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RESEARCH PAPER

The Oleaceae-feeding lace bugs of the genus *Perissonemia* from Japan (Hemiptera: Heteroptera: Tingidae)

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Abstract. The present study revises the taxonomy of the lace bug genus *Perissonemia* Drake & Poor, 1937 (Hemiptera: Heteroptera: Tingidae: Tinginae) from Japan. Three species are recognized and (re)described: *P. occasa* Drake, 1942 from Honshu, *P. okinawensis* sp. nov. from the central part of the Ryukyu Islands, and *P. yaeyamensis* sp. nov. from the southern part of the Ryukyu Islands. Previous records of *P. occasa* from the central and southern parts of the Ryukyu Islands are confirmed as misidentifications of *P. okinawensis* sp. nov. and *P. yaeyamensis* sp. nov., respectively. The host plant relationships are discussed for *P. occasa* and *P. yaeyamensis* sp. nov. Photographs of living individuals of *P. occasa* and *P. yaeyamensis* sp. nov. are presented. A key is provided to facilitate the identification of the three species of *Perissonemia* distributed in Japan.

Key words. Hemiptera, Heteroptera, Tingidae, biology, host plant, identification key, new species, taxonomy, Japan, East Asia, Palaearctic Region

Zoobank: http://zoobank.org/urn:lsid:zoobank.org:pub:C9003335-99FA-427E-988A-4A3CC2A73E4A

Introduction

The lace bug genus *Perissonemia* Drake & Poor, 1937 (Hemiptera: Heteroptera: Tingidae) has been known only from the Old World, with 18 species distributed mainly in subtropical or tropical climates (cf. Drake & Poor 1937; Takeya 1962; Drake & Ruhoff 1965; Péricart 1985, 1986; Guilbert 2002). However, all species formerly treated as *Perissonemia* from the Afrotropical Region, now belong to other genera or are synonymized with species of other genera (cf. Linnavuori 1977; Duarte Rodrigues 1978, 1979, 1982a, b, 1987; Göllner-Scheiding 2004). In East Asia, five species have been recorded to date: *P. bimaculata* (Distant, 1909), *P. borneensis* (Distant, 1909), and *P. gressitti* Drake & Poor, 1936, all from China, *P. hasegawai* Takeya, 1962 from Taiwan, and *P. occasa* Drake, 1942 from Japan and China (Drake & Poor 1936, Drake 1942, Takeya 1962, Jing 1981, Péricart & Golub 1996, Tomokuni 2006). According to the published papers, the only Japanese species, *P. occasa*, is distributed in Honshu and the central and southern parts of the Ryukyu Islands, and feeds on evergreen oleaceous trees of the genus *Osmanthus* Lour. (Takeya 1962; Miyamoto 1964a,b,c; Nakano 1984; Tsukada 1995; Yamada & Tomokuni 2012; Yamada & Ishikawa 2016). Four evergreen oleaceous trees, *Osmanthus* × *fortunei* Carrière, *O. fragrans* Lour. var. *aurantiacus* Makino, *O. heterophyllus* (G.Don) P.S.Green, and *O. insularis* Koidz., are known to be food sources for *P. occasa*, but as host plants in the field, only two species, *O. heterophyllus* and *O. insularis*, are eaten by this lace bug in Honshu and the southern part of the Ryukyu Islands, respectively (Miyamoto 1964b, Nakano 1984, Tsukada 1995, Yamada & Tomokuni 2012). Therefore, the host plant for *P. occasa* in the central part of the Ryukyu Islands is unknown, and more field research in this region focusing on oleaceous plants is needed.

Although *P. occasa* has been known from a wide region of Japan, the distributional records from some regions are unreliable in terms of identification. The populations from the central and southern parts of the Ryukyu Islands in the literature (Miyamoto 1964a,b,c; Takara & Azuma 1972; Azuma & Kinjo 1987; Hayashi 2002; Yamada & Tomokuni 2012) differ from each other and from that of Honshu in general appearance. However, *P. occasa* was described from "Japan" in the original description (Drake 1942), and the detailed locality data and morphological information of the holotype are necessary to identify "true" *P. occasa*

to solve the aforementioned taxonomic problems.

In the present study, I identified "true" *P. occasa* as the populations from Honshu, based on the original description (Drake 1942) and photographs of the holotype (United States National Museum of Natural History 2021), and concluded that the populations of the central and southern part of the Ryukyu Islands consist of two undescribed species. In conclusion, I recognize and (re)describe three species of *Perissonemia* from Japan: *P. occasa* Drake, 1942 from Honshu; *P. okinawensis* sp. nov. from the central part of the Ryukyu Islands; and *P. yaeyamensis* sp. nov. from the southern part of the Ryukyu Islands. Previous records of *P. occasa* from the central and southern parts of the Ryukyu Islands correspond to *P. okinawensis* sp. nov. and *P. yaeyamensis* sp. nov., respectively. The host plants for *P. occasa* and *P. yaeyamensis* sp. nov. are *O. heterophyllus*, *O. insularis* and *O. marginatus* (Champ. ex Benth.) Hemsl. Photographs of living males and females of *P. occasa* and *P. yaeyamensis* sp. nov. are also presented. In addition, an identification key to the three Japanese species of *Perissonemia* is provided.

Material and methods

Dried specimens were used to observe morphological characteristics. To examine the genitalia, male terminalia were removed from the body after softening the specimens in hot water. The removed parts were immersed in a hot 15% KOH solution for 5 min and then soaked in 99% ethanol for further dissection. The male genitalia were observed by fixing the angles with a gel (Museum Gel Clear, Ready America, California, U.S.A) laid on the microscope slide and preserved in small polyethylene vials containing 50% glycerin and mounted on a pin with the respective specimens. Morphological characteristics were observed, illustrated, and measured using a stereoscopic microscope (SZ60; Olympus, Tokyo, Japan) equipped with an ocular grid. The measurements were obtained using a micrometer on an ocular grid. The specimens were photographed using digital microscopes (VHX-1100, Keyence, Osaka, Japan; Dino-Lite Premier M, Opto Science, Tokyo, Japan), and image stacks were processed using Adobe Photoshop 2021 ver.22.5.1 when using Dino-Lite Premier M. Photographs of living individuals and host plants were taken with a compact digital camera (Tough TG-6, Olympus, Tokyo, Japan) and a smartphone (iPhone 8, Apple, California, U.S.A.), respectively. Morphological terms were generally assigned in accordance with previous monographs (Drake & Davis 1960; Takeya 1962, 1963; Drake & Ruhoff 1965).

Abbreviations for the relevant institutions are as follows:

ELKU	Entomological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka, Japan;
KUM	Kyushu University Museum, Fukuoka, Japan;
NIAES	Institute of Agro-Environmental Sciences, NARO, Ibaraki, Japan;
NSMT	National Museum of Nature and Science, Ibaraki, Japan;
TUA	Laboratory of Entomology, Faculty of Agriculture, Tokyo University of Agriculture, Kanagawa, Japan;
USNM	United States National Museum of Natural History, Washington, D.C., U.S.A.

All specimens used in this study are deposited at ELKU, KUM, NIAES, NSMT, and TUA.

In accordance with a previous study (Takahashi et al. 2008), I refer to the Ryukyu Islands' north of the Tokara Tectonic Strait as the northern part, between the Tokara Tectonic Strait and the Kerama Gap as the central part, and south of the Kerama Gap as the southern part. Distribution records of species were mapped using SimpleMappr (Shorthouse 2010). Geographical coordinates were obtained from Google Maps (https://www.google.co.jp/maps). The map was edited using Adobe Photoshop 2021 ver.22.5.1. The scientific names of the host plants were assigned according to Yonekura & Kajita (2003–2021).

Taxonomy

Genus *Perissonemia* Drake & Poor, 1937

Perissonemia: Drake & Poor (1936): 439. Unavailable name.
Perissonemia Drake & Poor, 1937: 2. Type species by original designation: *Perissonemia torquata* Drake & Poor, 1937.

Diagnosis. Recognized among other tingid genera by a combination of the following characters: only macropterous morph known; body oblong; head shorter than its maximum width across compound eyes, generally with five spines (occasionally with two spines); total length of antenna longer than pronotum; antennal segments I close to each other at their bases; bucculae contiguous with each other at anterior ends; pronotum convex in anterior part, tricarinate; hood absent; collar raised towards its apex; pronotal carinae ridge-like; paranotum carinate at level of callus and humerus, not carinate in remaining parts; anterior margins of hemelytra nearly parallel to each other in rest; costal area of hemelytron distinct; subcostal area subhorizontal; discoidal area flat, extending beyond middle part of hemelytron; sutural area completely overlap each other in rest; hypocostal lamina with a single row of areolae throughout its length; Cu (cubital) vein distinct, carinate; R+M (radiomedial) vein distinct, carinate; ostiolar peritreme well-developed, oblong; metasternum narrower than mesosternum; meso- and metasternal laminae curved outward; abdominal sternites IV–VIII in male and IV–VII in female each with a transverse furrow throughout their width; pygophore flat on ventral surface; and ovipositor with well-developed ovivalvula at base.

Differential diagnosis. Among the Oriental tingid genera, *Perissonemia* strongly resembles *Eritingis* Drake & Ruhoff, 1962 and *Ulonemia* Drake & Poor, 1937 in general appearance. However, *Perissonemia* is easily distinguished from *Eritingis* and *Ulonemia* by the following characteristics: total length of antenna longer than pronotum (shorter in *Eritingis*); hood absent (sometimes present in *Ulonemia*); collar raised towards its apex (not raised in *Eritingis* and *Ulonemia*); and paranotum carinate at level of callus and humerus, not carinate in remaining parts (carinate in anterior half and not carinate in posterior half in *Eritingis*; carinate throughout its length in *Ulonemia*).

