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Revision of the family Metarbelidae (Lepidoptera) of the Oriental Region. XI. Genus *Psychidarbela* Roepke, 1938

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Abstract
The article presents an illustrated catalog of the genus *Psychidarbela* Roepke, 1938 (Lepidoptera: Cossoidea, Metarbelidae), which includes four species. New synonymy and combination is established: *Psychidarbela* Roepke, 1938 = *Laonagoda* Nonaka, 2021 **syn. n**. and *Psychidarbela pellucida* (Nonaka, 2021) **comb. n**. Two new species are described: *Psychidarbela lehmanni* Yakovlev & Hulsbosch, **sp. n**. (Type locality: Indonesia, West Timor, env. Buraen, 60 km SE Kupang) and *Psychidarbela blancoi* Yakovlev & Hulsbosch, **sp. n**. (Type locality: Philippinen, Mindanao, Prov. Simangani, Cotabato, Mt. Busa, near Kainba). The female of *Psychidarbela pellucida* (Nonaka, 2021) is described. The distributional maps for all the species of the genus are provided.

Key words: biodiversity, Cossoidea, entomology, Asia, Paleotropics, Metarbelidae, taxonomy, new species.

Introduction

Roepke (1938) described the special monotypic genus, *Psychidarbela,* for *P. kalshoveni* Roepke, 1938 (by original designation) from Java Island. The type series of *P. kalshoveni,* in addition to the holotype (male), includes the allotype (female) and 7 paratypes (2 males and 5 females) bred from pupae picked up from the trunks of *Cordia obliqua* Willd. (Boraginaceae) in the forest of *Tectona grandis* L.f. (Lamiaceae). One of the brightest characters of the genus *Psychidarbela* is the distinctive sexual dimorphism (males are smaller than females, and have transparent wings, unlike the females). In the original description Roepke (1938) suggests that *P. kalshoveni* may refer to "Fam. Squamuridae (Arbelidae or Metarbelidae auct.)", however, as he writes later himself (Roepke 1957: 42) "Having investigated the genitalia of a number of Eastern Squamuridae, it is clear to me that *Psychidarbela* undoubtedly belongs to the Cossidae". Schoorl (1990) does not mention the genus *Psychidarbela* in his dissertation at all.

Nonaka (2021) described the genus *Laonagoda* Nonaka, 2021 (Limacodidae) from Laos for *L. pellucida* Nonaka, 2021 (by original designation). *L. pellucida* was described on two males, externally very similar to the males of *P. kalshoveni.* The male genitalia of *P. kalshoveni* and *L. pellucida* are very similar in the structure (with narrow lanceolate valves and wide lamellar processes at the bases of the gnathos arms). Thus, *P. kalshoveni* and *L. pellucida* belong to one genus.

In the recent years, the data on the little studied family of Metarbelidae have been collected, firstly due to the active explorer from Germany, Ingo Lehmann, who published (in some cases, with co-authors) a significant number of thorough and important revisions, firstly on the African fauna (Lehmann 1997, 2008, 2009, 2010a, b, 2011, 2012, 2013, 2014, 2019a, b; Lehmann & Rajaei 2013; Lehmann & Dalsgaard 2023; Lehmann et al. 2018, 2023). Our scientific team (Yakovlev & Zolotuhin 2020, 2022) is developing the taxonomy of the oriental Metarbelidae. *Aukorbela golovizini* Yakovlev & Zolotuhin, 2022, recently described by us, has the habitus "typical" for the Metarbelidae family, and the male genitalia are very similar to those of the genus *Psychidarbela.*

Thus, we support Roepke's opinion that the genus *Psychidarbela* belongs to the family Metarbelidae. The overview of this little studied genus is presented below.

Material and methods

The materials for the study were the adult Metarbelidae specimens deposited in various collections:

MWM Museum of Thomas Witt (Munich, Germany) – nowadays a part of ZSM since 2020;
NBCL Naturalis Biodiversity Center, Leiden (the Netherlands);
RYB private collection of Roman Yakovlev (Barnaul, Russia);
RHE private collection of Ramon Hulsbosch (Echt, the Netherlands);
UMTU The University Museum, The University of Tokyo, Tokyo (Japan);
ZSM Zoologische Staatssammlung der Bayerischen Staaten (Munich, Germany).

