



## The identity of *Psychomyia nipponica* Tsuda (Trichoptera: Psychomyiidae), with descriptions of five allied new species from Japan

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### Abstract

*Psychomyia nipponica* Tsuda is a commonly occurring species in Japan, and widely distributed throughout Honshu Island and southwestern Hokkaido Island. The male has very characteristic genitalia that allow its easy separation from other species of the genus. My recent study on the Japanese *Psychomyia*, however, revealed the presence of several undescribed species closely similar to and possibly confused with *P. nipponica*. In this paper I redescribe *P. nipponica* to resolve taxonomic confusion and describe five new species of the genus from Japan: *P. pseudonipponica* sp. nov., *P. curvicacumen* sp. nov., *P. incisa* sp. nov., *P. serrata* sp. nov. and *P. quadridentata* sp. nov.

**Key words:** caddisfly, taxonomy, male genitalia, *Psychomyia nipponica* Species Complex

### Introduction

Six species of the genus *Psychomyia* are known from Japan: *P. acutipennis* Ulmer 1908, *P. armata* Schmid 1964, *P. billnis* (Kobayashi 1987), *P. flavida* Hagen 1861, *P. morishitai* Tsuda 1942, *P. nipponica* Tsuda 1942 (Tanida 2005, 2018). Of these *P. nipponica* is widely distributed and commonly collected in Honshu Island and southwestern Hokkaido Island of Japan (Tanida 2018). The male is easily identified by the broad triangular preanal appendages, the apically widened lateral branches of the inferior appendages and the reflexed apex of the phallus. In my recent study, however, I found five undescribed species of *Psychomyia*, which are very similar to *P. nipponica* in the overall morphology of male genitalia and may be confused with *P. nipponica*. In this paper, therefore, I redescribe *P. nipponica* to resolve taxonomic confusion and describe the five new species from Japan.

### Material and methods

Specimens for this study were mostly collected in Honshu and Shikoku Islands of Japan by the author with a light trap and supplemented with material from colleagues; material of *P. nipponica* from Hokkaido Island was donated by the late Toshio Hattori. The illustrations of genitalia are made from specimens prepared for examination by clearing their abdomens in a solution of 10% KOH. In this paper male genitalia are illustrated and described for all six species. I have many series of associated females but have not included them because females of this species complex are extremely similar to each other. Although Ito *et al.* (2010) illustrated the female genitalia of *P. nipponica*, further examination of female genital structures is needed for species discrimination. Morphological terminology follows that of Hur and Morse (2006), with the exception of the term “intermediate branch” which is used here for the processes projecting from mesal branches of inferior appendages.

Holotypes and some paratypes are deposited in the Lake Biwa Museum, Shiga (LBM); the remaining paratypes and other specimens examined are in the author’s personal collection (HNC). Most material is preserved

in alcohol, except for the collection by Toshio Hattori, whose specimens are dry and pinned. Three frequently occurring collector's names are abbreviated as follows: HN, H. Nishimoto; ST, S. Tsukaguchi; TH, T. Hattori.

### Definition of *P. nipponica* Species Complex

The *Psychomyia nipponica* Species Complex, consisting of *P. nipponica* and five new species, is characterized by the following diagnostic features in the male genitalia: Tergum IX+X semimembranous, elongate-semicircular in lateral view; inferior appendages single-segmented, each bearing clavate lateral branch and caudally elongate mesal branch, sometimes with an additional intermediate branch near base or middle of mesal branch; preanal appendages broad, with variously shaped projections; phallus curved ventrad, with apex variously directed. The males of the six species of the *Psychomyia nipponica* species complex are very similar in overall morphology, but distinguished by detailed structures of the inferior appendages, preanal appendages, and phallus.

### *Psychomyia nipponica* Tsuda

(Figs. 1, 2)

*Psychomyia nipponica* Tsuda 1942, 272–273, fig. 31; Tanida, 2005, 468, fig. 32.3; Ito *et al.*, 2010, 60, fig. 3; Tanida, 2018, 550, fig. 46.3.

