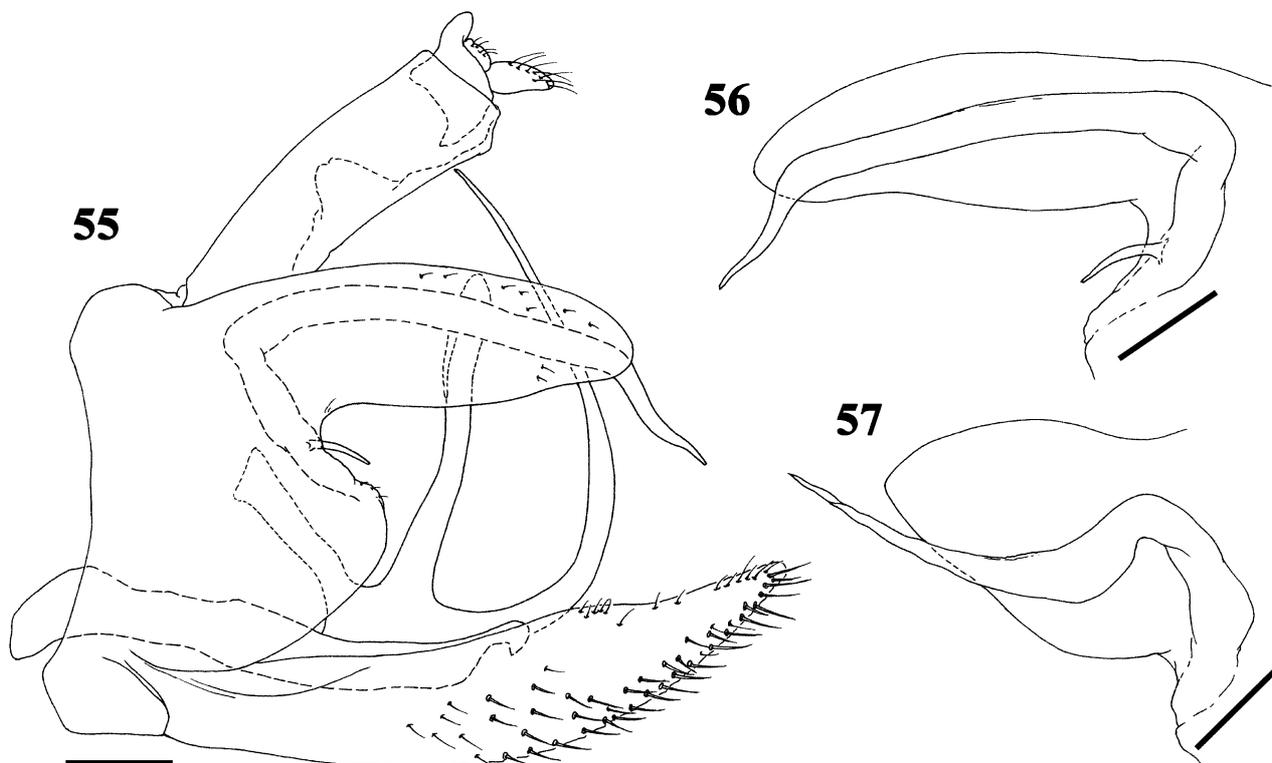
*Pagaronia spinosa* Hori, 1994: 156, figs. 8–14.

**Taxonomic note.** This leafhopper had been known from four localities in Aichi Prefecture, and it was previously reported that the fuscous marking of the fore wing is sometimes obscure (Hori, 1994). Through our research, eleven localities in three prefectures are newly recorded, and some variations in the shape of male genitalia are recognizable. This species is unique in the structure of the male genitalia. The inner pygofer process is very long and the short ventral branch is forked near the base of the process. The shaft of the aedeagus is slender and has a very long spine-like ventral projection (Figs. 55, 56). Two males collected from northeasternmost localities, Bungui Pass and Ôkawara, are slightly different from the others in the pygofer lobe and inner pygofer process; the pygofer lobe is shorter and wider; the inner process has no ventral branch and is directed dorsally (Fig. 57).

