

A new species of *Pachyrhabda* Meyrick (Lepidoptera: Stathmopodidae) from the Korean Peninsula

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Abstract

The Stathmopodidae, belonging to the Gelechioidea, was first reported by Edward Meyrick in 1913. Since then, species with various morphological characters and various ecological adaptations such as feeding on crops, mosses, and aphids have been reported. In this study, we report the genus *Pachyrhabda* Meyrick, 1897, for the first time in the Korean Peninsula. This genus of moths is known for consuming spores of ferns. In the present article, we report the discovery of a new species, *Pachyrhabda benearena* **sp. nov.** It is diagnosed from the congeneric species by irregular brown spots on the forewings. The new species' description and geographic distribution information are provided. Additionally, a world checklist of the genus is provided.

Key words: Stathmopodidae, *Pachyrhabda*, new species, Korea, taxonomy

Introduction

Stathmopodidae is one of the families within the superfamily Gelechioidea (Lepidoptera), with over 350 species that have been reported up to the present (Shen & Hsu 2023). Stathmopodid moths are distributed worldwide, with the highest diversity in Indo-Australian and Afrotropical regions (Koster & Sinev 2003). The characters shared within the family are as follows: i) long hind tibia with dense tufts; ii) stathmopodids have a wide variety of forewing colours and patterns depending on the species (Park *et al.* 2018). Some species within the family are considered pests because they feed on crops (e.g. *Stathmopoda auriferella* Walker), but some other species feed on mosses (e.g. *S. opticaspis* Meyrick) and fern spores (e.g. *Cuprina atayalica* Shen & Hsu) (Terada 2013; Yang *et al.* 2013; Shen & Hsu 2020). Within this family, even predators are found (e.g. *Atkinsonia ignipicta* Butler) which feed on small insects like aphids (Aoki & Kurosu 2010). However, because of the lack of taxonomic and ecological studies and the similarity of species, confusion in species identification remains a problem (Kim *et al.* 2017). Depending upon the food choice, this family of moths can act as a serious pest, so further study into species identification problematics is necessary to establish an accurate quarantine regime (Terada *et al.* 2011).

In the Korean Peninsula, the first record of Stathmopodidae was reported by Park (1983) presenting four species belonging to the genus *Stathmopoda*. Since then, additional genera and species have been reported at a regular basis, and recently, the genera *Cuprina* Sinev and *Calicotis* Meyrick were added to the list. The biological peculiarity of the latter genera is that the moths feed on the spores of ferns (Koo *et al.* 2018; Sohn 2023). In the present study, we report the distribution pattern of the genus *Pachyrhabda* Meyrick for the first time in Korean Peninsula. The moths of this genus are known to feed on fern spores. Our investigation led to the discovery of *P. benearena* **sp. nov.** We also present the checklist of all *Pachyrhabda* species in the world, see Table 1.

TABLE 1. Checklist of the genus *Pachyrhabda* Meyrick in the world.

New species from this study is indicated with an asterisk*.

Abbreviations: AFR, Afrotropic: Sc, Seychelles; Za, South Africa; AUS, Australasia: Au, Australia; Nz, New Zealand; OCE, Oceania: Ws, Samoa; Sb, Solomon Island; Vu, Vanuatu; PAL, Palearctic: Jp, Japan; Kr, Korea; Tw, Taiwan; IND, Indomalaya; In, India; Id, Indonesia; Lk, Sri Lanka; TL, Type Locality.)

Species of <i>Pachyrhabda</i>	Distribution												
	AFR		AUS		OCE			PAL		IND			
	Sc	Za	Au	Nz	Ws	Sb	Vu	Jp	Kr	Tw	In	Id	Lk
<i>P. acrosicia</i> Turner, 1941 TL: Queensland.			•										
<i>P. adela</i> Turner, 1923 TL: Queensland.			•										
<i>P. aedificatrix</i> Terada, 2016 TL: Honshu.								•					
<i>P. amianta</i> Meyrick, 1927a TL: Samoa.					•								
<i>P. antinoma</i> Meyrick, 1910 TL: Kermadec Islands.			•	•									
<i>P. argyritis</i> Turner, 1941 TL: North Queensland.			•										
<i>P. argyrocosmos</i> Terada, 2016 TL: Ishigaki Island.								•					
<i>P. aurea</i> Terada, 2016 TL: Honshu.								•					
<i>P. bacterias</i> Meyrick, 1913b TL: Ceylon.			•										•
<i>P. benearena</i> Kim sp. nov.* TL: Republic of Korea, Gangwan Province, Yangyang, Ganghyeon.									•				
<i>P. campylosticha</i> Turner, 1941 TL: Queensland.			•										
<i>P. capnoscia</i> Turner, 1923 TL: Queensland.			•										
<i>P. citrinacma</i> Meyrick, 1936 TL: Formosa.										•			
<i>P. dicastis</i> (Meyrick, 1905) TL: Ceylon.													•
<i>P. epichlora</i> (Meyrick, 1889) TL: Auckland.				•									
<i>P. euphanopsis</i> Meyrick, 1927b TL: New Hebrides.							•						
<i>P. fissa</i> Meyrick, 1921 TL: Java.											•		
<i>P. fuscimaculata</i> Terada, 2016 TL: Honshu.								•					
<i>P. hygrophaes</i> Turner, 1923 TL: Queensland.			•										