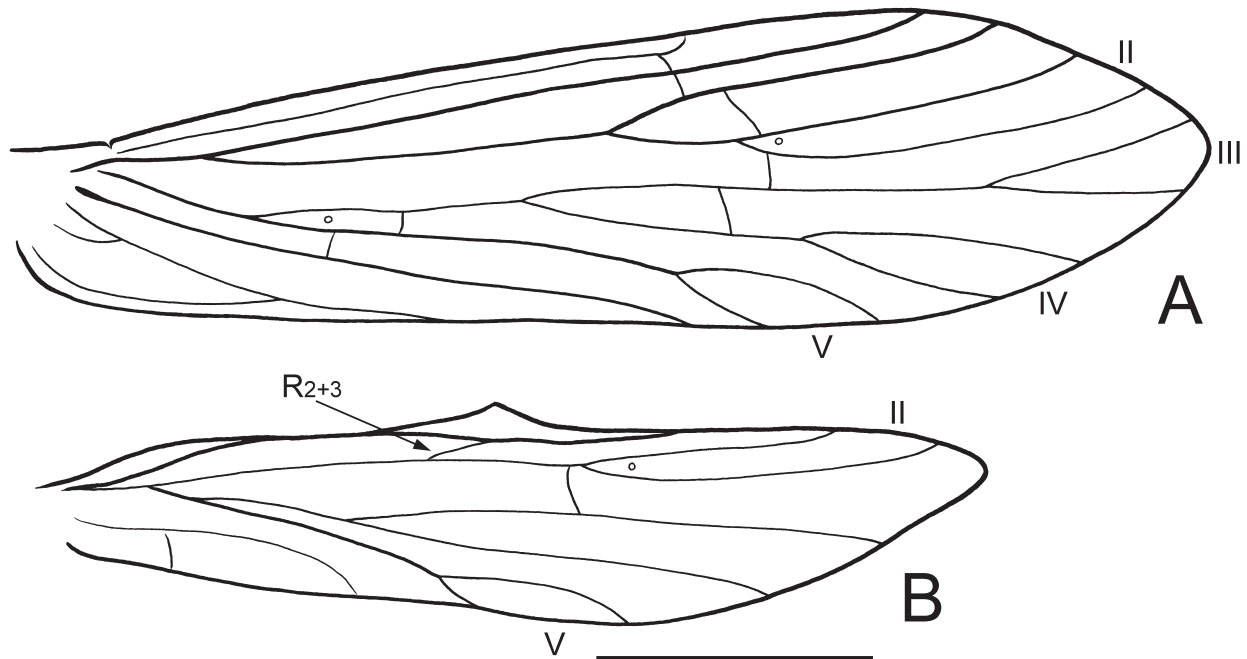
This species can be distinguished from other species in the *P. nipponica* Complex by the shape of the inferior appendages. The inferior appendages each have a short, ventrolaterally curved intermediate branch. The apically bifurcated preanal appendages and the hook-like apex of the phallus are characteristic of this species; however, similar features are observed in *P. pseudonipponica*.

**Male.** General appearance as in other males of *Psychomyia*. Forewing length 3.5–4.0 mm (n = 6). Forewings yellowish brown and hind wings pale yellowish; wing venation (Fig. 1) as in *Psychomyia poltavkaensis* (Hur & Morse 2006, figs. 5, 6), forewings with forks II, III, IV, and V; hind wings with forks II and V, R2+3 short and ending on Sc.

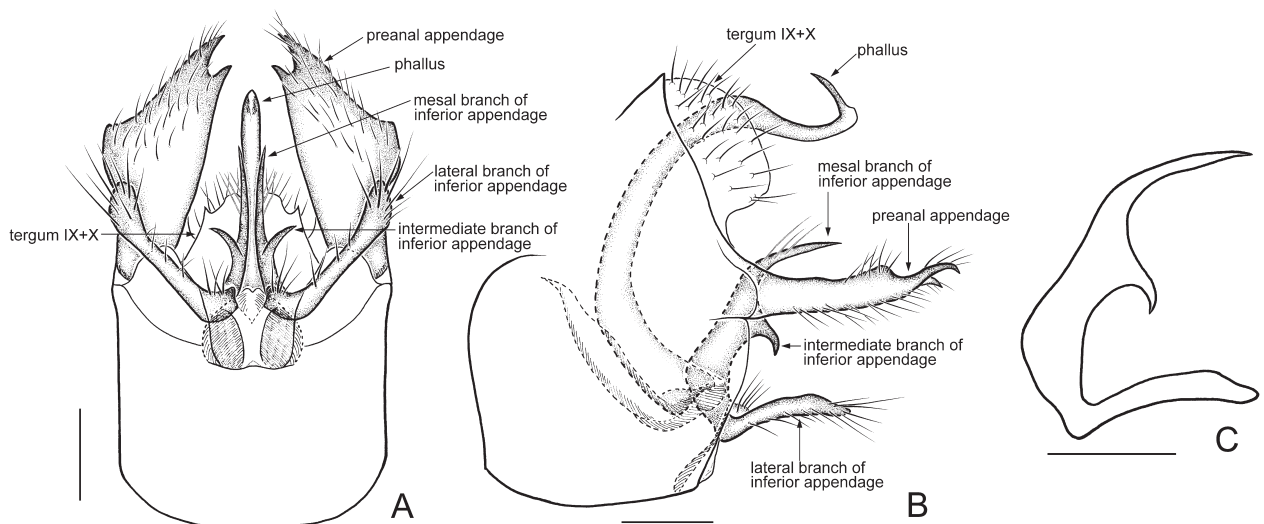
**Genitalia** (Fig. 2). Tergum IX+X composed of a pair of semimembranous plates, elongate-semicircular in lateral view. Lateral branch of each inferior appendage with apex angularly widened, about as long as mesal branch in ventral view; mesal branch weakly flattened laterally, gradually curved posterad in lateral view, with apex acuminate; intermediate branch arising from midlength of mesal branch, about 1/3 length of posterior mesal branch after forking, and slightly curved ventrolaterad. Preanal appendages subtriangular in dorsal and ventral views, each with weakly concave posterior margin; apex bifurcate with distal prong lightly darkened and slightly hooked. Phallus slightly flattened laterally (compressed), strongly arched throughout its length with upwardly reflexed and sharply pointed apex.

