





https://doi.org/10.11646/zootaxa.5497.1.6

http://zoobank.org/urn:lsid:zoobank.org:pub:A73F5587-06DC-478D-9C18-61B6556948AA

Pacifimusotima Ko & Solis, new genus and species of the Musotiminae (Lepidoptera: Crambidae) from the Federated States of Micronesia, including two newly combined species

JAE-HO KO^{1,5}, M. ALMA SOLIS^{2,*}, DAVID C. LEES^{3,6} & AUSTIN ALBERT^{4,7}

¹DASARI Research Institute of BioResources, Dunsan-daero, 117 beon-gil, Seo-gu, Daejeon 35203, Republic of Korea.

²Systematic Entomology Laboratory, Beltsville Agriculture Research Center, Agricultural Research Service, U.S. Department of Agriculture, National Museum of Natural History, MRC 168, Smithsonian Institution, P.O. Box 37012, Washington, District of Columbia, United States of America.

³Department of Science, Natural History Museum, Cromwell Road, South Kensington, SW7 5BD, United Kingdom.

⁴Kosrae State Historic Preservation Office, Kosrae Island Resource Management Authority, Kosrae State, Federated States of Micronesia.

⁵] *js125t@naver.com; https://orcid.org/0000-0001-6557-4281*

⁶ david.lees@nhm.ac.uk; ^b https://orcid.org/0000-0002-7580-8560

⁷ siklava@gmail.com; https://orcid.org/0009-0003-3878-4314

*Corresponding author: 🖃 alma.solis@usda.gov; 💿 https://orcid.org/0000-0001-6379-1004

Abstract

Pacifimusotima kosrena Ko & Solis, **gen. nov.** & **sp. nov.**, is described from the Federated States of Micronesia (FSM). We newly combine *Parthenodes eugethes* (Tams, 1935), **comb. nov.** and *Parthenodes rectangulalis* (Kenrick, 1907), **comb. nov.** in *Pacifimusotima* Ko & Solis. Illustrations of adults, genitalia, and brief remarks on related species are provided.

Key words: new genus, new species, new combination, Samoa, Papua New Guinea, Pacific Ocean

Introduction

The subfamily Musotiminae Meyrick, 1884 is one of the smaller subfamilies within the Crambidae, comprising only 23 genera and 208 described species worldwide (Nuss *et al.* 2013–2024). It is widely distributed worldwide, and includes United States, Argentina, Africa, Madagascar, Russia, Japan, China, Australia, Micronesia, and Samoa (Munroe & Solis 1999). Notably, larvae within this subfamily are known for their distinctive feeding habit on fern genera such as *Cyathea* Sm. (Cyatheaceae), *Lygodium* Sw. (Lygodiaceae), and *Nephrolepis* Schott (Nephrolepidaceae) (Phillips Rodriguez & Solis 1996; Solis *et al.* 2005b; Yen *et al.* 2004).

Musotiminae was initially placed within Nymphulinae [=Acentropinae] by Hampson (1897) and Munroe (1972), until Minet (1982) first established it as a separate subfamily based primarily on tympanic organ morphology. Its monophyly has since been consistently maintained to the present day (Léger *et al.* 2021; Mally *et al.* 2019; Munroe & Solis 1999; Regier *et al.* 2012; Solis 2007; Solis & Maes 2002) and the subfamily was recovered as sister to the Lathrotelinae (although with low support) (Léger *et al.* 2021). Recent studies in this subfamily include a major study by Yoshiyasu (1985) about Japanese musotimines that included immatures and their distribution in Asia, followed by Phillips Rodriguez & Solis (1996), Yen *et al.* (2004), Solis *et al.* (2004), Speidel & Stüning (2004), Solis *et al.* (2005a), Solis *et al.* (2005b), Landry & Roque-Albelo (2006), and Wu *et al.* (2015). However, research on the monophyly of musotimine genera and their phylogenetic relationships, including placement of species within genera, remains scarce, indicating a great need for taxonomic revisionary studies in this subfamily (Solis *et al.* 2004).