Perissonemia occasa Drake, 1942

(Figs 1A, B, 2A, B, 3A, 4A, 5A, 6A, 7A, 8A, D, 9A, D, 10A, B)

Perissonemia occasa Drake, 1942: 2. Holotype: ♂, Japan: "3/14 Harima" [= Honshu, southwestern part of Hyogo-ken, iii.1914] (USNM) (see United States National Museum of Natural History 2021).

Perissonemia occasa: Takeya (1951): 18 (checklist: Japan); Drake & Ruhoff (1961): 135 (distribution); Takeya (1962): 56 (distribution); Drake & Ruhoff (1965): 324 (catalog); Jing (1981): 311 (monograph); Nakano (1984): 482 (host plant); Miyamoto & Yasunaga (1989): 167 (checklist: Japan); Takahashi (1990): 3 (checklist: Hyogo Prefecture); Tsukada (1995): 49 (biology); Péricart & Golub (1996): 53 (catalog: Palaearctic); Yamada & Tomokuni (2012): 198 (monograph); Yamada & Ishikawa (2016): 432 (checklist: Japan).

Baeochila occasa: Lee (1969): 233 (male genitalia).

Material examined. Non-types (23 ♂♂ 22 ♀♀): **JAPAN: Honshu:** Gifu-ken, Nakatsugawa-shi, Shizumo-yama, 7.x.2018, leg. Y. Yazaki (1 ♀, TUA); Mie-ken, Tsu-shi, Misugi-cho, Shimonogawa, 18.–21.iv.2011, leg. T. Shimada & Y. Hirano (3 ♀♀, TUA); Kyoto, Kitashirakawa, Kyoto Univ., 28.vii.1994, leg. M. Tsukada (4 ♂♂ 4 ♀♀, NSMT – referring to Tsukada 1995); Prov. Harima [= southwestern part of Hyogo-ken], 2.vii.1906, leg. S. Iguchi (1 ♂ 1 ♀, ELKU – referring to Takeya 1962); Kobe [= Hyogo-ken, Kobe-shi], Oshibedani, Kizu, 8.viii.1982, leg. K. Nakano (1 ♀, NSMT – referring to Nakano 1984); Hyogo-ken, Kobe-shi, Suma-ku, Ote, 2.viii.2020, leg. M. Yamashita (4 ♂♂, TUA), as above but 7.vii.2021, leg. J. Souma (14 ♂♂ 12 ♀♀, TUA).

Diagnosis. Recognized among other species of *Perissonemia* by a combination of the following characters: body length 3.7–4.1 mm (Figs 1A, B, 2A, B); pronotal disc, posterior process and hemelytron except for areolae brown; frontal and median spines distinct (Fig. 3A); occipital spine reaching middle part of compound eye; buccula with 3 rows of areolae at highest part; rostrum not reaching beyond posterior margin of mesosternum (Fig. 7A); lateral carina of pronotum present on pronotal disc and posterior process (Fig. 4A); costal area of hemelytron more than 0.5 times as wide as subcostal area at widest part of each, with 2 rows of areolae in basal part and a single row (occasionally 2 rows in very small sections) in remaining parts (Fig. 5A); subcostal area less than 0.5 times as wide as discoidal area at widest part of each, with 3 rows of areolae at apex and 2 rows (occasionally 3 rows in very small sections) in remaining parts (Fig. 6A); discoidal area with 6 rows of areolae at widest part; sutural area with 7 rows of areolae at widest part; and anterior margin of pygophore weakly concave in middle part of dorsum (Fig. 9A).

Redescription. ***Male.*** Head, antennae, bucculae, pronotum, hemelytra except for most of areolae, legs and ventral surface brown; compound eye dark red; areolae of hemelytron except for sutural area translucent; pubescence on body yellowish (Figs 1A, 2A, 3A, 4A, 5A, 6A, 7A, 8A).

Body 3.3 times as long as maximum width across hemelytra (Fig. 1A). Head (Figs 3A, 4A, 7A) covered with pubescence; pair of frontal spines distinct, touching each other at apices, reaching apex of clypeus; median spine distinct, as long as frontal spines, reaching beyond bases of frontal spines; pair of occipital spines longer than median spine, reaching middle part of compound eyes; antenniferous tubercles obtuse, slightly curved inward; clypeus smooth. Lateral margin of compound eye round. Antenna covered with pubescence; segment I cylindrical; segment II conical, shortest among antennal segments; segment III longest among antennal segments; segment IV cylindrical, longer than segment I. Buccula with 3 rows of areolae throughout its length. Rostrum not reaching beyond posterior margin of mesosternum.

Pronotum (Figs 3A, 4A) 1.6 times as long as maximum width across humeri, glabrous. Pronotal disc coarsely punctate. Hood absent. Calli smooth, partly covered with wax. Collar with 2 rows of areolae throughout its width, with anterior margin slightly curved outward. Pronotal carinae without distinct areolae. Median carina straight, extending to apex of posterior process. Lateral carina present on pronotal disc and posterior process. Posterior process of pronotum triangular, obtuse at apex.

Hemelytron (Figs 2A, 5A, 6A) 2.7 times as long as its maximum width, extending beyond apex of abdomen, glabrous; maximum width across hemelytra 1.2 times as long as maximum width across humeri; costal area more than 0.5 times as wide as subcostal area at widest part of each, with 2 rows of areolae in basal part and single row (occasionally 2 rows in very small sections) in remaining parts; subcostal area less than 0.5 times as wide as discoidal area at widest part of each, with 3 rows of areolae at apex and 2 rows (occasionally 3 rows in very small sections) in remaining parts; discoidal area with 6 rows of areolae at widest part; sutural area with 7 rows of areolae at widest part.

Thoracic pleura (Fig. 2A) coarsely punctate. Prosternum (Fig. 7A) narrower than mesosternum. Sternal laminae lower than bucculae; anterior and posterior margins lower than lateral margin; prosternal lamina nearly straight, lower than mesosternal lamina; mesosternal lamina as high as metasternal lamina. Legs (Fig. 1A) smooth, covered with pubescence; femora thickest in middle.

Abdomen oblong in dorsal and ventral views. Pygophore (Figs 8A, 9A) compressed dorsoventrally, hexagonal in ventral view, covered with pubescence; anterior margin weakly concave in middle part of dorsum. Paramere (Fig. 9D) expanded in middle part, angularly curved inward in apical part; outer and inner margins covered with pubescence in middle part.

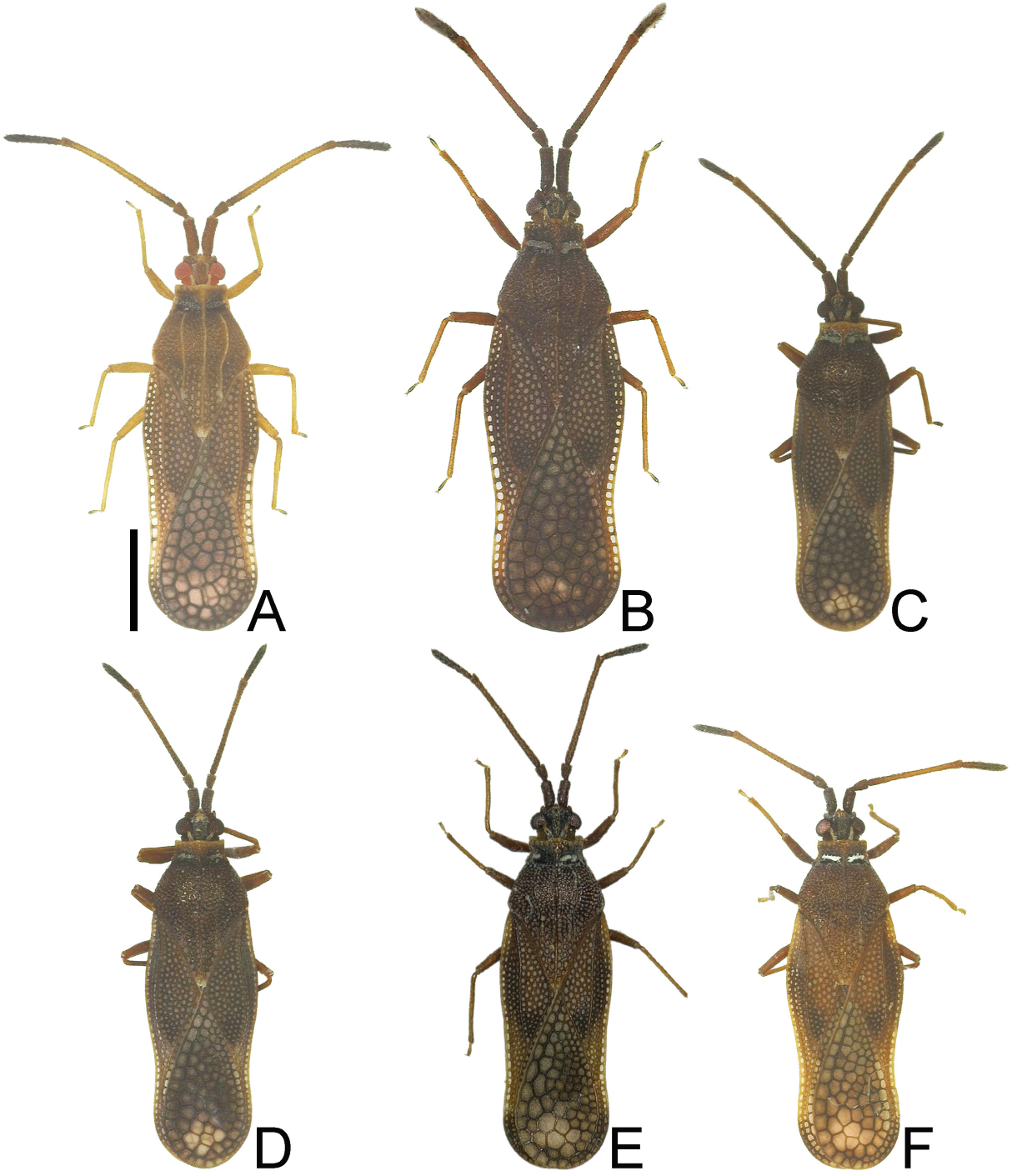
Measurements (n = 20). Body length with hemelytra 3.7–3.9 mm; maximum width across hemelytra 1.1–1.2 mm; length of antennal segments I to IV 0.3 mm, 0.1 mm, 1.2 mm, and 0.5 mm, respectively; pronotal length 1.5–1.6 mm; pronotal width across humeri 1.0 mm; hemelytral length 2.6–2.8 mm; maximum width of hemelytron 1.0–1.1 mm.