**Specimens examined.** Japan, Hokkaido: 2 males, Kamiiso-gun, Shiriuchi-cho, Yuno-kawa (alt. 60 m), 8–13.vii.1976, T. Kumata *et al.* (Hattori collection); 1 male, Kamiiso-gun, Shiriuchi-cho, Jorai (alt. 50–250 m), 8–13.vii.1976, T. Kumata *et al.* (Hattori collection); 1 male, Kamiiso-gun, Shiriuchi-cho, Idesu R. (alt. 150 m), 8–13.vii.1976, T. Kumata *et al.* (Hattori collection). Honshu, Niigata: 1 male, Murakami-shi, Chinawa, Miomote-chosuichi (alt. 130 m), 10.ix.2003, TH & T. Ito. Yamanashi: 1 male, Minamikoma-gun, Minobu-cho, Aimata, 4.viii.1990, TH. Shizuoka: 1 male, Izu-shi, Kumasaka, 14.v.1995, TH; 1 male, Izunokuni-shi, Nagaoka, 4.x.1986, HN. Gifu: 1 male, Ibi-gun, Ibigawa-cho, Kadonyu, 17.vii.1992, F. Nishimoto; 24 males, Nakatsugawa-shi, Naegi, 18.ix.2010, HN. Aichi: 4 males, Shinshiro-shi, Furi, Kansa-gawa, 1.x.1993, HN; 6 males, Shinshiro-shi, Aigo, Kansa-gawa, 14.vii.1991, HN & F. Nishimoto; 1 male, same locality, 3.vii.1993, HN; 48 males, same locality, 4.vii.1998, HN; 32 males, same locality, 15.vii.1999, HN; 54 males, same locality, 9.vi.2001, HN; 35 males, same locality, 15.ix.2007, HN; 19 males, Shinshiro-shi, Shiose, Shimada-gawa, 5.ix.1998; 3 males, Shinshiro-shi, Tsukudemoriyoshi, Tokaizu-gawa, 22.ix.2013, HN; 2 males, Shinshiro-shi, Toyooka, Ichinose, Otsutani-gawa, 29.vi.2013, HN; 84 males, Kitashitara-gun, Shitara-cho, Tanaiyonma, Yonma-gawa, 1.vii.2007, HN; 9 males, Kitashitara-gun, Toei-cho, Shimoda, Oochise-gawa, 14.ix.2013, HN; 16

males, Toyota-shi, Kugyudaira-cho, Tomoe-gawa, 12.v.2006, HN; 1 male, Toyota-shi, Inabu-cho, Iyama-gawa, 25.ix.2008, HN; 73 males, Toyota-shi, Kawate-cho, Nagura-gawa, 23.v.2008, HN; 24 males, Toyota-shi, Odo-cho, Yahagi-gawa, 12.vi.2010, HN; 1 male, Toyota-shi, Kusakabe-cho, 15.ix.2012, HN; 1 male, same locality, 15.x.2012, HN; 1 male, Toyota-shi, Mitsukuri-cho, 31.v.2013, HN; 8 males, Toyota-shi, Tatsuhara-cho, Kawai, 2.viii.2013, HN; 1 male, Okazaki-shi, Sakuragata-cho, 7.vi.1991, HN. Mie: 16 males, Watarai-gun, Watarai-cho, Miya-gawa, 4.v.2001, HN; 2 males, Matsusaka-shi, Ureshinoyashita-cho, Ioki-gawa, 3.x.2018, HN; 1 male, same locality, 14.x.2018, HN. Nara: 1 male, Yoshino-gun, Kawakami-mura, Shimotako, 23.ix.1984, HN.



**FIGURE 1.** Wing venation of *Psychomyia nipponica* Tsuda. 1A, right forewing, dorsal; 1B, right hind wing, dorsal. Scale bar = 1 mm.



**FIGURE 2.** Male genitalia of *Psychomyia nipponica* Tsuda. 2A, ventral; 2B, left lateral; 2C, left inferior appendage (outline), left lateral. Scale bars = 0.1 mm.