The only previous record of Musotiminae in the Federated States of Micronesia (FSM) was the report of two endemic species in Munroe (1996) on the Lepidoptera of the Pacific. However, they were described only as

an endemic species of *Musotima* Meyrick and an "unnamed endemic in Kosrae." During a study of Pyraloidea collected in Kosrae, FSM, in 2022–2023, the first author discovered a musotimine species that could be the same species mentioned by Munroe (1996) (see below species label data with Munroe handwritten labels and original CNC dissections and numbers). Furthermore, two more congeneric species were discovered that were misplaced in the genus *Parthenodes* Guenée.

In this study, we describe a new genus *Pacifimusotima* gen. nov., based on the new species *Pacifimusotima* kosrena Ko & Solis, sp. nov., from the FSM, and two species, *Parthenodes eugethes* (Tams, 1935) comb. nov., and *Parthenodes rectangulalis* (Kenrick, 1907) comb. nov., misplaced in the genus *Parthenodes*, that are newly combined.

Abbreviations

CNC—Canadian National Collection, Ottawa, Canada DASARI—DASARI Research Institute of BioResources, Republic of Korea FSM—Federated States of Micronesia HT—holotype KIRMA—The Kosrae Island Resource Management Authority NHMUK (=BMNH)—The Natural History Museum, United Kingdom NIBR—The National Institute of Biological Resources, Republic of Korea NMNH (=USNM)—National Museum of Natural History, United States PT—paratype TL—type locality TS—type species USNMENT—barcode acronym for NMNH

Materials and Methods

The specimens used in this study were collected during expeditions to Kosrae, Micronesia, under the Memorandum of Understanding (MOU) between the National Institute of Biological Resources (NIBR), Ministry of Environment, Korea, and the Kosrae Island Resource Management Authority (KIRMA), for cooperation concerning biological resources and information. Specimens were collected at night using a light tent with mercury vapor lamps (200 V/300 W), and are deposited in the National Institute of Biological Resources (NIBR), Ministry of Environment, Incheon, Korea.

Specimens examined at the NIBR and NHMUK were photographed using a Canon EOS 5DS digital camera coupled with a Canon MP-E 65 mm F2.8 1–5x Macro photo lens (Canon, Inc., Tokyo, Japan) and illuminated with a Leica 5000HDI lamp. At the NHMUK stacking was done using Helicon Remote (version 3.8.4W) and Helicon Focus (version 6.7.1). Genitalia was dissected using standard methodology and stained either with chlorazol black or mercurochrome (Robinson 1976), then slide-mounted in Euparal. The dissection were examined under a Nikon SMZ445 stereomicroscope. Genitalia were captured using a Leica S Apo (Wetzlar, Germany) stereomicroscope attached with Dhyana 400 DC (Tucsen, China) at the DASARI. At the NMNH adults were photographed using a Canon EOS 5DS camera and a Canon EOS 7D Mark II camera with the Visionary Digital® imaging system for slide mounted structures.

[Zoobank registrations: *Pacifimusotima* Ko & Solis, new genus, urn:lsid:zoobank.org:act:DCC260B3-F70C-4A5C-AD39-431BA0D33340; *Pacifimusotima kosrena* Ko & Solis, new species, urn:lsid:zoobank.org: act:54A6071D-01AB-4C07-BA90-9082BAEB9473]

Systematic accounts

Genus Pacifimusotima Ko & Solis, gen. nov.

TS: Pacifimusotima kosrena Ko & Solis, sp. nov. Gender: feminine.