Female. General appearance very similar to that of male (Figs 1B, 2B, 8D) except for the following characters: body 3.2 times as long as maximum width across hemelytra; antennal segment III shorter than in male; maximum width across hemelytra 1.3 times as long as maximum width across humeri; terminalia pentagonal in ventral view.

Measurements (n = 20). Body length with hemelytra 3.7–4.1 mm; maximum width across hemelytra 1.2–1.4 mm; length of antennal segments I to IV 0.3 mm, 0.1 mm, 1.0–1.1 mm, and 0.5 mm, respectively; pronotal length 1.5–1.7 mm; pronotal width across humeri 1.0–1.1 mm; hemelytral length 2.6–2.9 mm; maximum width of hemelytron 1.0–1.1 mm.

Remark. Although the type locality of *P. occasa* was merely indicated as "Japan" (Drake 1942), the label on the holotype mentions "Japan: Harima" [= Japan: Honshu, southwestern part of Hyogo-ken] (United States National Museum of Natural History 2021). The morphological species from Honshu described above match well the holotype and the original description (Drake 1942) in terms of morphological characteristics. Consequently, "true" *P. occasa* was definitely described from Honshu.

Differential diagnosis. Among the East Asian species, *Perissonemia occasa* is most similar to *P. gressitti* in the morphological characteristics. However, based on a comparison between a number of non-type materials together with the photograph of the holotype of *P. occasa* (United States National Museum of Natural History 2021) and the original description (Drake & Poor 1936) together with the photographs of the holotype of *P. gressitti* (United States National Museum of Natural History 2021),



Figs 1A–F. Three species of *Perissonemia* from Japan, dorsal view: A, B – *P. occasa* Drake, 1942: A – male, B – female; C, D – *P. okinawensis* sp. nov.: C – male, D – female; E, F – *P. yaeyamensis* sp. nov.: E – male, F – female. Scale bar: 1.0 mm.

two main characteristics were recognized to differentiate *P. occasa* from *P. gressitti*; discoidal area of hemelytron with 6 rows of areolae at widest part (Fig. 5A) (5 rows in *P. gressitti*); and sutural area with 7 rows of areolae at widest part (6 rows in *P. gressitti*). Morphological differences between this species and the other two Japanese species are provided in the identification key below.

Host plant. *Osmanthus heterophyllus*, "Hiiragi" (Oleaceae) (Fig. 10C) (Nakano 1984, Tsukada 1995, Yamada & Tomokuni 2012; present study). *Perissonemia occasa* feeds only on this oleaceous plant in the field and is monophagous, similarly to many tingids (Schuh & Weirauch 2020). However, this lace bug sometimes occurs on planted *O. insularis* within its distribution range (Tsukada 1995) and feeds on *O.* × *fortunei* (a hybrid of *O. fragrans* and *O. heterophyllus*) and *O. fragrans* var. *aurantiacus* in captivity (Nakano 1984).

Biology. *Perissonemia occasa* feeds on the abaxial surface of the leaves of the aforementioned host plant (Tsukada 1995; present study), similarly to many tingids (Schuh & Weirauch 2020). This lace bug is considered to be univoltine (Tsukada 1995); adults were collected in almost all seasons (Drake 1942, Takeya 1962, Nakano 1984, Tsukada 1995; present study); nymphs were observed in June and July (Tsukada 1995); and the overwintering stage appears to be adult because of the holotype collected in March (cf. Drake 1942).

Distribution. Japan (Honshu) (Fig. 11) (Drake 1942; Takeya 1962; Nakano 1984; Tsukada 1995).

Previous records from China (Drake & Ruhoff 1961, Jing 1981) do not list the examined specimens and appear to be erroneous. *Perissonemia occasa* inhabits laurilignosa in the temperate climate of Honshu, which is located in the Palaearctic Region.

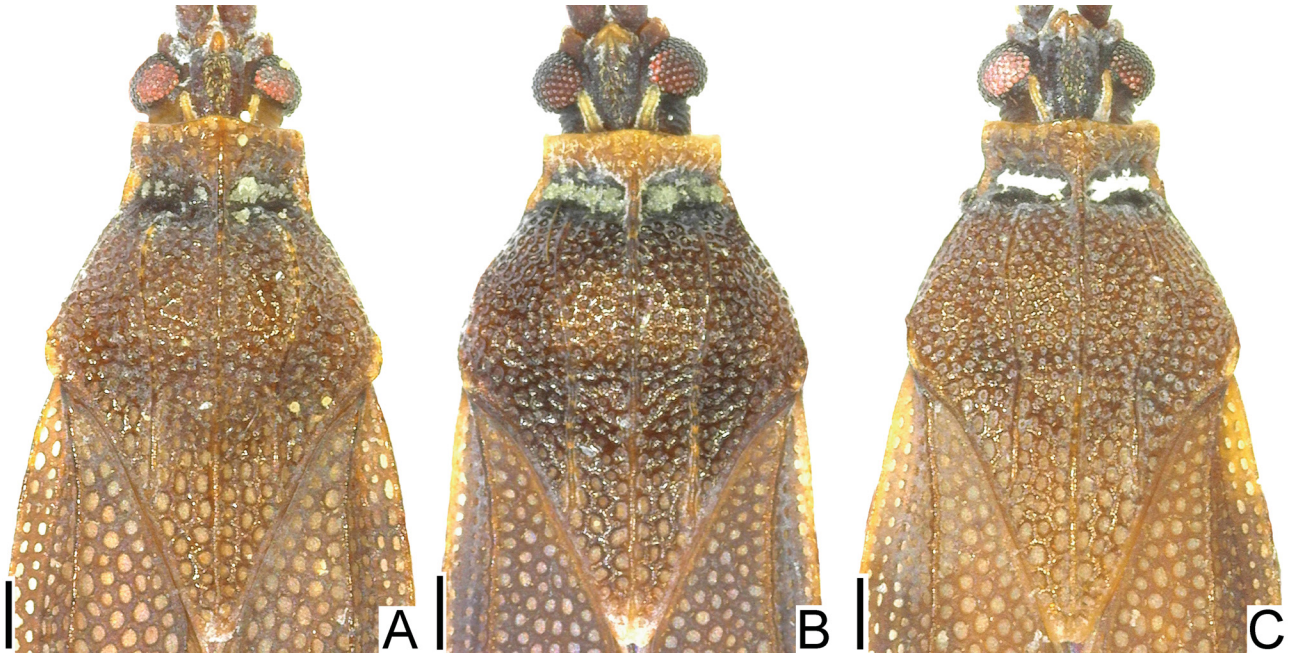
Perissonemia okinawensis sp. nov.

(Figs 1C, D, 2C, D, 3B, 4B, 5B, 6B, 7B, 8B, E, 9B, E)

Perissonemia occasa (misidentification): Azuma & Kinjo (1987): 34 (checklist: Okinawa Prefecture); Hayashi (2002): 137 (checklist: Ryukyu Islands).

Type series. Holotype: ♂ (ELKU), "[JAPAN]: the Ryukyus, Okinawa Isls., Okinawa Honto Is., Kunigami-son, Yona" [= **JAPAN: Ryukyu Islands (central part): *Okinawa Group*: Okinawa Island:** Kunigami-son, Yona], 26.iv.2021, leg. K. Saito. Paratypes (4 ♂♂ 4 ♀♀), **JAPAN: Ryukyu Islands (central part): *Okinawa Group*: Okinawa Island:** Mt. Oppadake, 30.vi.1992, leg. M. Hayashi (1 ♂ 1 ♀, TUA); as holotype (1 ♂ 1 ♀, ELKU); Higashi-son, Takae, 6.vi.2019, leg. H. Yoshitake (1 ♀, NIAES). **Geruma Island:** 10.viii.1977, leg. S. Azuma (2 ♂♂ 1 ♀, NSMT – referring to Azuma & Kinjo 1987, as *P. occasa*).

Figs 2A–F. Three species of *Perissonemia* from Japan, lateral view: A, B – *P. occasa* Drake, 1942: A – male, B – female; C, D – *P. okinawensis* sp. nov.: C – male, D – female; E, F – *P. yaeyamensis* sp. nov.: E – male, F – female. Scale bar: 1.0 mm.



Figs 3A–C. Heads and pronota, dorsal view: A – *Perissonemia occasa* Drake, 1942; B – *P. okinawensis* sp. nov.; C – *P. yaeyamensis* sp. nov. Scale bars: 0.2 mm.