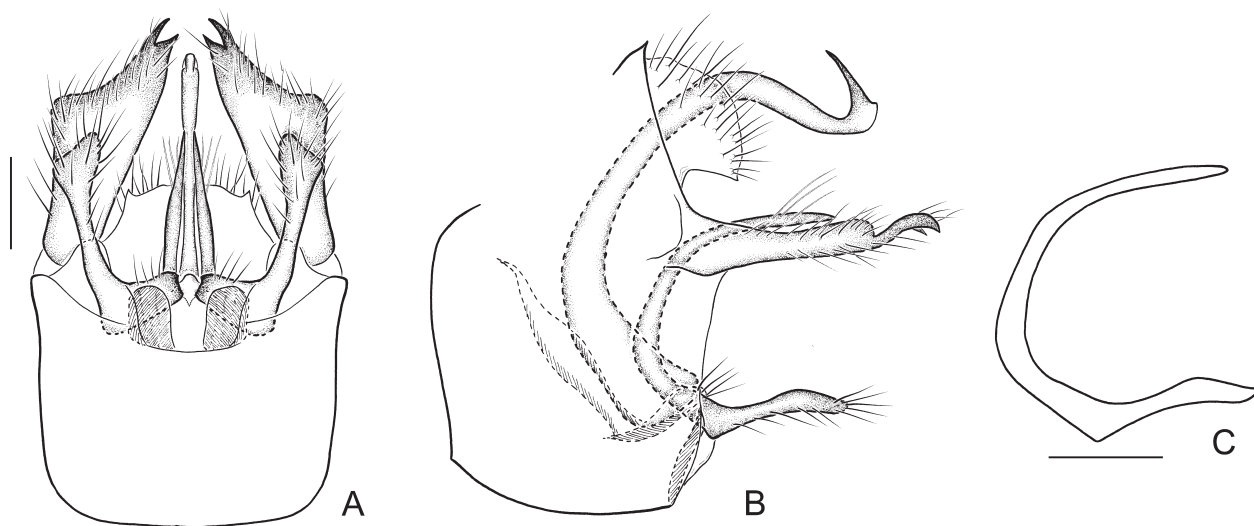
**Distribution.** This species has the widest distribution among the six species, occurring throughout Honshu Island and in southwestern Hokkaido Island.

**Remarks.** *Psychomyia nipponica* is very similar to *P. pseudonipponica* in having the phallus with upwardly reflexed and sharply pointed apex, and distinguished from the latter only by the shape of the mesal branches of the inferior appendages. Tsuda (1942) described *P. nipponica* based on the specimens collected in Kyoto and Nagano of Honshu Island. In his original description, he did not provide figures and description of the mesal branches of the inferior appendages. However, *P. nipponica* is allopatric with *P. pseudonipponica* which is confined to Shikoku Island and therefore the present species is identified as *P. nipponica*.

***Psychomyia pseudonipponica* sp. nov.**

(Fig. 3)

This species is most similar to *P. nipponica* and can be distinguished from it only by the absence of the intermediate branch of the inferior appendages. Both species share a bifurcated apex of the preanal appendages and upwardly reflexed, acute apex of the phallus, and therefore, they are easily confused with each other. However, these two species show an allopatric distribution with *P. nipponica* on Honshu and Hokkaido Islands and *P. pseudonipponica* on Shikoku Island.



**FIGURE 3.** Male genitalia of *Psychomyia pseudonipponica* new species. 3A, ventral; 3B, left lateral; 3C, left inferior appendage (outline), left lateral. Scale bars = 0.1 mm.

**Male.** General appearance as in other males of *Psychomyia*. Forewing length 3.8–4.9 mm (n = 6). Forewings yellowish brown and hind wings pale yellowish; wing venation as in *P. nipponica*.

Genitalia (Fig. 3). Tergum IX+X composed of a pair of semimembranous plates, elongate-semicircular in lateral view. Lateral branch of each inferior appendage with apex angularly widened, about as long as mesal branch in ventral view; mesal branch weakly flattened laterally (compressed), strongly curved and directed posterad in lateral view, with apex bluntly pointed; intermediate branch absent. Preanal appendages subtriangular in dorsal and ventral views, each with distinctly concave posterior margin; apex narrowly produced and bifurcated with distal prong heavily darkened and slightly hooked. Phallus slightly flattened laterally, strongly arched throughout its length with upwardly reflexed and sharply pointed apex.

**Type material.** Holotype male: Japan, Shikoku, Kochi: Kami-shi, Monobe-cho, Befu, Monobe-gawa, 16.vi.2017, HN (LBM). Paratypes: 26 males, same data as holotype (16 males in LBM, 10 males in HNC).

**Other specimens examined.** Japan, Shikoku, Kochi: 47 males, same data as holotype. Tokushima: 1 male, Anan-shi, Nakagawa-cho, 30.viii.1998, ST; 2 males, Anan-shi, Oi-cho, 2.vi.2016, HN; 13 males, Naga-gun, Naka-cho, Yokodani, Sakashukito-gawa, 3.vi.2016, HN. Ehime: 6 males, Kita-gun, Uchiko-cho, Yoshinogawa,



Miyanodani, 2.vii.1999, E. Yamamoto; 25 males, Kita-gun, Uchiko-cho, Teramura, 14.vi.1999, E. Yamamoto; 11 males, same locality, 2.vii.1999, E. Yamamoto.