Male and female genitalia were mounted in euparal on slides following Lafontaine and Mikkola (1987) and examined with an Olympus SZX16 microscope. The images were taken with the digital camera CMOS 20.7 megapixels and processed using Corel Photo-Paint 2017 software. The morphological terminology follows Kristensen (2003).

Taxonomical part

Genus *Psychidarbela* Roepke, 1938

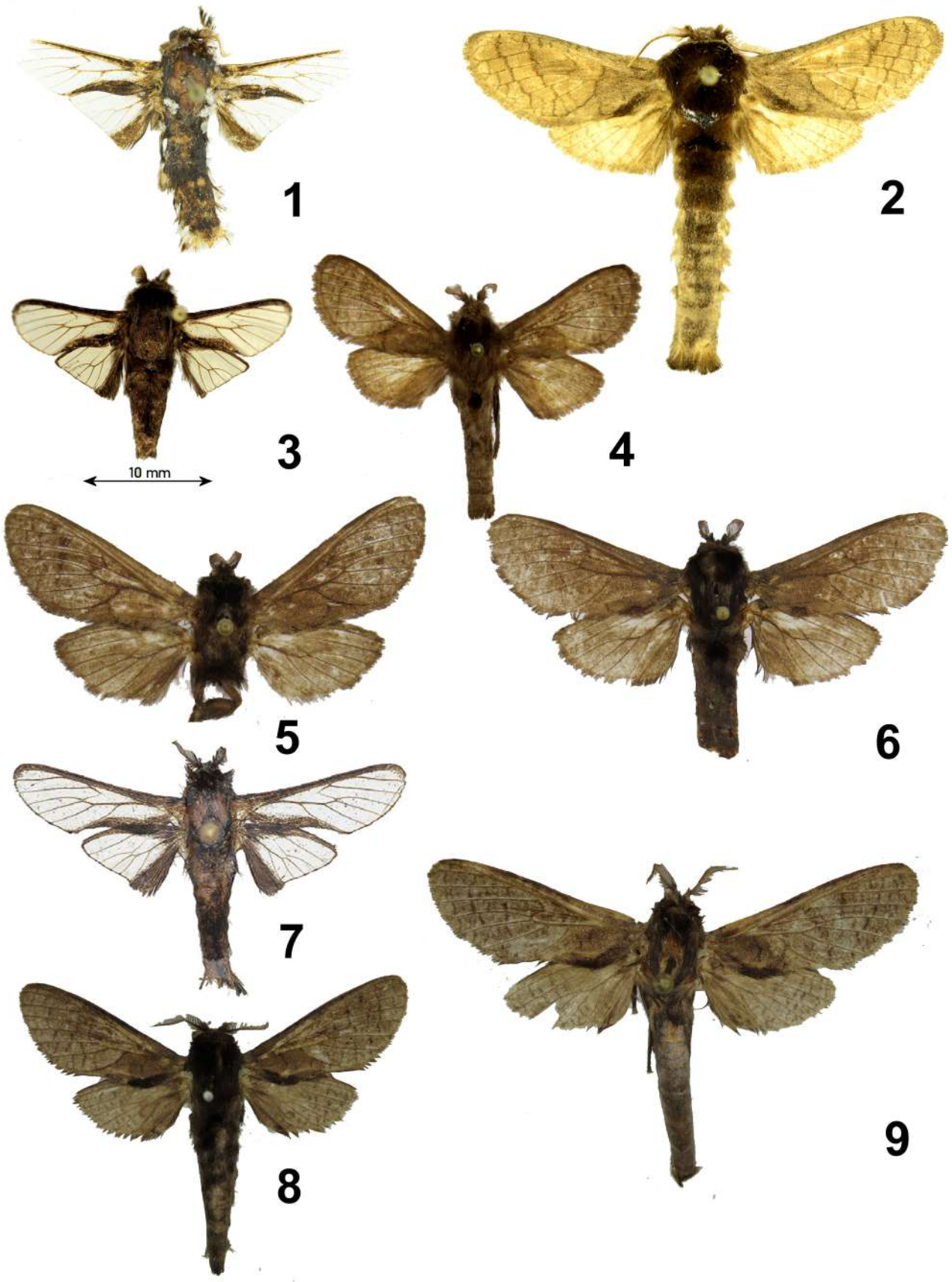
Roepke, 1938: 22−23.
Type species (by original designation) *Psychidarbela kalshoveni* Roepke, 1938