FIGURES 1–8. Adults of *Pacifimusotima* and *Parthenodes* spp. 1a. *Pacifimusotima kosrena* Ko & Solis, sp. nov., holotype, male, Kosrae, Micronesia; 1b. *Pacifimusotima kosrena* Ko & Solis, sp. nov., paratype, female, Kosrae, Micronesia; 2. *Pacifimusotima rectangulalis* comb. nov., male, Chuuk, Micronesia, USNMENT01894106, USNM genitalia slide no. 116393; 3. *Pacifimusotima eugethes*, comb. nov., male, Apia, Samoa, USNMENT01894135; 4. *Parthenodes hydrocampalis* (co-type), NHMUK015666233; 5. *Parthenodes parallelalis* (= *P. paralleloidalis*), holotype, Chanchamayo, Peru, NHMUK015666232; 6. *Parthenodes bisangulata*, holotype, Sikkim, India, NHMUK013699575; 7. *Pacifimusotima rectangulalis*, comb. nov., syntype, Ekeikei, Papua New Guinea, NHMUK010919370; 8. *Parthenodes nigriplaga*, syntype, Khasia Hill, Meghalaya, India, NHMUK013699595.

Diagnosis. The new genus (Figs. 1–3, 7, 9–20) is similar to *Aeolopetra* Meyrick, 1934 (Yen 1996: p. 293–299, and see figs. 1–8), in its general large size with a forewing length greater than 1 cm, but can be distinguished by the following characteristics: ground color of the wings is white, but whitish-ocherous in *Aeolopetra*; termen of the wings nearly straight, but sinuous in *Aeolopetra*; forewing has a striking brown W-shaped marking that is lacking in *Aeolopetra*. In the venation of the forewing, R_1 , R_2 , and R_3 originate before the upper angle of the discal cell but they originate in the upper angle in *Aeolopetra*; CuA₁ originates before the lower angle of the discal cell, but originates in the lower angle in *Aeolopetra*; A_3 is absent, but present in *Aeolopetra*. In the venation of the lower angle of the discal cell in *Aeolopetra*; A_3 is present but absent in *Aeolopetra*. In the genitalia, the uncus and the gnathos in this genus are shorter than those of *Aeolopetra*; the valva is nearly subspatulate and ovate in *Aeolopetra*. The female genitalia of *Aeolopetra* are unknown and therefore cannot be compared.

Description. *Adult* (Figs. 1–3, 7, 9–13). Head covered with white scales; antennae prismatic, laterally compressed; ocellus and chaetosemata absent; labial palpus three-segmented, upturned; maxillary palpus three-segmented, very short; proboscis well–developed. Thorax covered with white mixed brown scales. Forewing rhomboid; basal and median band present; postmedial area with W-shaped marking; costal margin nearly straight; apex weakly pointed; termen rounded, obtuse angled from M_2 to M_3 ; dorsum nearly straight; frenulum hook a short set of hooked setae basally. Hindwing fan–shaped; costal margin rather straight; apex weakly hooked; termen rounded, obtuse angled from M_2 to CuA₁; dorsum rather rounded; frenulum one in male, two or more in female. Venation: forewing with 12 veins: Sc free; R_1 free, faded from 1/3 of R_1 to costal margin; R_2 free; R_3 and R_4 stalked for most of length; R_2 and R_3+R_4 approximated; R_5 free, from upper angle of discal cell; M_1 free; M_2 and M_3 approximated at base, from lower angle of discal cell; CuA₁ and CuA₂ free; 1A+2A free; discal cell open, 1/2 length of forewing. Hindwing with 10 veins: Sc+R₁ and Rs stalked for 1/2 length of Rs; M_1 free; M_2 free, faded from 1/2 of M_2 to base; M_3 and CuA₁ free; CuA₂ free; CuP free, faded from 1/3 of CuP to base; 1A+2A and 3A free; discal cell absent. Abdomen with white scales.

Tympanal organs (Figs. 19–20). Tympanal cases (=bulla tympani, caisses tympaniques) enlarged, broadly separated, and areas on either side of the elongated pons tympani slightly sclerotized, tympanic frame (=fornix tympani, cadre tympanique) and ramus tympani highly sclerotized, with a sclerotized medial line extending posteriorly, and praecinctorium a single long lobe.

Male genitalia (Figs. 14–16). Hood-like uncus and gnathos cheliform; gnathos smooth, not dentate; tegumen almost same length as vinculum; valva nearly subspatulate; juxta broad, slightly sclerotized; saccus U-shaped; phallus cylindrical, coecum slightly over two times the length of the distal area beyond the ductus ejaculatorius, hook or club-shaped cornuti present.