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TABLE 1 (Continued)

Species of <i>Pachyrhabda</i>	Distribution												
	AFR		AUS		OCE			PAL			IND		
	Sc	Za	Au	Nz	Ws	Sb	Vu	Jp	Kr	Tw	In	Id	Lk
<i>P. inanis</i> Meyrick, 1936 TL: Java.												•	
<i>P. liriopis</i> Turner, 1941 TL: Queensland.			•										
<i>P. margaritacea</i> Terada, 2016 TL: Kyushu.								•					
<i>P. phanta</i> Bradley, 1957 TL: Rennell Island.						•							
<i>P. punctifera</i> Turner, 1941 TL: Queensland.			•										
<i>P. steropodes</i> Meyrick, 1897 TL: Warragul.			•										
<i>P. suspecta</i> Meyrick, 1921 TL: Java.	•											•	
<i>P. tridora</i> (Meyrick, 1911) TL: Silhouette.		•											
<i>P. triplecta</i> Meyrick, 1913a TL: Barberton.		•											
<i>P. tumida</i> Meyrick, 1913b TL: Ceylon.													•
<i>P. unctoria</i> Meyrick, 1911 TL: Haenertsburg.		•											
<i>P. vaginivella</i> Terada, 2016 TL: Tokunoshima Island.											•		
<i>P. viscosa</i> Meyrick, 1913b TL: Assam.											•		
<i>P. xanthoscia</i> Turner, 1923 TL: Queensland.			•										

Materials and methods

This specimen was collected in July 2011 at an altitude of 165 m, in the Republic of Korea, Gangwon Province, Yangyang-gun (38°08'01"N, 128°33'31"E) using a light trap. Genitalia slide preparation followed the procedure of Kim *et al.* (2017). The specimens and their genitalia were photographed using Leica Z16APO photographing system with Dome illuminator Leica LED5000HDI and processed with the software Tucsen Mosaic 2.4. The Software DeltaBio MultiFocus Ver.24 was used to composite photos taken at multiple focal points of the same object. Examined in this study specimens and their slide vouchers are deposited in the laboratory of Insect Phylogenetics and Evolution, Jeonbuk National University (IPE JBNU), Republic of Korea.

Taxonomic accounts

Genus *Pachyrhabda* Meyrick, 1897

Pachyrhabda Meyrick, 1897; *Proceedings of the Linnean Society of New South Wales*, 22 (2): 312. Type species: *Pachyrhabda steropodes* Meyrick, 1897, by monotypy.

***Pachyrhabda benearena* Kim sp. nov.**

Type material. Holotype: ♂, Republic of Korea, Gangwon Province, Yangyang, Ganghyeon, 10 July 2011, leg. Sora Kim, gen. slide no. 9157; [deposited in JBNU].

Diagnosis

The new species is superficially similar to *Pachyrhabda argyrocossus* Terada, 2016 but can be easily distinguished by the ground colour and markings of the forewing. The latter species has paler forewings with large two darker blotches and hind tibia with dense tufts, while in the new species *Pachyrhabda benearena* Kim sp. nov. many irregular dark brown spots are dispersed in a disordered manner on the forewing; hairs on the hind tibia are almost absent.

Male genitalia of the new species are close to *P. fuscimaculata* Terada, 2016 but differ in the shape of uncus and aedeagus. Uncus of the new species is tapering towards the apex with a swollen part at the middle and mainly has few setae at the middle, aedeagus has a sclerotized plate and a tooth-shaped cornutus at vesica. While uncus of *P. fuscimaculata* is bell-shaped and densely setose; aedeagus has only a sclerotized plate at vesica.