= *Laonagoda* Nonaka, 2021, **syn. n.**
Nonaka, 2022: 60−61.
Type species (by original designation) *Laonagoda pellucida* Nonaka, 2021

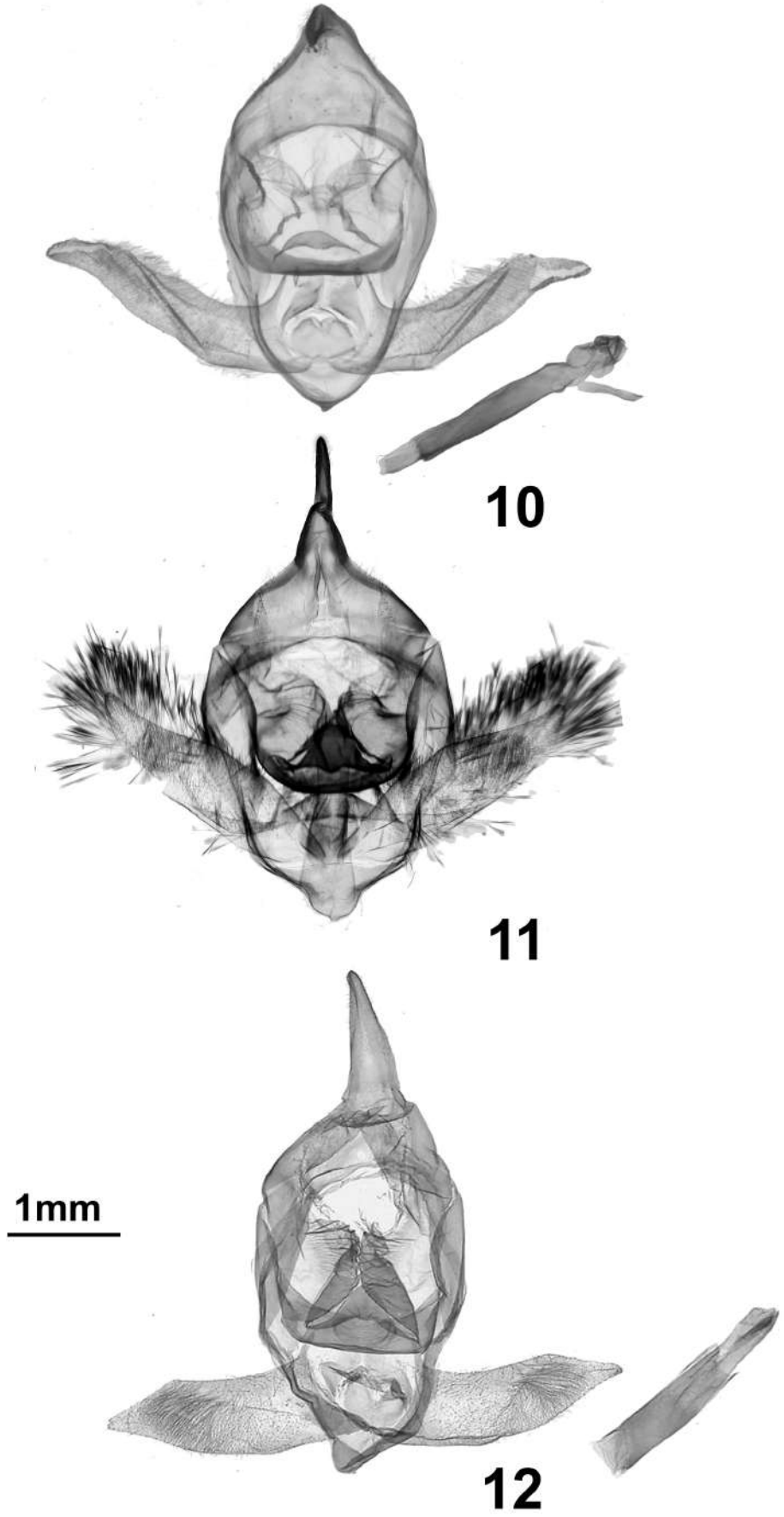
Psychidarbela kalshoveni Roepke, 1938

Figs 1–2, 10, 13, 17