Female genitalia (Figs. 17–18). Anterior apophyses and posterior apophyses long of almost equal size; ostium tube-shaped, membranous; antrum weakly sclerotized; ductus bursae narrow, membranous; corpus bursae ovoid, without signum.

Distribution. Micronesia (Chuuk, Kosrae), Samoa, Fiji, Papua New Guinea, Borneo.

Etymology. The generic name is a combination of the prefix "*Pacifi*," from "Pacific Ocean," and the suffix "*Musotima*," from the type genus "*Musotima*". Gender is feminine.

Remarks. We place *Pacifimusotima* in Musotiminae based on the laterally compressed antennae, in the forewing venation R_2 is stalked or approximated with R_{3+4} , and the tympanal cases are enlarged, although it lacks a reduced coecum in the phallus that is found in most musotimines (it is three times the length of the distal area beyond the ductus ejaculatorius) (Minet 1982, 1985; Solis *et al.* 2005a, b; Yen 1996; Yen *et al.* 2004).

The genus is exclusively found on islands in the Pacific Ocean, with its most easily recognizable characteristic being the W-shaped marking on the postmedial area of the white forewing. We searched for species resembling the new genus within Musotiminae, but especially in the genus *Parthenodes* where the undescribed species had been placed previously by E. G. Munroe and E. L. Martin (see label data below). An examination of all species within *Parthenodes* revealed that the species *P. eugethes* and *P. rectangulalis* were congeneric with the new genus described here. Therefore, we transfer *Parthenodes eugethes* **comb. nov.** and *P. rectangulalis* **comb. nov.** to the genus *Pacifimusotima*, newly described in this study. Additionally, species labeled *Musotima* sp. 6 and sp. 17 and figured in the recently published volume of Bornean moths by Whitaker *et al.* (2023), have the characteristic W-shaped marking on the postmedial area on a white forewing and upon examination they will probably be found to belong in this new genus. Upon preliminary examination of type specimen images of species in *Parthenodes*, we noted

that they are not congeneric with the type species, *P. hydrocampalis* Guenée, 1854, described from two syntypes (labelled "co-types"), one male and one female, from Cayenne, French Guiana (Fig. 4) (lectotype to be designated in a future paper). We figure type specimens of some of the other species, *P. parallelalis* Hampson, 1917 (Fig. 5) from Peru (not to be confused with *Paracymoriza parallelalis* Sauber in Semper, 1902, (Acentropinae) described from the Philippines), and from India *P. bisangulata* (Hampson, 1896) (Fig. 6) and *P. nigriplaga* (Swinhoe, 1894) (Fig. 8). They will require careful examination and study for their placement in a future paper.

Pacifimusotima kosrena Ko & Solis, sp. nov.

(Figs. 1, 9–14, 17, 19)

Type materials. Holotype: ♂, MICRONESIA, KOSRAE: Okat, 09.XI.2022, (Jung S.W., Kim Y.H., Ko J.H.), (N5°20'41.4", E162°58'15.5" Alt.: 3 m), genitalia slide no. DIC-051.