Description

Male (Fig. 1). *Head*. Vertex and frons yellowish ochreous, covered with white scales shaped rounded at the base and tapering toward the apex. Occiput of the same colour as vertex and covered with scales of the same shape as on vertex. Antennal flagellomeres are dark ochreous without cilia. Flagellum up to 54th flagellomere, ochreous interchanging with dark ochreous flagellomere one by one, but from 55th flagellomere, one ochreous flagellomere is followed by three dark ochreous flagellomeres and such interchangeable pattern of flagellomere colour is repeated up to the apex. Antenna ca. 4/5 the length of forewing; scape pale ochreous. Labial palpus pale ochreous, slightly upcurved with acute apex; terminal palpomere partially brownish ochreous.

Thorax. Mostly yellowish ochreous. Wing span ca. 10.5 mm. Forewing with irregular dark brownish spots on a pale ochreous background; pale yellowish cilia along termen. The ground colour of the hindwing is pale ochreous with darker shading towards the apex; cilia pale yellowish. Fore tibia dark ochreous. Mid tibia is mostly ochreous; a pair of brownish long and thick spurs present at the apical part of the mid tibia. Hind tibia is dorsally dark brown and pale ochreous ventrally with two pairs of ochreous long and thick spurs at the basis and at the apex of the tibia. Each tarsus is dark brown dorsally with a pair of short brownish erect scales.

Male genitalia (Fig. 2). Uncus straight, tapering apically, with a swollen part at the middle and some sparsely distributed setae laterally. Gnathos consists of two parts: posterior round-shaped part, and the anterior part that is broadly tongue-shaped, as long as uncus; with short dense setae at the caudal anterior part. Tegumen is as long as half of valval length. Valva broad, slightly arched with gently rounded cucullus; dorsal margin of cucullus smoothly arched; sacculus convex caudally, sclerotized at the base which is covered by short setae, gently concave near the dorsal margin, the inner surface of sacculus with numerous setae. Vinculum short, broad, and irregularly shaped. Aedeagus as long as a genital capsule, narrow tubular shaped and long sclerotized cornutus on vesica, a tooth-shaped sclerotized structure present near the base of vesica, long, narrow, lineal cornutus stretches along almost the entire length of aedeagus dorsally.

Female genitalia. Unknown.