**Etymology.** This species is named for its similarity to *P. nipponica*.

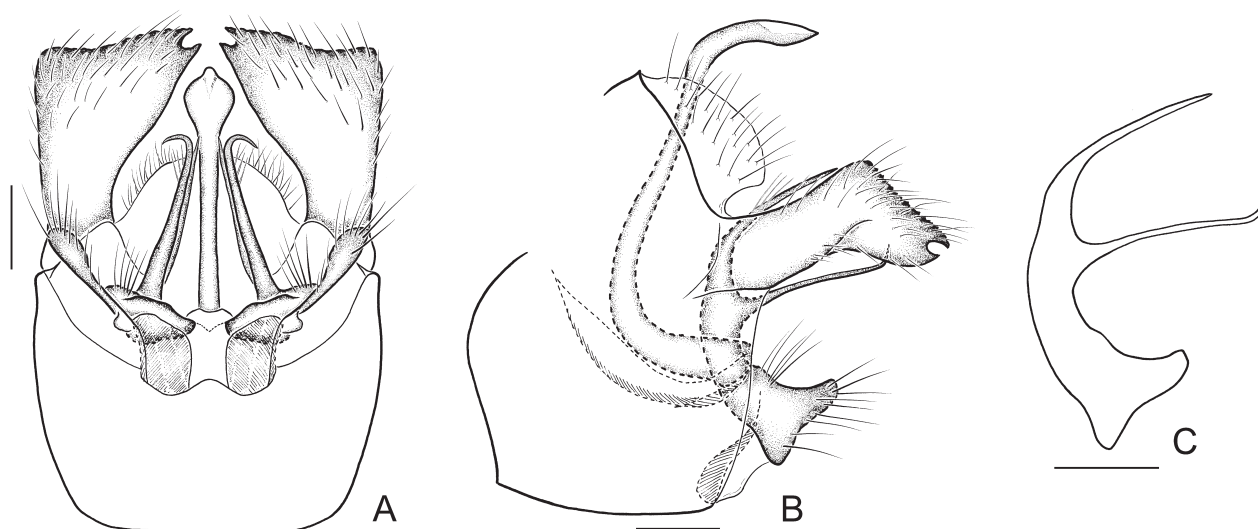
**Distribution.** This species is distributed only on Shikoku Island.

***Psychomyia curvicacumen* sp. nov.**

(Fig. 4)

This species is similar to *P. nipponica* and *P. pseudonipponica*, but easily distinguished from them by the shape of the mesal branches of the inferior appendages. The shape of the phallus is also different from that of those species, with the apex not reflexed in *P. curvicacumen* or in *P. serrata*.

**Male.** General appearance as in other males of *Psychomyia*. Forewing length 3.8–4.6 mm (n = 6). Forewings yellowish brown and hind wings pale yellowish; wing venation as in *P. nipponica*.



**FIGURE 4.** Male genitalia of *Psychomyia curvicacumen* new species. 4A, ventral; 4B, left lateral; 4C, left inferior appendage (outline), left lateral. Scale bars = 0.1 mm.

Genitalia (Fig. 4). Tergum IX+X composed of pair of semimembranous plates, elongate-semicircular in lateral view. Lateral branch of each inferior appendage thumb-like in lateral view, shorter than mesal branch; mesal branch slender, almost cylindrical, gently curved overall and directed posterad in lateral view, with apex acute; intermediate branch arising from about 1/3 of mesal branch, slender, slightly flattened laterally (compressed), somewhat longer than posterior mesal branch after forking, with apex acute and abruptly curved dorsolaterad. Preanal appendages triangular in dorsal and ventral views, each darkly pigmented and slightly concave on posterior margin; apex narrowly incised, forming two acute points. Phallus almost cylindrical, strongly curved near base and apex, with apex directed posterad; apical portion dorsoventrally compressed and laterally expanded with tip bluntly pointed.

**Type material.** Holotype male: Japan, Honshu, Fukui, Oi-cho, Natashonotai, Minami-gawa, 18.vi.2016, HN (LBM). Paratypes: 26 males, same data as holotype (16 males in LBM, 10 males in HNC).

**Other specimens examined.** Japan, Honshu, Fukui: 70 males, same data as holotype; 6 males, same locality, 6.vi.2010, HN; 1 male, Ono-shi, Mana-gawa, 25.v.2002, ST; 2 males, Katsuyama-shi, 14.vii.2003, ST; 1 male, Obama-shi, Takatsuka, 4–5.viii.2006, ST; 2 males, Obama-shi, Wakasa-cho, 12.x.2006, ST. Gifu: 13 males, Ibi-gun, Ibigawa-cho, Kadonyu, 17.vii.1992, F. Nishimoto; 1 male, Ibi-gun, Ibigawa-cho, Higashiyo-koyama, 5.vi.2004, HN; 3 males, same locality, 12.vi.2004, HN. Shiga: 5 males, Takashima-shi, Kamogawa-daira, 27.vi.1997, ST. Mie: 1 male, Inabe-shi, Hokusei-cho, 12.vi.1997, S. Morita.

**Etymology.** The specific name is derived from the abruptly curved apex of the intermediate branches of the inferior appendages.

**Distribution.** This species is collected on central Honshu Island. To date, *Psychomyia curvicacumen* is known from Gifu, Shiga, and Fukui.