Diagnosis. Recognized among other species of *Perissonemia* by a combination of the following characters: body length 3.0–3.5 mm (Figs 1C, D, 2C, D); pronotal disc, posterior process and hemelytron except for areolae brown; frontal and median spines distinct (Fig. 3B); occipital spine reaching middle part of compound eye; buccula with 3 rows of areolae at highest part; rostrum reaching beyond posterior margin of mesosternum (Fig. 7B); lateral carina of pronotum present on pronotal disc and posterior process (Fig. 4B); costal area of hemelytron 0.5 times as wide as subcostal area at widest part of each, with a single row of areolae throughout its length (Fig. 5B); subcostal area less than 0.5 times as wide as discoidal area at widest part of each, with 3 rows of areolae at apex and 2 rows in remaining parts (Fig. 6B); discoidal area with 6 rows of areolae at widest part; sutural area with 7 rows of areolae at widest part; and anterior margin of pygophore weakly concave in middle part of dorsum (Fig. 9B).

Description. ***Male.*** Head, antennae, bucculae, pronotum, hemelytra except for most of areolae, legs and ventral surface brown; compound eye dark red; areolae of hemelytron except for sutural area translucent; pubescence on body yellowish (Figs 1C, 2C, 3B, 4B, 5B, 6B, 7B, 8B).

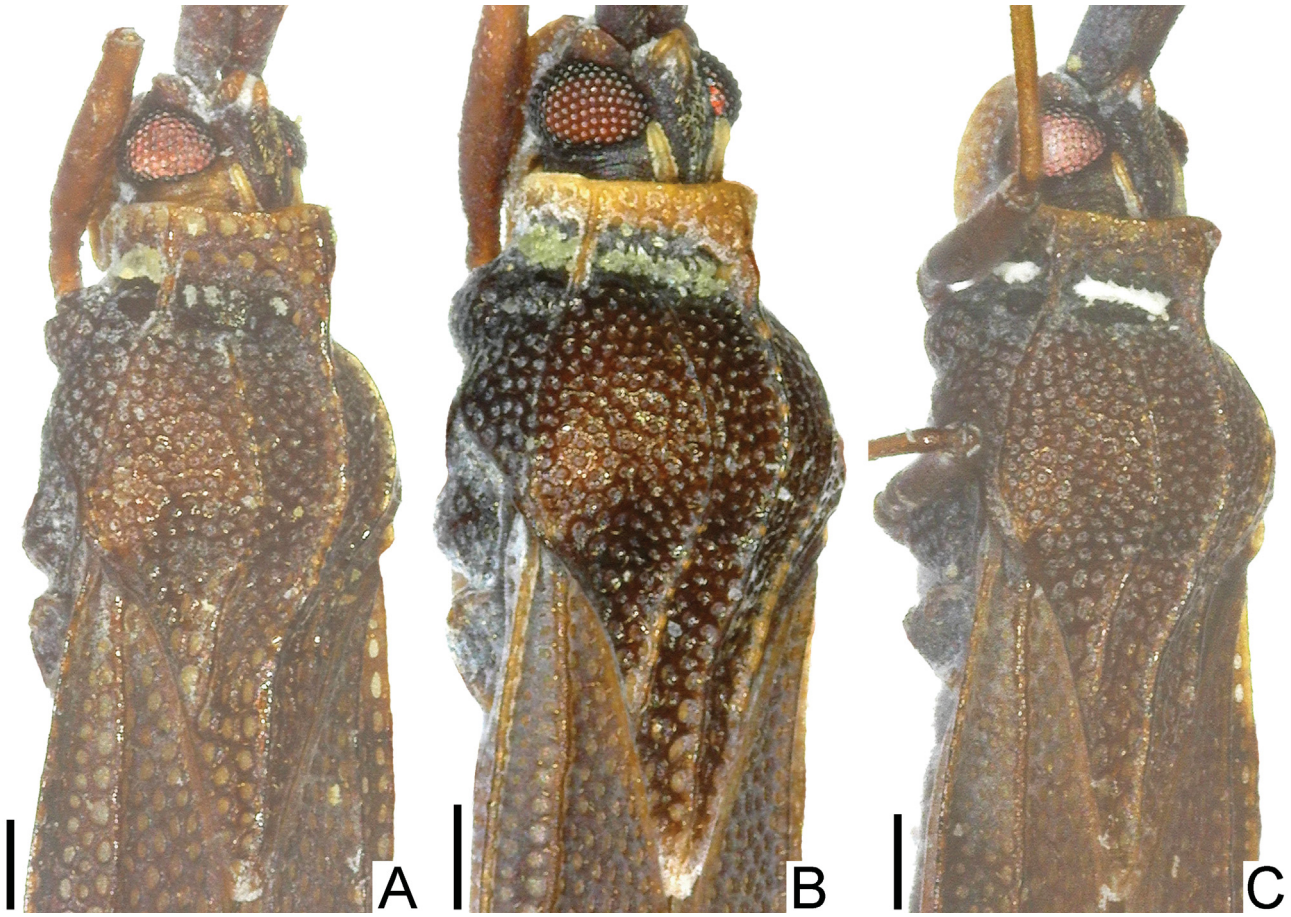
Body 3.3 times as long as maximum width across hemelytra (Fig. 1C). Head (Figs 3B, 4B, 7B) covered with pubescence; pair of frontal spines distinct, touching each other at apices, reaching apex of clypeus; median spine distinct, as long as frontal spines, reaching beyond bases of frontal spines; pair of occipital spines longer than median spine, reaching middle part of compound eyes; antenniferous tubercles obtuse, slightly curved inward; clypeus smooth. Compound eye round in dorsal view. Antenna covered with pubescence; segment I cylindrical; segment II conical, shortest among antennal segments; segment III longest among antennal segments; segment IV cylindrical, longer than segment I. Buccula with 3 rows of areolae throughout its length. Rostrum reaching beyond posterior margin of mesosternum.

Pronotum (Figs 3B, 4B) 1.5 times as long as maximum width across humeri, glabrous. Pronotal disc coarsely punctate. Hood absent. Calli smooth, partly covered with wax. Collar with 2 rows of areolae throughout its width, with anterior margin slightly curved laterad. Pronotal carinae without distinct areolae. Median carina straight, extending to apex of posterior process. Lateral carina present on pronotal disc and posterior process. Posterior process triangular, obtuse at apex.

Hemelytron (Figs 2C, 5B, 6B) 2.7 times as long as its maximum width, extending beyond apex of abdomen, glabrous; maximum width across hemelytra 1.1 times as long as maximum width across humeri; costal area 0.5 times as wide as subcostal area at widest part of each, with single row of areolae throughout its length; subcostal area less than 0.5 times as wide as discoidal area at widest part of each, with 3 rows of areolae at apex and 2 rows in remaining parts; discoidal area with 6 rows of areolae at widest part; sutural area with 7 rows of areolae at widest part.

Thoracic pleura (Fig. 2C) coarsely punctate. Prosternum (Fig. 7B) narrower than mesosternum. Sternal laminae lower than bucculae; anterior and posterior margins lower than lateral margin; prosternal lamina nearly straight, lower than mesosternal lamina; mesosternal lamina as high as metasternal lamina. Legs (Fig. 1C) smooth, covered with pubescence; femora thickest in middle.

Abdomen oblong in dorsal and ventral views. Pygophore (Figs 8B, 9B) compressed dorsoventrally, hexagonal in ventral view, covered with pubescence; anterior margin weakly concave in middle part of dorsum. Paramere (Fig. 9E) expanded in middle part, angularly



Figs 4A–C. Heads and pronota, dorsolateral view: A – *Perissonemia occasa* Drake, 1942; B – *P. okinawensis* sp. nov.; C – *P. yaeyamensis* sp. nov. Scale bars: 0.2 mm.

curved inward in apical part; outer and inner margins covered with pubescence in middle part.

Measurements (n = 5). Body length with hemelytra 3.0–3.5 mm; maximum width across hemelytra 0.9–1.1 mm; length of antennal segments I to IV 0.2 mm, 0.1 mm, 0.9–1.1 mm, and 0.3 mm, respectively; pronotal length 1.2–1.4 mm; pronotal width across humeri 0.8–1.0 mm; hemelytral length 2.1–2.4 mm; maximum width of hemelytron 0.8–0.9 mm.

Female. General appearance very similar to that of male (Figs 1D, 2D, 8E) except for the following characters: body 3.2 times as long as maximum width across hemelytra; antennal segment III shorter than in male; hemelytron 2.8 times as long as its maximum width; maximum width across hemelytra 1.2 times as long as maximum width across humeri; terminalia pentagonal in ventral view.

Measurements (n = 4). Body length with hemelytra 3.3–3.5 mm; maximum width across hemelytra 1.0–1.1 mm; length of antennal segments I to IV 0.2 mm, 0.1 mm, 0.8–0.9 mm, and 0.3 mm, respectively; pronotal length 1.4 mm; pronotal width across humeri 0.9–1.0 mm; hemelytral length 2.4–2.5 mm; maximum width of hemelytron 0.9–1.0 mm.

Differential diagnosis. Among the East Asian species, *Perissonemia okinawensis* sp. nov. is most similar to *P. borneensis* in morphological characteristics. However, based on a comparison between the type material of the new species and the photographs of the syntype (Natural History Museum 2014), together with the original description (Distant 1909) of *P. borneensis*, two main characteristics were recognized to easily differentiate *P. okinawensis* sp. nov. from *P. borneensis*: body length 3.0–3.5 mm (Figs 1C, D, 2C, D) (4.0 mm in *P. borneensis*); and pronotal disc, posterior process and hemelytron except for areolae brown (black in *P. borneensis*). Moreover, morphological differences between the new species and the other Japanese species are provided in the identification key below.