**Body length (mean).** ♂, 8.5–9.5 mm (8.8 mm); ♀, 9.0–9.6 mm (9.4 mm).

**Additional material.** [Nagano Pref.] 1♂ 2♀ (SUU), Bungui Pass, Haseichi-nose, Ina, 4. VII. 2006, S. Okudera; 1♂ (ELKU), Ôkawara, Ôshika, 11. VI. 2010, S. Okudera; 1♂ (SUU), Chisato, Achi, 8. VI. 2005, S. Okudera; 4♂ 5♀ (SUU), Namiai, Achi, 6. VII. 2006, S. Okudera; 1♂ (SUU), Wagô, Anan, 8. VI. 2005, S. Okudera. [Gifu Pref.] 1♂ 5♀ (ELKU), Yamaokachô-tashiro, Ena, 28. V. 2009, S. Okudera. [Aichi Pref.] 2♂ 3♀ (SUU), Furikusa, Tôtei, 8. VI. 2005, S. Okudera; 4♂ 1♀ (ELKU), Higashi-sonome, Tôtei, 27. V. 2009, S. Okudera; 3♂ 4♀ (SUU), Damine, Shitara, 26. VI. 2007, S. Okudera; 2♂ (ELKU), Ônumachô, Toyota, 28. V. 2009, S. Okudera; 4♂ 1♀ (ELKU), Ôdairachô, Toyota, 28. V. 2009, S. Okudera.

**Distribution.** Japan (central Honshu: Nagano, Gifu and Aichi Prefectures).



**FIGURES 55–57.** *Pagaronia spinosa*, ♂ genitalia (55–57). — 55, pygofer in lateral view; 56–57, left inner pygofer process. Scales; 0.3 mm.

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## References

- Anufriev, G.A. & Emeljanov, A.F. (1988) Homoptera Cicadinea (Auchenorrhyncha). *Key to Insects of Far East USSR*, 2, 12–495.
- Hayashi, M., & Arai, K. (1990) Five new species of the genus *Pagaronia* Ball (Homoptera, Cicadellidae-Cicadellinae) from central Honshu. *Esakia*, special issue (1), 5–13.
- Hayashi, M., Kamitani, S. & Yoshida, K. (2005) High diversification of *Pagaronia* leafhoppers (Cicadellidae, Cicadellinae, Pagaroniini) in East Asia. *Abstracts of Talks and Posters, 12th International Auchenorrhyncha Congress, Berkeley*, P-20.
- Hayashi, M., Kamitani, S., Okudera, S. & Yoshida, K. (2010) Biodiversity and Species-Group Classification of East Asian *Pagaronia*. *Abstracts of Talks and Posters, 13th International Auchenorrhyncha Congress, Vaison-la-Romaine*, pp. 118–119.
- Hayashi, M. & Okudera, S. (2007) Six new species of the leafhopper genus *Pagaronia* (Auchenorrhyncha, Cicadellidae, Evacanthinae) from Japan. *Japanese Journal of Systematic Entomology*, 13, 321–331.
- Hayashi, M., & Okudera, S. (2009) Six new evacanthine leafhoppers of the genus *Pagaronia* Ball (Auchenorrhyncha, Cicadellidae) from western Japan. *Japanese Journal of Systematic Entomology*, 15, 159–169.
- Hayashi, M. & Yoshida, K. (1995) New species of the genus *Pagaronia* (Homoptera, Cicadellidae, Cicadellinae) from Japan. *Japanese Journal of Systematic Entomology*, 1, 73–93.
- Hori, Y. (1994) Three new species of the genus *Pagaronia* from Mt. Ena-san and Mt. Chausu-yama, central Japan (Homoptera: Cicadellidae). *Transactions of the Shikoku Entomological Society*, 20, 155–160.
- Huh, E.Y. & Kwon, Y.J. (1994) Systematic and biogeographic studies on the subfamily Cicadellinae from Korea (Homoptera: Cicadellidae). *Insecta Koreana*, 11, 99–159.
- Imai, A. (2010) Four new species of the genus *Pagaronia* belonging to the *harpagonis*-group (Auchenorrhyncha, Cicadellidae, Evacanthinae) from Shikoku. *Journal of Systematic Entomology*, 16, 115–122.
- Metcalf, Z.P. (1963) General Catalogue of the Homoptera. Fascicle VI. Cicadelloidea. Part 6. Evacanthidae. U.S. Department of Agriculture, Agriculture Research Service. 63 pp.
- Okada, T. (1978) Twelve new species of *Pagaronia* Ball (Homoptera, Cicadellidae) from Japan. *Kontyû, Tokyo*, 46, 371–384.