***Psychomyia incisa* sp. nov.**

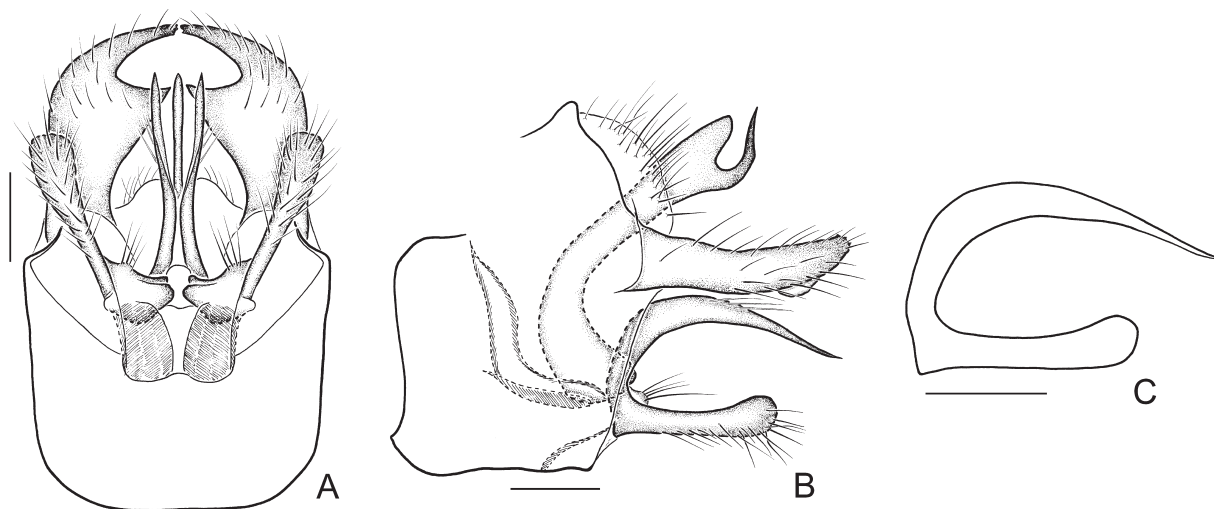
(Fig. 5)

*Psychomyia* sp. (aff. *nipponica*), Torii & Hattori 2006, 36.

This species resembles *P. nipponica*, *P. pseudonipponica*, and *P. curvicacumen*, but is clearly separated from them on the basis of the shapes of the mesal branches of the inferior appendages, the preanal appendages, and the phallus. The deeply notched preanal appendages are especially different from those of other members of the *P. nipponica* Species Complex and the configuration of the phallus apex is also characteristic.

**Male.** General appearance as in other males of *Psychomyia*. Forewing length 3.3–4.2 mm (n = 6). Forewings yellowish brown and hind wings pale yellowish; wing venation as in *P. nipponica*.

Genitalia (Fig. 5). Tergum IX+X composed of a pair of semimembranous plates, elongate-semicircular in lateral view. Lateral branch of each inferior appendage with apex roundly widened, shorter than mesal branch in ventral view; mesal branch weakly flattened laterally (compressed), slightly twisted basally, strongly curved and directed posterad in lateral view, gradually tapered apically with apex acute; intermediate branch absent. Preanal appendages rounded along lateral margins, each with posteromedial portion deeply notched and forming apically dentate distal process and sharply angled proximal process. Phallus flattened laterally (compressed), curved ventrad, with apex consisting of rounded upper process and upwardly curved, tapered lower process.



**FIGURE 5.** Male genitalia of *Psychomyia incisa* new species. 5A, ventral; 5B, left lateral; 5C, left inferior appendage (outline), left lateral. Scale bars = 0.1 mm.

**Type material.** Holotype male: Japan, Honshu, Shizuoka: Fujieda-shi, Setonoya, Seto-gawa, Bikuishi-shin-bashi, 7.ix.2007, HN (LBM). Paratypes: 5 males, same data as holotype (4 males in LBM, 1 male in HNC); 3 males, Fujieda-shi, Setonoya, Utouge-no-taki, 13.ix.2004, T. Torii (HNC).

**Other specimens examined.** Japan, Honshu, Shizuoka: 1 male, Shizuoka-shi, Suruga-ku, Mariko, Izumigaya, 19.vii.1989, TH; 3 males, same locality, 27.x.1989, TH; 2 males, Shizuoka-shi, Aoi-ku, Nyujima, Abe-kawa (alt. 375 m), 2.viii.1994, TH; 3 males, Shizuoka-shi, Aoi-ku, Tawarazawa, Abe-kawa (alt. 140 m), 28.vii.1994, TH; 4 males, Shizuoka-shi, Aoi-ku, Mizumiuro (alt. 150 m), 27.ix.1995, TH; 1 male, Shizuoka-shi, Aoi-ku, Yunoshima, Warashima-gawa (alt. 280 m), 15.x.1995, TH; 1 male, Shizuoka-shi, Aoi-ku, Nakahira, Abe-kawa (alt. 250 m), 25.vii.1998, TH. Aichi: 1 male, Shinshiro-shi, Yoshikawa, Dainyu-gawa, 1.vi.2008, HN; 1 male, Kitashitara-gun, Toei-cho, Shimoda, Ochise-gawa, 14.ix.2013, HN.