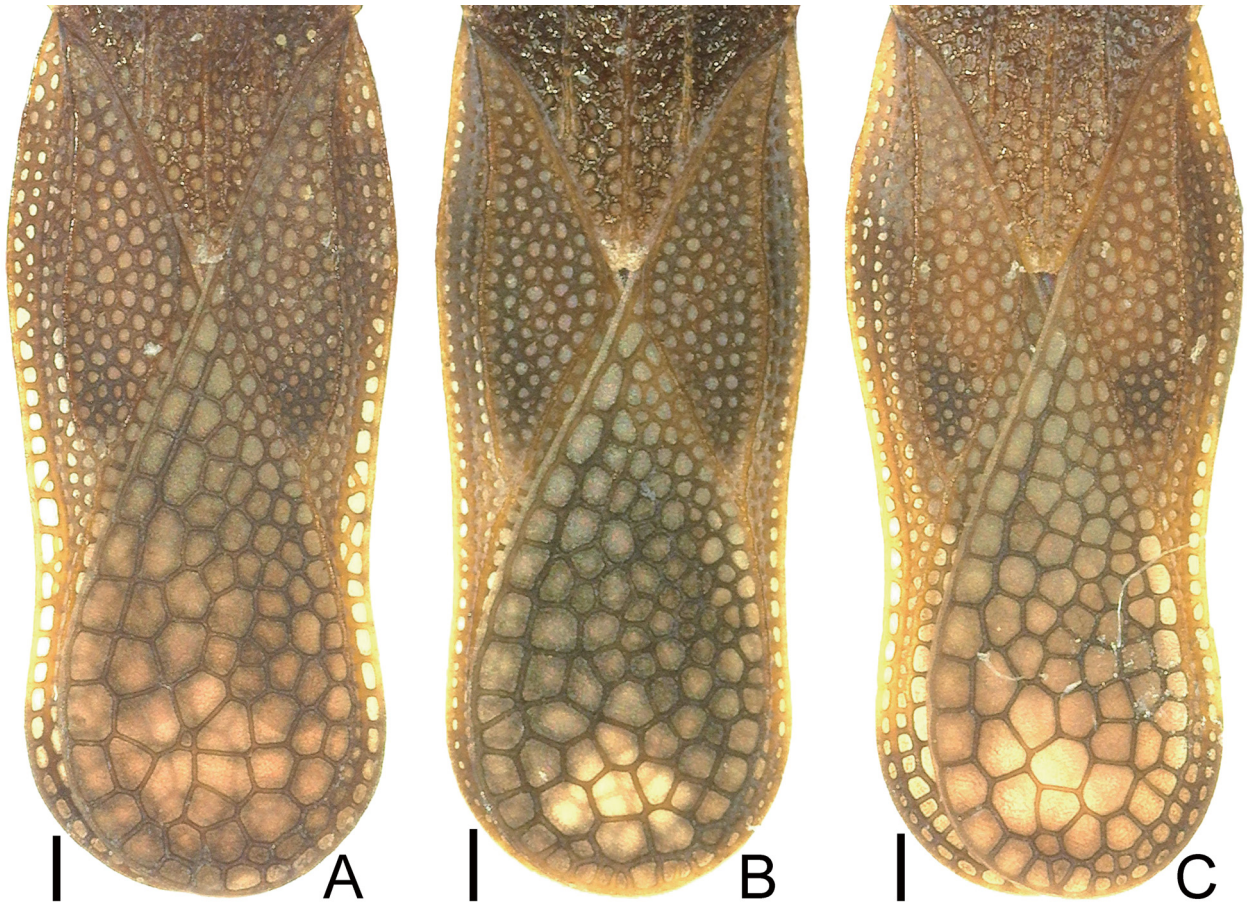
Etymology. The specific epithet refers to its occurrence in Okinawa Group, the central part of the Ryukyu Islands, Japan; an adjective.

Host plant. Unknown. More field surveys focusing on evergreen oleaceous trees are needed, especially on those of the genus *Osmanthus*.

Biology. Adults were collected in April, June, and August. Nymph is unknown.

Distribution. Japan (Ryukyu Islands (central part): Okinawa Group: Okinawa Island, Geruma Island) (Fig. 11) (Azuma & Kinjo 1987, Hayashi 2002).

Although the specimens could not be examined, the previous record of "*Perissonemia occasa*" from Aka Island, Okinawa Group, the central part of the Ryukyu Islands (Azuma & Kinjo 1987) can correspond to the new species. *Perissonemia okinawensis* sp. nov. inhabits the laurilignosa in the subtropical climate of the central part of the Ryukyu Islands.



Figs 5A–C. Hemelytra, dorsal view: A – *Perissonemia occasa* Drake, 1942; B – *P. okinawensis* sp. nov.; C – *P. yaeyamensis* sp. nov. Scale bars: 0.2 mm.

Perissonemia yaeyamensis sp. nov.

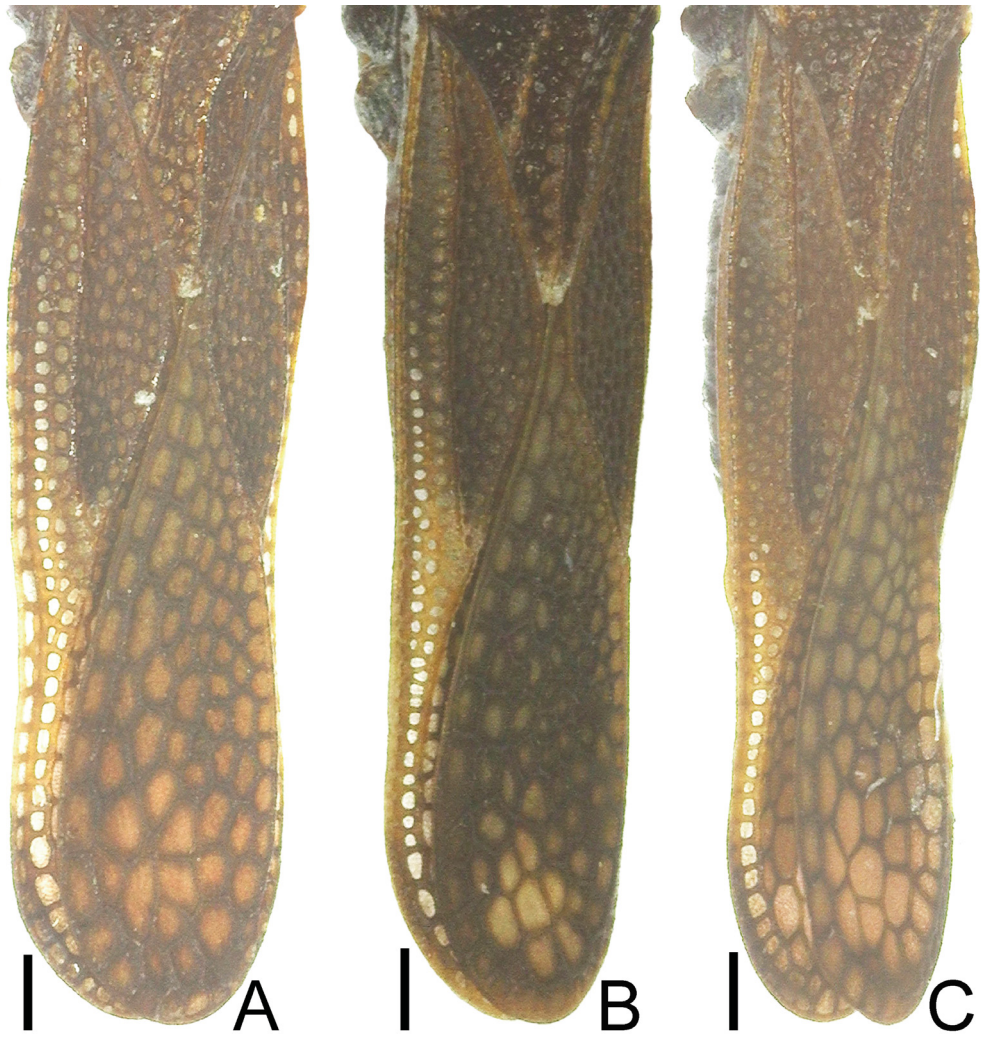
(Figs 1E, F, 2E, F, 3C, 4C, 5C, 6C, 7C, 8C, F, 9C, F, 10D, E)

Perissonemia occasa: Miyamoto (1964a: 272) (distribution); Miyamoto (1964b: 523) (distribution); Miyamoto (1964c: 104) (distribution); Takara & Azuma (1972: 113) (distribution); Azuma & Kinjo (1987: 34) (checklist: Okinawa Prefecture); Hayashi (2002: 137) (checklist: Ryukyu Islands); Yamada & Tomokuni (2012: 198) (monograph).