Paratypes. (16 \mathcal{J} , 3 \mathcal{Q}), MICRONESIA: 6 \mathcal{J} , KOSRAE: Okat, 09.XI.2022, (Jung S.W., Kim Y.H., Ko J.H.), (N5°20'41.4", E162°58'15.5" Alt.: 3 m); 1 ♀, Sipyen waterfall, 10.XI.2022, (Jung S.W., Kim Y.H., Ko J.H.), (N5°17'02.9", E162°57'25.5"Alt.: 17m), genitalia slide no. DIC-052; 2 ♂, Okat, 14.II.2023, (Jung S.W., Kim Y.H., Ko J.H.), (N5°20'34.0", E162°58'35.0"Alt.: 8 m), genitalia slide no. DIC-100; 1 ♂, Tafunsak, 15.II.2023, (Jung S.W., Kim Y.H., Ko J.H.), (N5°22'06.0", E163°00'02.0"Alt.: 5 m), genitalia slide no. DIC-101; 1 3, Tofol, 16.II.2023, (Jung S.W., Kim Y.H., Ko J.H.), (N5°19'42.0", E163°00'40.0"Alt.: 2 m), genitalia slide no. DIC-095; 2 Å, Mutunlik, Alt.: 22 m, 8.II.1953, (Clarke, J.F.G.), light trap, USNMENT01894167, USNM genitalia slide no. 116386 (handwritten Munroe label "Parthenodes" sp. 1); 1 3, Mutunlik, Alt.: 22 m, 6.II.1953, (Clarke, J.F.G.), light trap, USNMENT01899030, USNM genitalia slide no. 105165 (originally CNC slide #ER460); 1 3, Mutunlik, Alt.: 22 m, 8.II.1953, (Clarke, J.F.G.), light trap, USNMENT01552840; 1 3, Mutunlik, Alt.: 22 m, 16.II.1953, (Clarke, J.F.G.), light trap, USNMENT01894098, USNM genitalia slide no. 116387; 1 3, Mutunlik, Alt.: 22 m, 26.I.1953, (Clarke, J.F.G.), light trap, USNMENT01374377; 1 ♀, Mutunlik, Alt.: 22 m, 15.II.1953, (Clarke, J.F.G.), light trap, USNMENT01374376 (handwritten labels: "Parthenodes" sp., not in B.M., nearest to eugethes Tams, det. E.L. Martin, 1953; species group placed in Parthenodes by Hampson, but are not Nymphulinae, E.L. Martin, 1953 (handwritten Munroe label "Parthenodes" sp. 1); 1 ♀, Wakap, Alt.: 490 m, 7.IV.1953. (Clarke, J.F.G.), light trap, USNMENT01552841, USNM genitalia slide no. 105166 (originally CNC slide #461).

Diagnosis. *Pacifimusotima kosrena* **sp. nov.** is morphologically very similar to *P. eugethes* (Tams, 1936), but can be distinguished by the following characteristics: a basal band is present in the basal area of the forewing; the discal reniform patch on the forewing is absent; basal and postmedial bands are present on the hindwing. In the male genitalia, the apex of the uncus is more pointed than that of *P. eugethes*; the gnathos is slender and more pointed than that of *P. eugethes*. In the female genitalia, the ductus bursae and corpus bursae are narrower than those of *P. eugethes*.

Description. *Adult* (Figs. 1, 9–13). Length of forewing 11–13 mm in both sexes. Head covered with white scales; antennae prismatic, laterally compressed; ocellus and chaetosemata absent; labial palpus upturned, covered with white scales; maxillary palpus short, covered with white scales; proboscis well–developed. Patagium and tegula covered with white scales, except brown band at dorsal center. Ground color of forewing white; basal and antemedial area with brown bands; brown postmedial fascia W-shaped from terminal area; fringe white. Ground color of hindwing white; basal band brown; postmedial band brown, with dark brown line inner; fringe white. Abdomen white.

Male genitalia (Fig. 14). Uncus elongated, strongly sclerotized, and weakly hooked at tip; gnathos elongated, almost same length as uncus and pointed at tip; tegumen almost same length as transtilla; valva nearly subspatulate, weakly curved at costa; juxta membranous, broad; saccus U-shaped; phallus cylindrical, sclerotized basally, with a hook-shaped cornutus.

Female genitalia (Fig. 17). Papillae anales ovate; posterior apophyses long, almost same length as anterior apophyses; antrum funnel-shaped, membranous; ductus seminalis from near anterior beginning of ductus bursae; ductus bursae membranous, about 1/2 length of corpus bursae; corpus bursae membranous, ovate, without signum.

Distribution. Micronesia (Kosrae), formerly known as Kusaie or Strong's Island.

Host plants. Unknown.

Etymology. The specific name was derived from the type locality, Kosrae, Micronesia.



FIGURES 9–10. Head of *Pacifimusotima kosrena* Ko & Solis, sp. nov. 9. Dorsal view; 10. Lateral view.