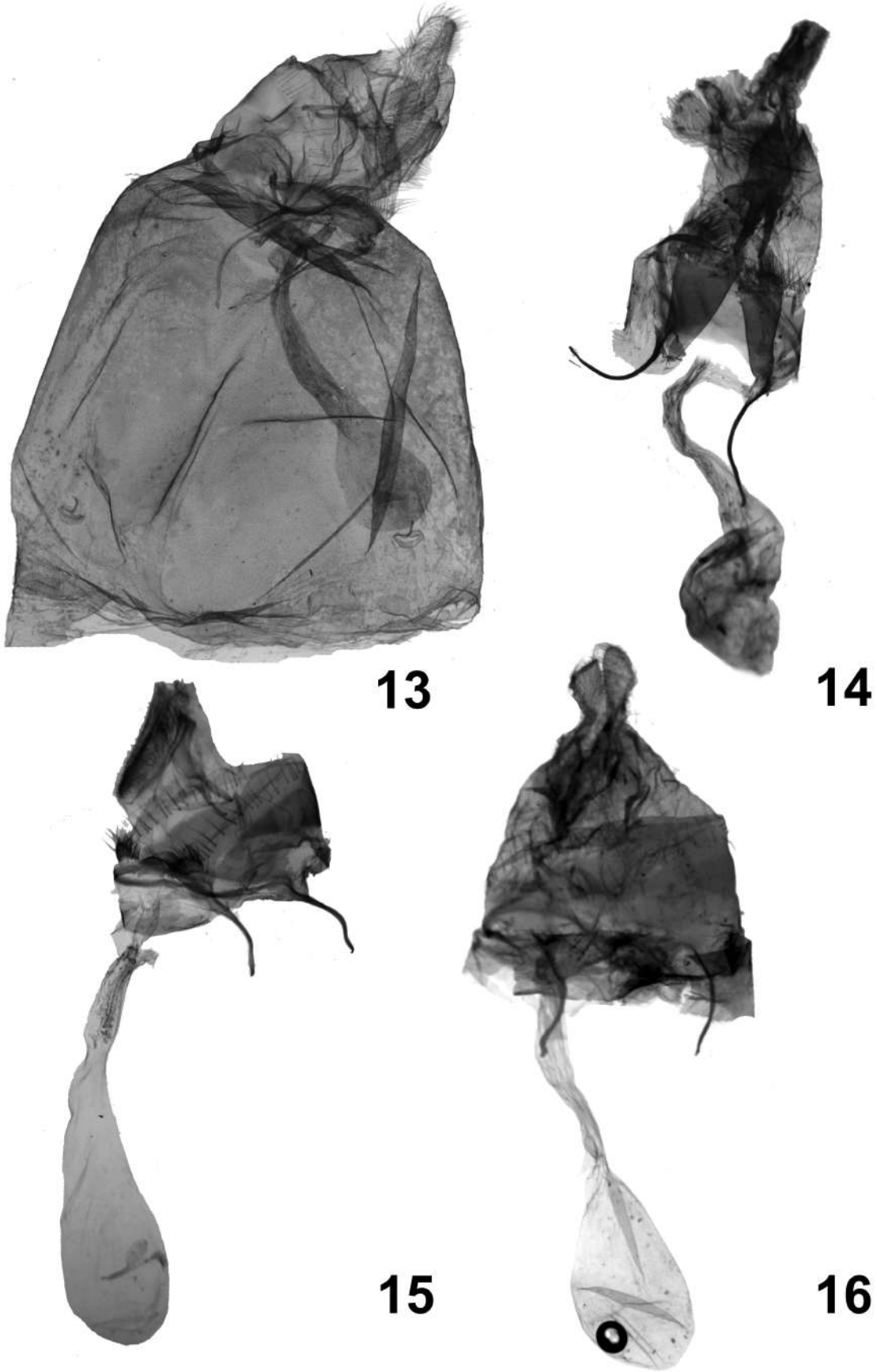
Roepke, 1938: 23−26.
Type material (Holotype, male) in NBCL, examined.
Type locality: [Indonesia], Kedoengdjati [-6.9608° / 109.3193°], Mittel-Java [Jawa Tengah Province].
Distribution: Indonesia, Java Island.