Type series. Holotype: ♂ (ELKU), "[Iriomote I.] Shirahama–Hoshidate" [= **JAPAN: Ryukyu Islands (southern part): *Yaeyama Group*: Iriomote Island:** Shirahama–Hoshidate], 8.iii.1964, leg. Y. Miyatake. Paratypes (66 ♂♂ 65 ♀♀), **JAPAN: Ryukyu Islands (southern part): *Yaeyama Group*: Ishigaki Island:** Yoshihara, 15.x.1963, leg. K. Morimoto (1 ♂, KUM); Kahara-yama, 14.iii.1964, leg. Y. Miyatake (3 ♂♂ 3 ♀♀, KUM); as above but 18.iii.1964 (1 ♀, KUM); as above but 18.iii.1964, leg. S. Kimoto (5 ♂♂ 6 ♀♀, KUM); Yonehara, 15.iii.1964, leg. T. Shirozu (1 ♂, KUM); Omoto-san, 16.iii.1964, leg. Y. Miyatake (1 ♂ 1 ♀, KUM); as above but leg. S. Kimoto (1 ♀, KUM); Mt. Omoto, 16.iv.1974, leg. H. Makihara (1 ♀, KUM); Mt. Banna-dake, 27.v.1990, leg. M. Hayashi et al. (1 ♀, TUA); as above but 22.vi.1991, leg. S. Miyakawa (1 ♀, NSMT); Nagura, Shiramizu, 6.v.1993, leg. M. Hayashi (1 ♂, TUA); Banna Park, 26.xi.1997, leg. M. Tomokuni (17 ♂♂ 19 ♀♀, NSMT); Shiramizu, 4.v.2004, leg. T. Tsuru (1 ♀, TUA); Mt. Maesedake, 16.xi.2018, leg. J. Souma (2 ♂♂, TUA); Sakieda, Yarabu-dake, 25.iii.2020, leg. R. Ito (1 ♂, TUA); Arakawa, Maese-dake, 25.iii.2020, leg. R. Ito (1 ♀, TUA). **Iriomote Island:** Upstream of Itajiki Riv., 9.vii.1963, leg. Y. Miyatake (5 ♂♂ 2 ♀♀, KUM); Shirahama, 7.iii.1964, leg. Y. Miyatake (7 ♂♂ 14 ♀♀, KUM); as holotype (6 ♂♂ 2 ♀♀, KUM); Ushiku-mori, 9.iii.1964, leg. Y. Miyatake (1 ♀, KUM); as above but 11.iii.1964 (1 ♂ 1 ♀, KUM); Upstream of Nakara-gawa Riv., 12.iii.1964, leg. S. Kimoto (1 ♂ 1 ♀, KUM); Funaura, 12.viii.1967, leg. T. Takara (3 ♂♂, NSMT); as above but 9.x.1977, leg. M. Kinjo (1 ♀, NSMT); as above but 31.iii.1996, leg. M. Hayashi (1 ♂ 1 ♀, TUA); Otomi, 18.iii.1969, leg. S. Azuma (1 ♂, NSMT); as above but 2.viii.1972, leg. S. Azuma (1 ♂ 3 ♀♀, NSMT); Kanbiri, 6.ix.1969, leg. M. Kinjo (1 ♂, NSMT); Komi, 15.v.1973, leg. T. Nakane (1 ♂, NSMT); as above but 2.iv.1978, leg. K. Baba (1 ♂ 1 ♀, NIAES); Gozaidake, 17.v.1973, leg. T. Nakane (1 ♂, NSMT); Shirahama-rindo, 1.vi.1999, leg. T. Ishikawa (1 ♂, TUA); Nakamagawa-rindou, 7.vi.2002, leg. T. Ishikawa (1 ♂ 1 ♀, TUA); Haiminaka, 29.viii.2020, leg. T. Mita (2 ♂♂ 1 ♀, ELKU).

Additional material examined. Non-types (5 nymphs – referring to Miyamoto 1964b, as *P. occasa*): **JAPAN: Ryukyu Islands (southern part): *Yaeyama Group*: Iriomote Island:** Shirahama, 7.iii.1964, leg. Y. Miyatake (3 nymphs, KUM); as holotype (2 nymphs, KUM). All five nymphs are in poor condition and were, thus, not described in the present study.

Diagnosis. Recognized among other species of *Perissonemia* by a combination of the following characters: body length 3.4–3.8 mm (Figs 1E, F, 2E, F); pronotal disc, posterior process and hemelytron except for areolae brown; frontal and median spines distinct (Fig. 3C); occipital spine reaching middle part of compound eye; buccula with 3 rows of areolae at highest part; rostrum reaching beyond posterior margin of mesosternum (Fig. 7C); lateral carina of pronotum present on pronotal disc and posterior process (Fig. 4C); costal area of hemelytron 0.5 times as wide as subcostal area at widest part of each, with 2 rows of areolae in basal part and a single row in remaining parts (Fig. 5C); subcostal area 0.5 times as wide as discoidal area at widest part of each, with 3 rows of areolae (occasionally 4 rows in very small sections) throughout its length (Fig.



Figs 6A–C. Hemelytra, dorsolateral view: A – *Perissonemia occasa* Drake, 1942; B – *P. okinawensis* sp. nov.; C – *P. yaeyamensis* sp. nov. Scale bars: 0.2 mm.

6C); discoidal area with 6 rows of areolae at widest part; sutural area with 7 rows of areolae at widest part; and anterior margin of pygophore strongly concave in middle part of dorsum (Fig. 9C).

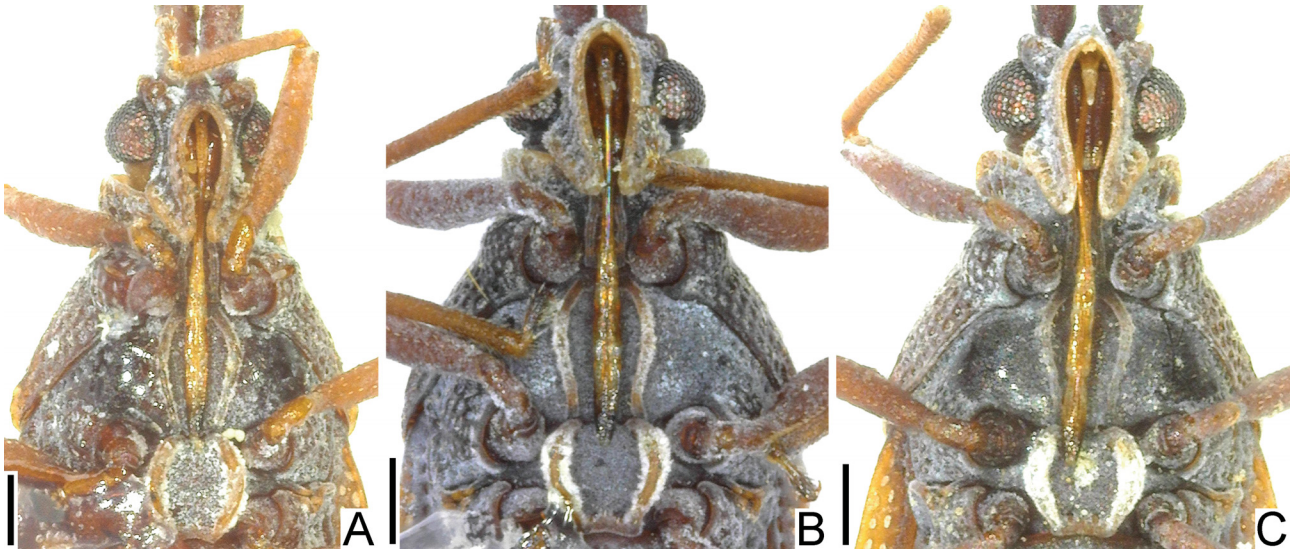
Description. ***Male.*** Head, antennae, bucculae, pronotum, hemelytra except for most of areolae, legs and ventral surface brown; compound eye dark red; areolae of hemelytron except for sutural area translucent; pubescence on body yellowish (Figs 1E, 2E, 3C, 4C, 5C, 6C, 7C, 8C).

Body 3.3 times as long as maximum width across hemelytra (Fig. 1E). Head (Figs 3C, 4C, 7C) covered with pubescence; pair of frontal spines distinct, touching each other at apices, reaching apex of clypeus; median spine distinct, as long as frontal spines, reaching beyond bases of frontal spines; pair of occipital spines longer than median spine, reaching middle part of compound eyes; antenniferous tubercles obtuse, slightly curved inward; clypeus smooth. Compound eye round in dorsal view. Antenna covered with pubescence; segment I cylindrical; segment II conical, shortest among antennal segments; segment III longest among antennal segments; segment IV cylindrical, longer than segment I. Buccula with 3 rows of areolae throughout its length. Rostrum reaching beyond posterior margin of mesosternum.

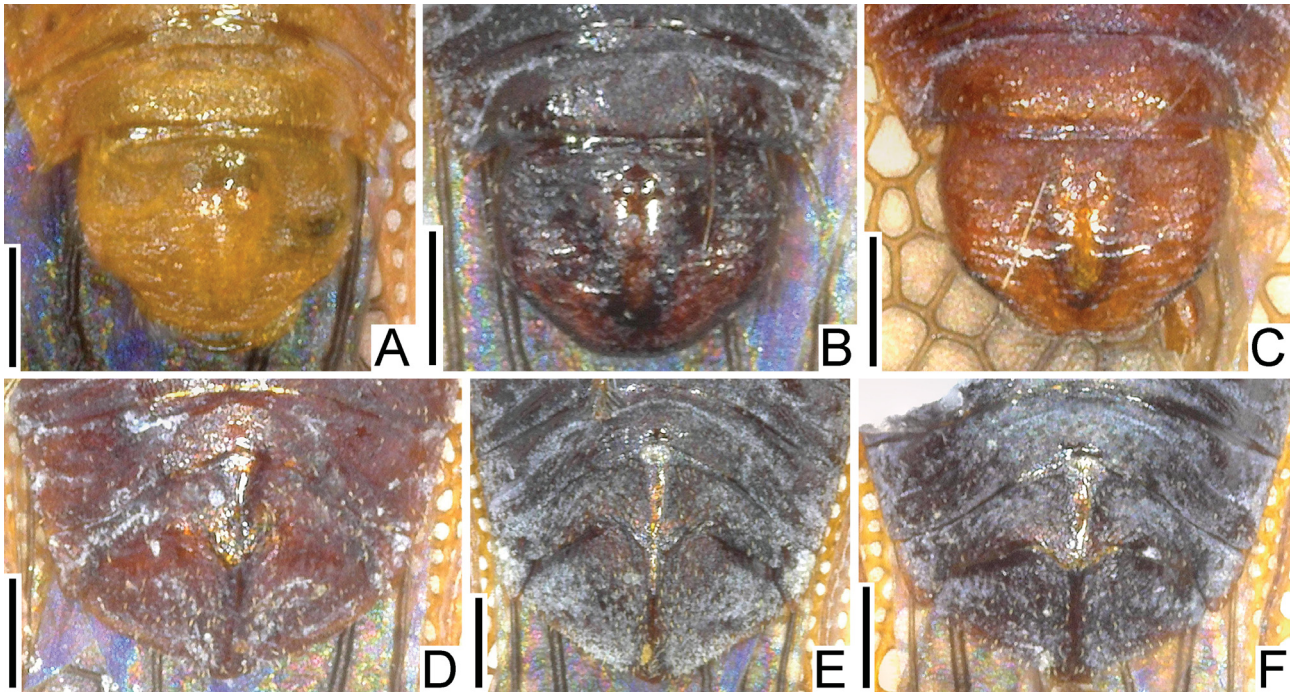
Pronotum (Figs 3C, 4C) 1.6 times as long as maximum width across humeri, glabrous. Pronotal disc coarsely punctate. Hood absent. Calli smooth, partly covered with wax. Collar with 2 rows of areolae throughout its width, with anterior margin slightly curved laterad. Pronotal carinae without distinct areolae. Median carina straight, extending to apex of posterior process. Lateral carina present on pronotal disc and posterior process. Posterior process triangular, obtuse at apex.