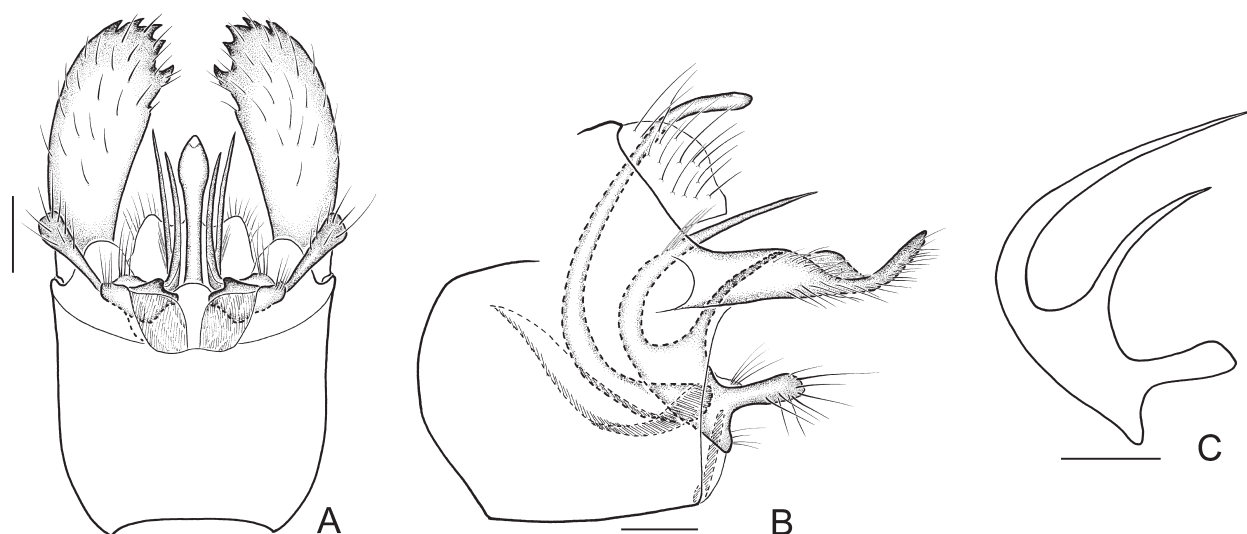
**Etymology.** The specific name is derived from the deeply notched preanal appendages.

**Distribution.** The distribution of this species is restricted so far to Shizuoka and adjacent eastern Aichi. *Psychomyia incisa* is commonly distributed in the Seto River system, Shizuoka (Torii & Hattori 2006).

***Psychomyia serrata* sp. nov.**

(Fig. 6)

This species is unique in the *P. nipponica* Species Complex in that the preanal appendages are not bifurcated or notched apically, but serrated along posterior margins. *Psychomyia serrata* resembles *P. curvicacumen* in having slender intermediate branches of inferior appendages, but in *P. serrata* the intermediate branches are shorter than the mesal branches and not curved apically. Moreover, both species have in common a simple phallus without a reflexed or forked apex, but the phallus of *P. serrata* is not strongly curved near the apex and its apex is more narrowly expanded than that of *P. curvicacumen*.



**FIGURE 6.** Male genitalia of *Psychomyia serrata* new species. 6A, ventral; 6B, left lateral; 6C, left inferior appendage (outline), left lateral. Scale bars = 0.1 mm.

**Male.** General appearance as in other males of *Psychomyia*. Forewing length 3.8–4.3 mm (n = 6). Forewings yellowish brown and hind wings pale yellowish; wing venation as in *P. nipponica*.

Genitalia (Fig. 6). Tergum IX+X composed of a pair of semimembranous plates, elongate-semicircular in lateral view. Lateral branch of each inferior appendage comparatively slender, evidently shorter than mesal branch in ventral view, with roundly widened apex and angular produced basal margin; mesal branch slender, almost cylindrical, strongly curved and directed posterad in lateral view, with apex acute; intermediate branch arising near base of mesal branch, slender, only slightly flattened, about 2/3 length of posterior mesal branch after forking, with apex acute. In ventral view, preanal appendages oval in overall shape, shallowly concave dorsally, each with 5 strong, acute, blade-like spines along posterior margin and small angulate projection located mesally. Phallus almost cylindrical, strongly curved near base and gently curved near apex, with apex directed posterad; apical portion dorsoventrally depressed and narrowly expanded laterally with tip bluntly pointed.

**Type material.** Holotype male: Japan, Shikoku, Tokushima: Naka-gun, Naka-cho, Yokodani, Sakashukito-gawa, 3.vi.2016, HN (LBM). Paratypes: 4 males, same data as holotype (3 males in LBM, 1 male in HNC). Kochi: 2 males, Kami-shi, Monobe-cho, Befu, Monobe-gawa, 16.vi.2017, HN (HNC).

**Other specimens examined.** Japan, Shikoku, Tokushima: 1 male, Naka-gun, Naka-cho, Kitosuke, 3.vi.2016, HN. Kochi: 2 males, Kami-shi, Monobe-cho, Befu, Monobe-gawa, 16.vi.2017, HN. Honshu, Wakayama: 1 male, Shingu-shi, 26.v.1997, ST; 1 male, same locality, 23.vii.1997, ST. Nara: 1 male, Totsugawa-mura, 25.v.2001, T. Murakami.