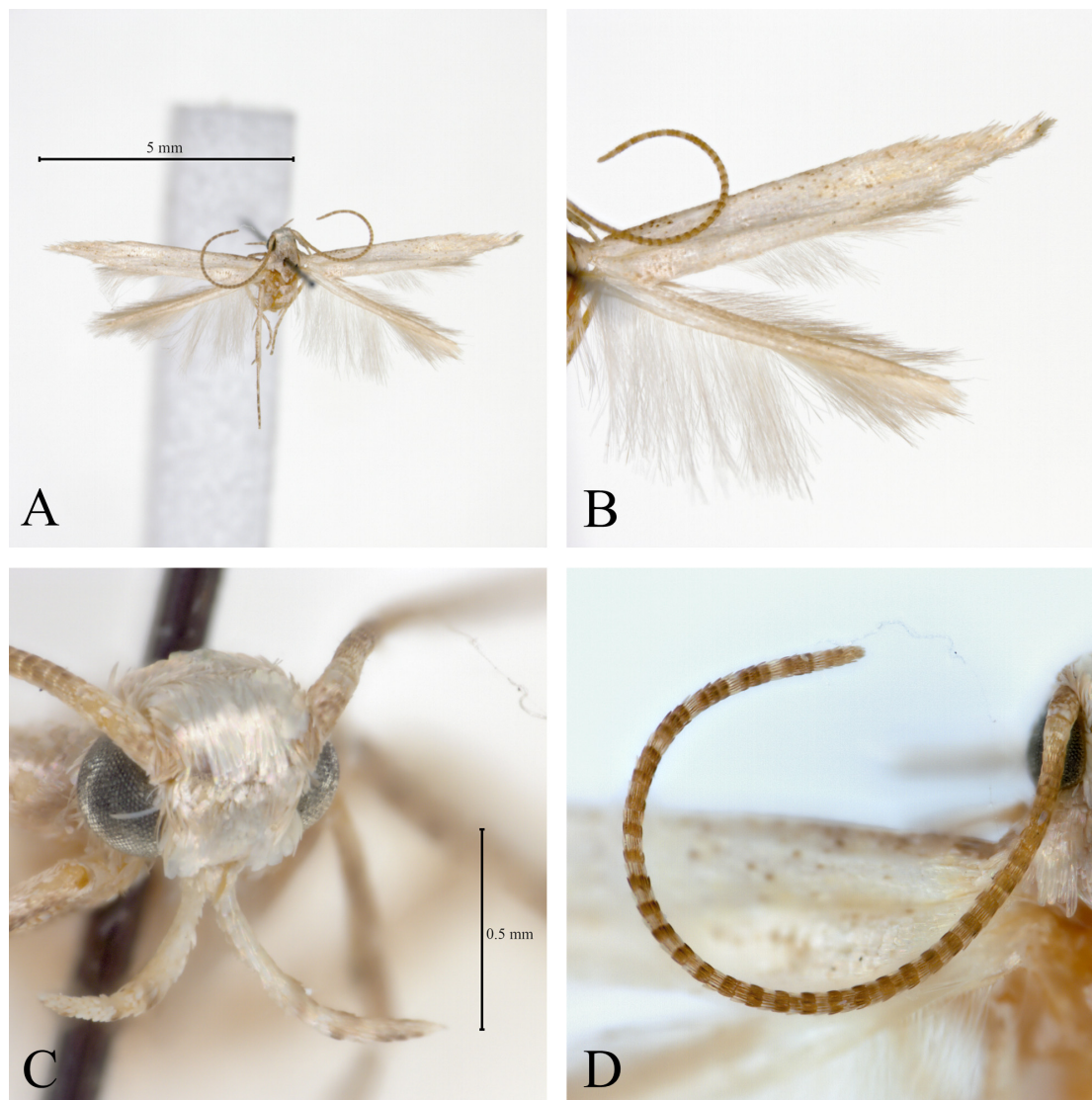


FIGURE 1. *Pachyrhabda benearena* sp. nov. A, adult; B, wing; C, head; D, antenna.

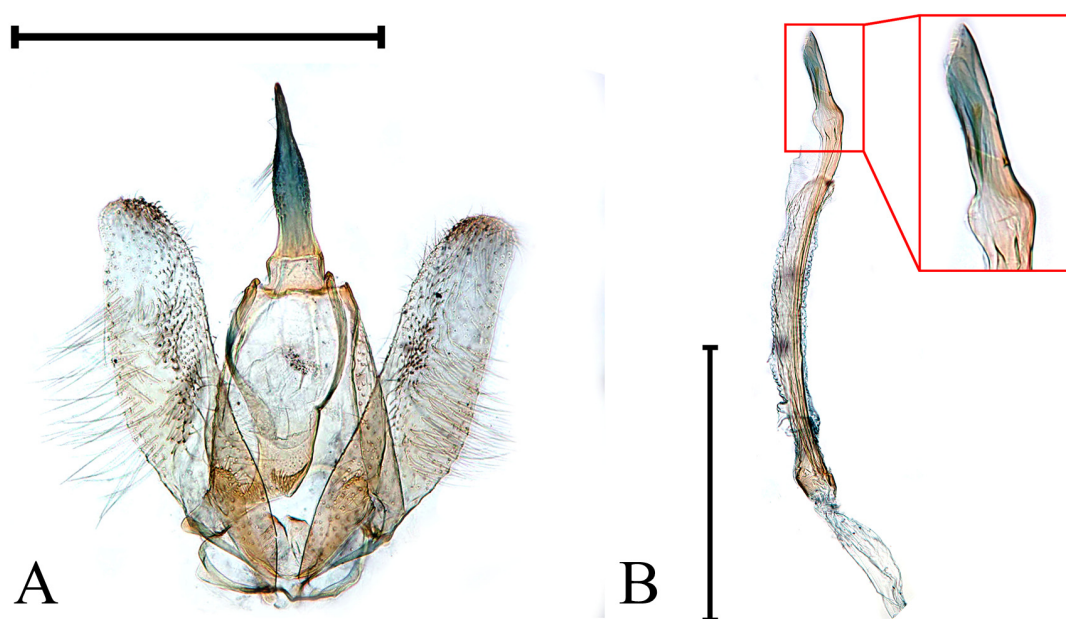


FIGURE 2. Genitalia of *Pachyrhabda benearena* sp. nov. A, male genitalia; B, aedeagus. Scale bar, 0.5 mm.

Distribution

Palearctic: Korea: known only from the type locality in Gangwon Province, Korean Peninsula (Fig. 3).