Hemelytron (Figs 2E, 5C, 6C) 2.7 times as long as its maximum width, extending beyond apex of abdomen, glabrous; maximum width across hemelytra 1.1 times as long as maximum width across humeri; costal area 0.5 times as wide as subcostal area at widest part of each, with 2 rows of areolae in basal part and single row in remaining parts; subcostal area 0.5 times as wide as discoidal area at widest part of each, with 3 rows of areolae (occasionally 4 rows in very small sections) throughout its length; discoidal area with 6 rows of areolae at widest part; sutural area with 7 rows of areolae at widest part.

Thoracic pleura (Fig. 2E) coarsely punctate. Prosternum (Fig. 7C) narrower than mesosternum. Sternal laminae lower than bucculae; anterior and posterior margins lower than lateral margin; prosternal lamina nearly straight, lower



Figs 7A–C. Rostrum, ventral view: A – *Perissonemia occasa* Drake, 1942; B – *P. okinawensis* sp. nov.; C – *P. yaeyamensis* sp. nov. Scale bars: 0.2 mm.



Figs 8A–F. Apical part of abdomen, ventral view: A, D – *Perissonemia occasa* Drake, 1942: A – male, D – female; B, E – *P. okinawensis* sp. nov.: B – male, E – female; C, F – *P. yaeyamensis* sp. nov.: C – male, F – female. Scale bars: 0.2 mm.

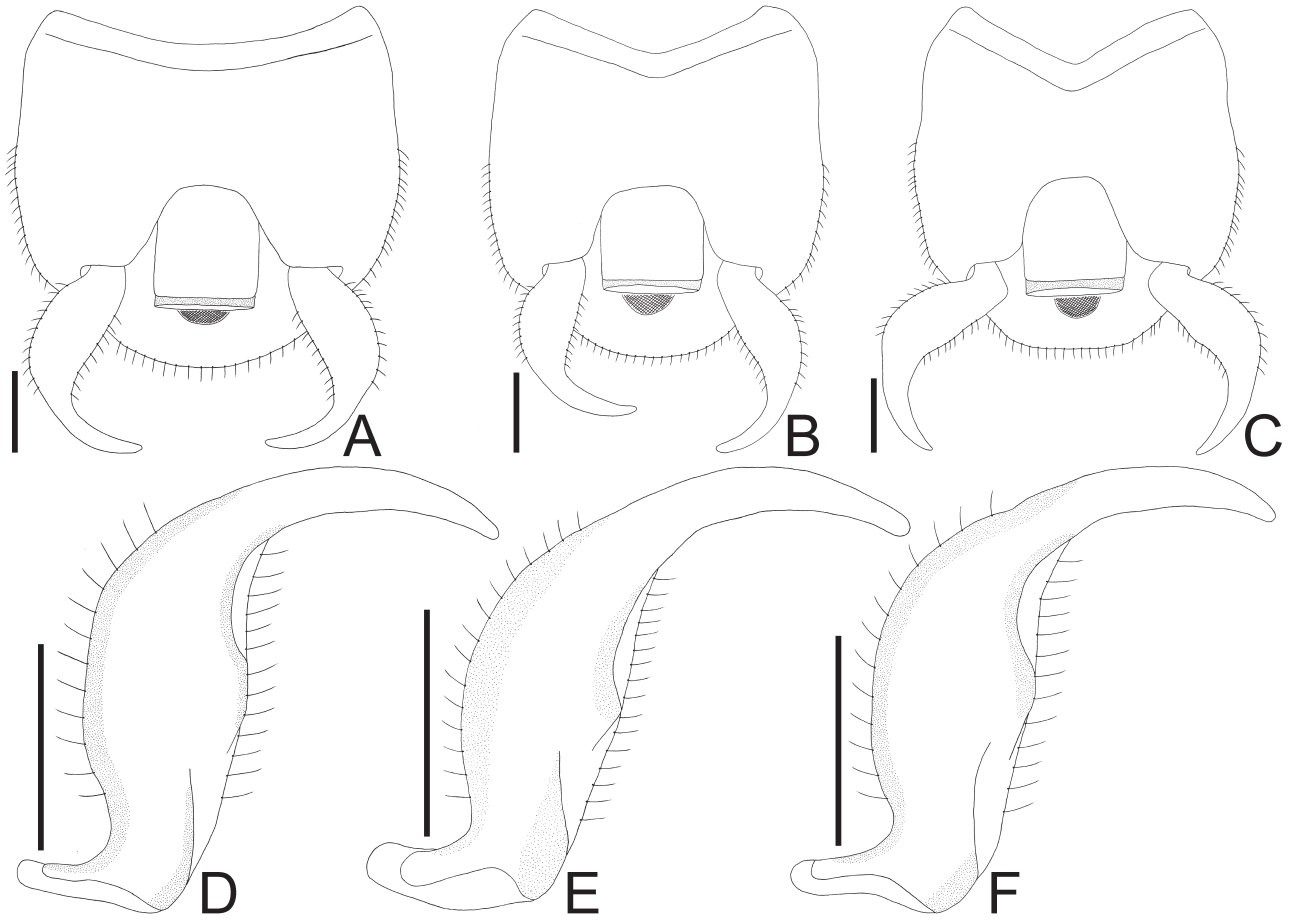
than mesosternal lamina; mesosternal lamina as high as metasternal lamina. Legs (Fig. 1E) smooth, covered with pubescence; femora thickest in middle.

Abdomen oblong in dorsal and ventral views. Pygophore (Figs 8C, 9C) compressed dorsoventrally, hexagonal in ventral view, covered with pubescence; strongly concave in middle part of dorsum. Paramere (Fig. 9F) expanded in middle part, angularly curved inward in apical part; outer and inner margins covered with pubescence in middle part.

Measurements (n = 20). Body length with hemelytra 3.4–3.6 mm; maximum width across hemelytra 1.1–1.2 mm; length of antennal segments I to IV 0.2 mm, 0.1 mm, 1.0 mm, and 0.4 mm, respectively; pronotal length 1.4–1.5 mm; pronotal width across humeri 0.9–1.0 mm; hemelytral length 2.4–2.5 mm; maximum width of hemelytron 0.9 mm.

Female. General appearance very similar to that of male (Figs 1F, 2F, 8F) except for the following characters: body 3.1 times as long as maximum width across hemelytra; antennal segment III shorter than in male; hemelytron 2.9 times as long as its maximum width; maximum width across hemelytra 1.3 times as long as maximum width across humeri; terminalia pentagonal in ventral view.

Measurements (n = 20). Body length with hemelytra 3.6–3.8 mm; maximum width across hemelytra 1.1–1.3 mm; length of antennal segments I to IV 0.2 mm, 0.1



Figs 9A–F. Pygophores, dorsal view: A – *Perissonemia occasa* Drake, 1942; B – *P. okinawensis* sp. nov.; C – *P. yaeyamensis* sp. nov. Parameres, dorsal view: D – *P. occasa*; E – *P. okinawensis* sp. nov.; F – *P. yaeyamensis* sp. nov. Scale bars: 0.1 mm.

mm, 0.9 mm, and 0.4 mm, respectively; pronotal length 1.5–1.6 mm; pronotal width across humeri 0.9–1.0 mm; hemelytral length 2.5–2.8 mm; maximum width of hemelytron 0.9–1.0 mm.

Differential diagnosis. Among the East Asian species, *Perissonemia yaeyamensis* sp. nov. is most similar to *P. gressitti* in morphological characteristics. However, based on a comparison between the type material of the new species and the photographs of the holotype (United States National Museum of Natural History 2021) together with the original description (Drake & Poor 1936) of *P. gressitti*, three main characters were recognized to easily differentiate *P. yaeyamensis* sp. nov. from *P. gressitti*: subcostal area of hemelytron with 3 rows of areolae (occasionally 4 rows in very small sections) throughout its length (Fig. 6C) (3 rows at apex and 2 rows in remaining parts in *P. gressitti*); discoidal area with 6 rows of areolae at widest part (5 rows in *P. gressitti*); and sutural area with 7 rows of areolae at widest part (6 rows in *P. gressitti*). Morphological differences between the new species and the other Japanese species are provided in the identification key below.