FIGURES 11–13. Palpi and wing venation of *Pacifimusotima kosrena* Ko & Solis, sp. nov. 11. Labial palpus; 12. Maxillary palpus; 13. Wing venation.

Pacifimusotima eugethes (Tams, 1935), comb. nov.

(Figs. 3, 16, 18, 20)

Parthenodes eugethes Tams, 1935: 261–262, pl. 15 fig. 7. TL: Samoa, Upolu, Malololelei.

Diagnosis. This species is morphologically very similar to *Pacifimusotima kosrena* Ko & Solis, **sp. nov.**, but can be distinguished by the following characteristics: a Y-shaped band is present in the basal area of the forewing; the discal reniform patch on the forewing is present; there is an ovate patch in the postmedial area of the hindwing. In the male genitalia, the apex of the uncus is more blunt than that of *P. kosrena* **sp. nov.**; the gnathos is wider and more blunt than that of *P. kosrena* **sp. nov.**; the phallus has a club-shaped cornutus. In the female genitalia, the ductus and corpus bursae are broader than those of *P. kosrena* **sp. nov.**

Redescription. *Adult* (Fig. 3). Length of forewing 11–14 mm in both sexes. Head covered with white scales; antennae prismatic, laterally compressed; ocellus and chaetosemata absent; labial palpus upturned, covered with white scales; maxillary palpus short, covered with white scales; proboscis well–developed. Patagium and tegula covered with white scales, except brown band at dorsal center. Ground color of forewing white; basal area of forewing with a brown Y-shaped band; median area with a brown reniform patch; postmedial fascia brown, W-shaped and edged with dark brown lines on both sides, except near M_3 ; Ground color of hindwing white; postmedial area with an ovate patch from M, to CuP; fringe white. Abdomen white.

Male genitalia (Fig. 16). Uncus elongated, strongly sclerotized, and weakly curved and blunt at tip; gnathos elongated, strongly sclerotized, about 2/3 length of uncus; tegumen almost same length as transtilla; valva nearly subspatulate, weakly curved at costa; juxta membranous, broad; saccus U-shaped; phallus cylindrical, sclerotized basally, with a club-shaped cornutus.

Female genitalia (Fig. 18). Papillae anales ovate; posterior apophyses long, almost same length as anterior apophyses; antrum funnel-shaped, membranous; ductus seminalis from near anterior beginning of ductus bursae; ductus bursae membranous, about 1/2 length of corpus bursae; corpus bursae membranous, ovate, without signum.

Material examined. $(2 \ 3, 1 \ 2)$, SAMOA: $2 \ 3$, Western Samoa, Upoulu Island, Apia District, Letava, 1800', 16–17.XI.1976, (D. & M. Gaskin), USNMENT01894135; USNMENT01894129, USNM genitalia slide no. 116392; $1 \ 2$, same locality, USNMENT01894141, USNM genitalia slide no. 116391.

Distribution. Samoa. **Host plants.** Unknown.

Pacifimusotima rectangulalis (Kenrick, 1907), comb. nov.

(Figs. 2, 7, 15)

Parthenodes rectangulalis Kenrick, 1907: 77, pl. 4 fig. 58. TL: Papua New Guinea, Ekeikei; Dinawa.

Diagnosis. This species is morphologically similar to *Pacifimusotima eugethes* (Tams, 1935), but can be distinguished by the following characteristics: brown basal and black antemedial bands are present on the forewing (only a Y-shaped basal band in *P. eugethes*); black broad marking near the dorsum on the forewing is present (absent in *P. eugethes*); wide broad marking of dark brown mixed with black patterns is present on the hindwing (dark brown an ovate patch in *P. eugethes*). In the male genitalia, the uncus is more curved than that of *P. eugethes*; the gnathos is more slender than that of *P. eugethes*; phallus has a hook-shaped cornutus (club-shaped in *P. eugethes*).