Figures 1–9. Adult specimens of *Psychidarbela*: 1. *P. kalshoveni*, male, paratype (NBCL); 2. *P. kalshoveni*, female, allotype (NBCL); 3. *P. lehmanni*, male, holotype (RHE); 4. *P. lehmanni*, female, paratype (MWM); 5. *P. blancoi*, female, holotype (MWM); 6. *P. blancoi*, female, paratype (MWM); 7. *P. pellucida*, male, holotype, from Nonaka 2021 (UMTU); 8. *P. pellucida*, female, Laos (RYB); 9. *P. pellucida*, female, Thailand (RYB).



Figures 10–12. Male genitalia of *Psychidarbela*: 10. *P. kalshoveni*, paratype (NBCL); 11. *P. lehmanni*, holotype (RHE); 12. *P. pellucida*, holotype, from Nonaka 2021 (UMTU).



Figures 13–16. Female genitalia of *Psychidarbela*: 13. *P. kalshoveni*, paratype (NBCL); 14. *P. lehmanni*, paratype (MWM); 15. *P. blancoi*, holotype (MWM); 16. *P. pellucida*, Laos (RYB).

***Psychidarbela lehmanni* Yakovlev & Hulsbosch, sp. n.**
https://zoobank.org/urn:lsid:zoobank.org:act:7E00AE60-E025-4411-88FD-4681ABB57563
Figs 3–4, 11, 14, 17

Material examined. Holotype, male, Indonesia, West Timor, env. Buraen, 60 km SE Kupang [Amarasi Selatan, Kupang, Nusa Tenggara Timur Province, 10°17'9" S / 123°51'28" E], 350 m, 10–27.ii.2006, leg. St. Jakl (RHE). Paratypes: 4 females, same data and same locality (MWM).

Description. Male. Length of fore wing 11 mm. Antenna short (about 1/4 of fore wing in length), bipectinate, setae 4 times longer than antenna stem in diameter. Thorax and abdomen densely covered with brown scales. Fore wing transparent, with portions covered with brown scales only along costal and margins. Hind wing with thin portion of brown scales along costal margin and wide portion of brown scales along anal margin.

Male genitalia. Uncus long, thin; tegumen tapered, apex relatively narrow, basal end wide; gnathos arms very thick, hypertrophied, with robust folds on sides; gnathos robust; valve narrow, lanceolate, costal margin slightly curved, abdominal margin almost smooth; juxta tiny, with small leaf-like lateral processes; saccus tiny, semicircular; phallus of medium thickness, shorter than valve, almost smooth and straight, vesica without cornuti.

Female. Length of fore wing 13–14 mm. Antenna short (about 1/4 of fore wing in length), bipectinate, setae 3 times longer than antenna stem in diameter. Thorax and abdomen densely covered with brown scales. Fore wing brown, pattern poorly expressed: sputtering of dark-brown scales discally, small dark-brown strokes postdiscally and submarginally, fringe brown. Hind wing light-brown with slight sputtering of dark-brown scales, fringe brown.