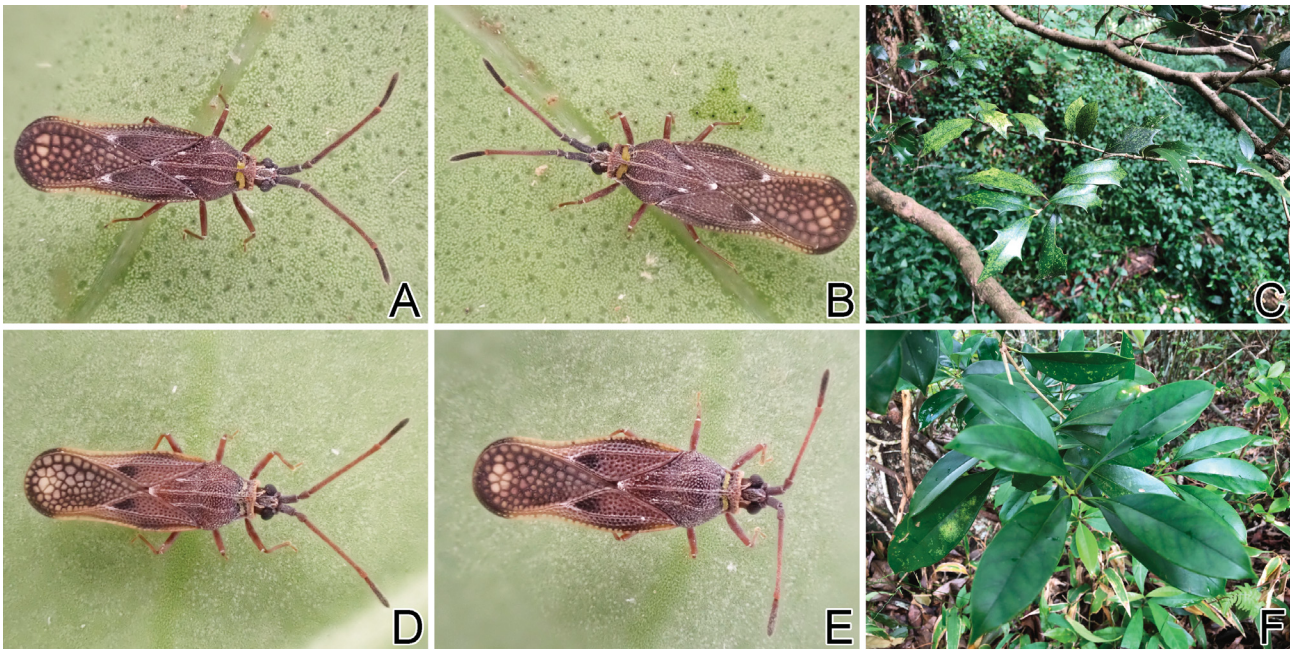
Etymology. The specific epithet refers to its occurrence in Yaeyama Group, the southern part of the Ryukyu Islands, Japan; an adjective.

Host plant. *Osmanthus insularis*, "Shimamokusei" or "Nataorenoki" (Oleaceae) (Miyamoto 1964b, Yamada & Tomokuni 2012); *O. marginatus*, "Ryukyumokusei" (Fig. 10F) (present study). *Perissonemia yaeyamensis* sp. nov. feeds only on these oleaceous plants and is oligophagous.

Biology. *Perissonemia yaeyamensis* sp. nov. feeds on the abaxial surface of the leaves of *Osmanthus marginatus* (present study), similarly to many tingids (Schuh & Weirauch 2020). Adults were collected in almost all seasons (Miyamoto 1964a,b,c; Takara & Azuma 1972; Yamada & Tomokuni 2012; present study), and nymphs were collected in March and November (Miyamoto 1964b, Yamada & Tomokuni 2012; present study).

Distribution. Japan (Ryukyu Islands (southern part): Yaeyama Group: Ishigaki Island, Iriomote Island) (Fig. 11) (Miyamoto 1964a,b,c; Takara & Azuma 1972; Yamada & Tomokuni 2012).

Perissonemia yaeyamensis sp. nov. inhabits the laurilignosa in the subtropical climate of the southern part of the Ryukyu Islands, which is located in the Oriental Region.



Figs 10A–D. A, B – habitus images of living adults (photographs taken indoors) of *Perissonemia occasa* Drake, 1942 from Hyogo, Honshu, Japan: A – male, B – female. C – host plant (*Osmanthus heterophyllus*) for *P. occasa* at Hyogo, Honshu, Japan. D, E – habitus images of living adults (photographs taken indoors) of *P. yaeyamensis* sp. nov. from Ishigaki Island, Ryukyu Islands, Japan (D – male, E – female). F – host plant (*O. marginatus*) for *P. yaeyamensis* sp. nov. at Ishigaki Island, Ryukyu Islands, Japan.

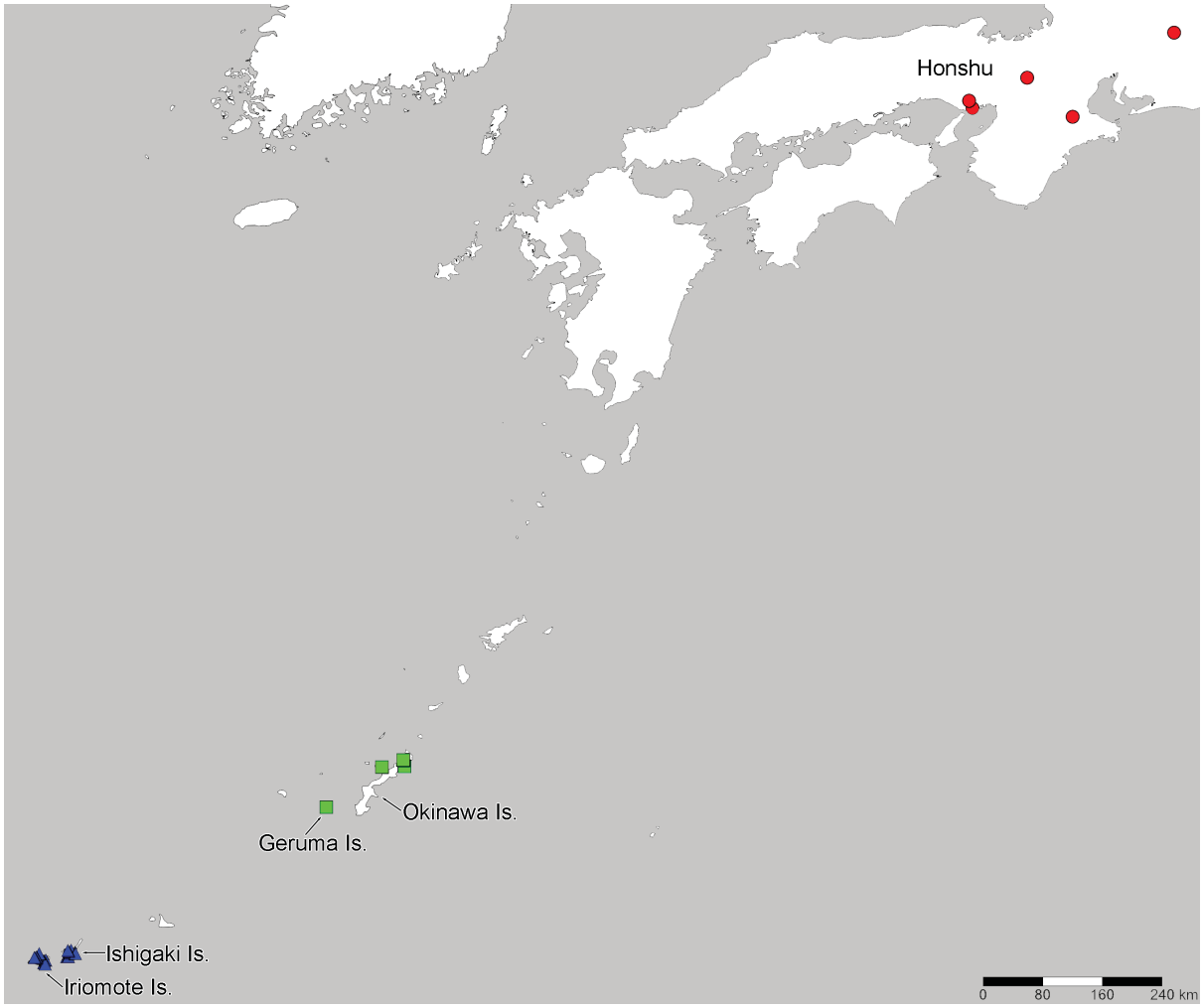


Fig. 11. Collection sites of three species of *Perissonemia* from Japan used in present study. Red circles = *P. occasa* Drake, 1942; green squares = *P. okinawensis* sp. nov.; blue triangles = *P. yaeyamensis* sp. nov.

Key to the species of *Perissonemia* occurring in Japan

1 Subcostal area of hemelytron 0.5 times as wide as discoidal area at widest part of each, with 3 rows of areolae (occasionally 4 rows in very small sections) throughout its length (Figs 5C, 6C); anterior margin of pygophore strongly concave in middle part of dorsum (Fig. 9C). ..... ***P. yaeyamensis* sp. nov.**
– Subcostal area of hemelytron less than 0.5 times as wide as discoidal area at widest part of each, with 3 rows of areolae at apex and 2 rows (occasionally 3 rows in very small sections) in remaining parts (Figs 5A, B, 6A, B); anterior margin of pygophore weakly concave in middle part of dorsum (Figs 9A, B). 2
2 Body length 3.7–4.1 mm (Figs 1A, B, 2A, B); rostrum not reaching beyond posterior margin of mesosternum (Fig. 7A); costal area of hemelytron more than 0.5 times as wide as subcostal area at widest part of each, with 2 rows of areolae in basal part and a single row in remaining parts (Figs 5A, 6A). .... ***P. occasa*** Drake, 1942
– Body length 3.0–3.5 mm (Figs 1C, D, 2C, D); rostrum reaching beyond posterior margin of mesosternum (Fig. 7B); costal area of hemelytron 0.5 times as wide as subcostal area at widest part of each, with a single row of areolae throughout its length (Figs 5B, 6B). .... ***P. okinawensis* sp. nov.**

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