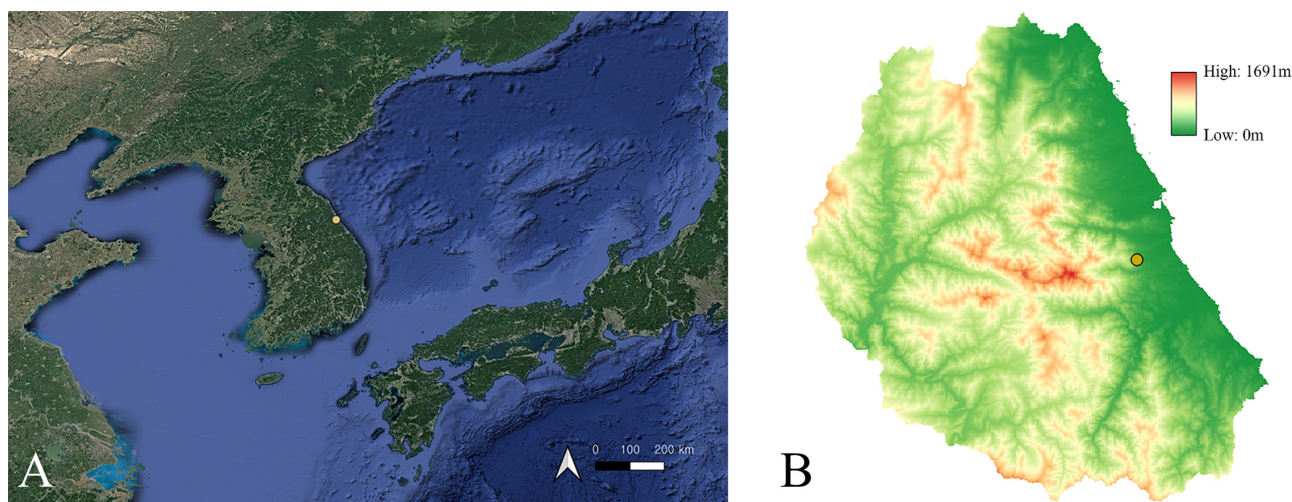


FIGURE 3. Collection site (in yellow circle) of *Pachyrhabda benearena* sp. nov. A, type locality of new species in Korean Peninsula by QGIS 3.30.0 using an EPSG:4326-WGS 84 coordinate system; B, the topography of the collecting site using QGIS 3.30.0 and data from the National Geographic Information and National Spatial Information Portal.

Etymology

The species name is a composite word derived from the Latin, “bene” and “arena”, meaning “well” and “sand”. The species-group name indicates the ground colour of the forewing with darker spots, a pattern reminiscent of sand in a desert.

Discussion

In this study, we present a new species belonging to the genus *Pachyrhabda* of the family Stathmopodidae. The genus has not been reported in the Korean Peninsula until now, and herewith we present the first record of this genus collected in Gangwon Province. The new species has been described in detail not only for the generally diagnosed characteristics such as the colour of the forewing, and genitalia traits but also for the specific pattern observed in the antenna. In 2016, Terada proposed the diagnostic characters attributed to the genus and provided a key for species identification within the genus *Pachyrhabda* with indications about the length of the antenna. However, the pattern of the antenna skipped the recording notes. We anticipate further study that is aimed to determine whether the colour pattern on antenna is a species-linked character and significant for species identification within the present genus or it lacks diagnostic significance.

The genus *Pachyrhabda* has been reported to feed on spores of fern, but many species belonging to the family Stathmopodidae have a diverse ecology, like feeding on fruits, aphids, and spider eggs (Elgar *et al.* 1983; Aoki & Kurosu 2010; Yang *et al.* 2013). Therefore, additional research on the ecology and diversity of the Stathmopodidae, including the genus *Pachyrhabda*, is essential for understanding the flora and insect fauna relationships in specific regions. Especially, the area where the new species described in this study was discovered, Gangwon Province, is among the few regions in Korea where the natural environment is well-preserved (Choe & Thorne 2017). Gangwon Province is located in the northeast region of South Korea, and 90% of its total area is covered by forests (Jun *et al.* 2017). Moreover, a warm micro-climate is formed in Yangyang-gun, the area adjacent to the coast and shielded from the cold monsoon by the Taebaek Mountains, facilitating the support of the high diversity of plants (Han & Kang 2009). Moreover, new species have continuously been reported in the area (Seung & Lee 2019; Park *et al.* 2023). So, it is anticipated that if additional biodiversity research is conducted in this area, various new species will be discovered and reported.

Acknowledgements

This study was carried out with the support of the Honam National Institute of Biological Resources (HNIBR) of the Republic of Korea (Project No. HNIBR202201201). Additionally, this work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIT) (No. RS-2024-00345586).

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