Redescription. *Adult* (Figs. 2, 7). Length of forewing 11–13 mm in both sexes. Head covered with yellow scales; antennae prismatic, laterally compressed; ocellus and chaetosemata absent; labial palpus upturned, covered with white scales; maxillary palpus short, covered with white scales; proboscis well–developed. Patagium and tegula covered with white scales, except brown band at dorsal center. Ground color of forewing white; basal band brown; antemedial band black; postmedial fascia brown, widely W-shaped, edged with black lines on both sides, except edge from M_2 to costal margin and a white line between M_1 and M_2 ; fringe white, except black from M_2 to M_3 . Ground color of hindwing white; brown spread marking from basal to postmedial area; postmedial area with black undulate marking from M_1 to CuP; fringe white, except black from 1A+2A to 3A. Abdomen white.



FIGURES 14–16. Male genitalia of *Pacifimusotima* spp. 14a. *P. kosrena* Ko & Solis, sp. nov., holotype, DIC-051; 14b. *P. kosrena* Ko & Solis, sp. nov., paratype, DIC-101; 15. *P. rectangulalis*, comb. nov., USNMENT01994059, USNM genitalia slide no. 116394; 16. *P. eugethes*, comb. nov., USNMENT01894141, USNM genitalia slide no. 116391.



FIGURES 17–20. Female genitalia and tympanal organs of *Pacifimusotima* spp. 17. *P. kosrena* Ko & Solis, sp. nov., female genitalia, paratype, DIC-052; 18. *P. eugethes* comb. nov., female genitalia, USNMENT01894129, USNM genitalia slide no. 116392; 19. *P. kosrena* Ko & Solis, sp. nov., tympanal organ, paratype, DIC-101; 20. *P. eugethes*, comb. nov., tympanal organ, USNMENT01894141, USNM genitalia slide no. 116391.

Male genitalia (Fig. 15). Uncus elongated, strongly sclerotized, and weakly hooked at tip; gnathos elongated, almost same length as uncus and pointed at tip; tegumen almost same length as transtilla; valva nearly subspatulate, weakly curved at costa; juxta membranous, broad; saccus U-shaped; phallus cylindrical, sclerotized basally, with a hook-shaped cornutus, and tip of cornutus very pointed.

Female genitalia. Unknown.

Material examined. (2 ♂), PAPUA NEW GUINEA: 1 ♂, Gulf Prov. Ivimka Res. Sta., Lakekamu, 4. IV. 2000, (E.T. Sears), (07°44'S 146°30'E), USNMENT01994059, USNM genitalia slide no. 116394; MICRONESIA: 1 ♂, Chuuk, Bubu, 24.VIII.1957, (no collector name), USNMENT01894106, USNM genitalia slide no. 116393.

Distribution. Micronesia (Chuuk), Papua New Guinea, Borneo (Whitaker et al. 2023).

Host plants. Unknown.

Acknowledgements

We thank Ben Proshek, Systematic Entomology Laboratory (SEL, USDA), who provided the modern dissections and photography of specimens at the NMNH for this paper. We extend our sincere thanks to Dr. Jae–Shin Kang, Dr. Mi–Jeong Jeon, and Dr. Seong-Hyeon Jo from the National Institute of Biological Resources (NIBR), Ministry of Environment, Korea, for their kind arrangements and support in organizing the field trip to Kosrae, Micronesia. We express our appreciation to the authority in Kosrae, Micronesia, particularly Mr. Steve Palik of the Kosrae Island Resource Management Authority, a semi-autonomous agency of the Kosrae State Government, FSM, for permission to conduct a survey in Kosrae to study its insect biodiversity. We also express our thanks to Dr. Sang Woo Jung and Dr. Yoon–Ho Kim of DASARI Research Institute of BioResources for their help collecting while in Kosrae, Micronesia. Special thanks are also extended to Dr. Théo Léger and Dr. Scott Miller for their invaluable help in searching for additional material, Dr. Shen-Horn Yen for discussions and a PDF of his paper on *Aeoloptera*, and Dr. Théo Léger and two additional reviewers for their comments on the manuscript. This work was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR202406203). Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by USDA. USDA is an equal opportunity provider and employer.

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