**Etymology.** The specific name is derived from the serrated posterior margins of the preanal appendages.

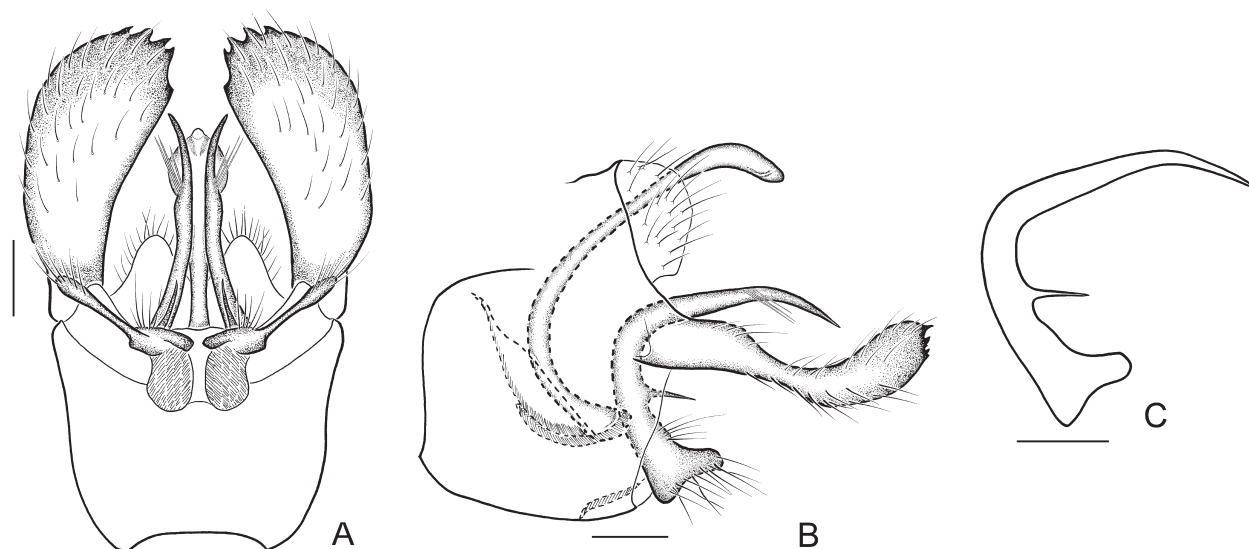
**Distribution.** This species is distributed on central Honshu (Kii peninsula) and Shikoku Islands.

***Psychomyia quadridentata* sp. nov.**

(Fig. 7)

This species is extremely similar to *P. serrata* in the shape of the preanal appendages, having serrated posterior margins, but it differs from the latter in the short intermediate branches of the inferior appendages and the number of blade-like spines on the posterior margins of the preanal appendages (4 spines in *P. quadridentata* and 5 spines in *P. serrata*).

**Male.** General appearance as in other males of *Psychomyia*. Forewing length 3.4–4.2 mm (n = 6). Forewings yellowish brown and hind wings pale yellowish; wing venation as in *P. nipponica*.



**FIGURE 7.** Male genitalia of *Psychomyia quadridentata* new species. 7A, ventral; 7B, left lateral; 7C, left inferior appendage (outline), left lateral. Scale bars = 0.1 mm.

Genitalia (Fig. 7). Tergum IX+X composed of a pair of semimembranous plates, elongate-semicircular in lateral view. Lateral branch of each inferior appendage slender, distinctly shorter than mesal branch in ventral view, with slightly broadened apex and roundly produced basal margin; mesal branch almost cylindrical, gradually tapering posteriorly but slightly thickened at middle in ventral view, strongly curved and directed ventroposterad in lateral view, with apex acute; intermediate branch arising near base of mesal branch, aciculate, distinctly short and about 1/5 length of posterior mesal branch after forking. In ventral view preanal appendages oval in overall shape, broadly concave dorsally, each with 4 small, acute, blade-like spines along posterior margin and small angulate projection located mesally. Phallus almost cylindrical, strongly curved near base and apex, with apex directed ventroposterad; apical portion dorsoventrally depressed and expanded laterally with tip rounded.

**Type material.** Holotype male: Japan, Honshu, Mie: Matsusaka-shi, Ureshinoyashita-cho, Ioki-gawa, 3.x.2018, HN (LBM). Paratypes: 26 males, same data as holotype (16 males in LBM, 10 males in HNC).

**Other specimens examined.** Japan, Honshu, Mie: 208 males, same data as holotype; 47 males, same locality, 14.x.2018, HN; 4 males, same locality, 20.x.2001, T. Mano.

**Etymology.** The specific name is derived from the four blade-like spines on the posterior margins of the preanal appendages.

**Distribution.** This species is only known from the type locality, Mie Prefecture, central Honshu Island.



## Acknowledgements

I cordially thank David E. Ruiter (Oregon) for his critical reading of the manuscript and assistance with English. My sincere thanks are due to the late Toshio Hattori (Shizuoka), a dignified caddisfly taxonomist, who kindly gave me the psychomyiid material in his collection during his lifetime. I also thank Tomiko Ito (Hokkaido Aquatic Biology, Hokkaido), Takaaki Torii (IDEA Consultants Inc., Shizuoka), Futaba Nishimoto (Aichi), Hisayuki Morita (Mie), Shigehiko Tsukaguchi (Hyogo), Toshiaki Murakami (Hyogo), and Takahiro Mano (Aichi) for their gifts of valuable material.

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