Female genitalia. Papillae anales lobe-like; apophyses posteriores short, tapered; apophyses anteriores thin, twice longer than apophyses posteriores; ostium slit-like; ductus bursae long, wide; ductus seminalis wide, passing from ductus bursae in basal third; bursa bag-like without signa.

Diagnosis. The new species clearly differs from the other species of the genus in the following characters:
- the relatively shorter fore wing in both sexes;
- the lanceolate apex of the valve, poorly curved in dorsal direction (in *P. kalshoveni* and *P. pellucida,* the apex of the valve is poorly curved in abdominal direction);
- The relatively longer apophyses antheriores (in the other species, apophyses anteriores are no more than twice longer than apophyses posteriores).

Etymology. The new species is named after the well-known specialist in Metarbelidae of the world fauna, Dr. Ingo Lehmann (Hamburg, Germany).

Distribution. Indonesia, Western Timor.

***Psychidarbela blancoi* Yakovlev & Hulsbosch, sp. n.**
https://zoobank.org/urn:lsid:zoobank.org:act:F0C6867C-DD2A-465E-A2CE-8429E7CCB5D9
Figs 5–6, 15, 17

Material examined. Holotype, female, Philippinen, Mindanao, Prov. Simangani, Cotabato, Mt. Busa, near Kainba [sic! – Kaimba, 5°25'8" N / 125°25'36" E], 700 m, vi.1998, leg. Bal (MWM, Genitalpräparat Heterocera MWM: 26647). Paratype, 1 female, Philipinen, Negros, Prov. Negros Occidental, Mt. Kanlaon, 600–800 m, W route via Mambucal, January 1998, primary forest, ex coll. Dr. Ronald Brechlin (MWM, Genitalpräparat Heterocera MWM: 9517).

Description. Female. Length of fore wing 15–18 mm. Antenna short (about 1/4 of fore wing in length), bipectinate, setae 3 times longer than antenna stem in diameter. Thorax and abdomen densely covered with brown scales. Fore wing brown, pattern poorly expressed: series of hardly noticeable dark-brown spots

postdiscally, poorly expressed thin wavy dark-brown lines submarginally, fringe brown. Hind wing brown, without pattern, fringe brown.

Female genitalia. Papillae anales lobe-like, wide; apophyses posteriores short, tapered; apophyses anteriores thin, short, one third longer than apophyses posteriores; ostium slit-like; ductus bursae long, wide; ductus seminalis narrow, passing from ductus bursae in basal third; bursa bag-like without signa.

Male unknown.

Diagnosis. The new species is distinguished from the known species of the genus by the dark spots on the fore wing postdiscally and in the poorly expressed wavy pattern on the fore wing submarginally.

Etymology. Francisco Manuel Blanco (1778–1845) was a Spanish friar and botanist. Towards the end of his life, he became the delegate of his order in Manila, traveling throughout the archipelago. He is the author of one of the first comprehensive flora of the Philippines, Flora de Filipinas. Según el sistema de Linneo (Flora of the Philippines according to the system of Linnaeus).

Distribution. Philippines (Mindanao and Negros Islands).

***Psychidarbela pellucida* (Nonaka, 2021) comb. n.**
Figs 7–9, 12, 16–17

Laonagoda pellucida Nonaka, 2021: 61−62.
Figs 7–9

Type material (Holotype, male) in UMTU, examined.
Type locality: Laos, Luan Prabang, Phou Khoun, Ban Kalo [19.50724°, 102.59606°].

Material examined. 1 female, West of Vang Vieng, 300 m, Vientiane Prov., Laos, 21.x.2011, leg. Kenichiro Nakao, No. 1110210030 (RYB, slide RYB 2017-10); 1 female, N-Thailand, Prov. Chiang Mai, Umg. Doi Kham, N 18º45.547′, 98º55.042′, 8–10.x.2001, leg. S. Loeffler (RYB, slide RYB 2017-9).

Description. Female. Length of fore wing 15–16 mm. Antenna short (about 1/4 of fore wing length), bipectinate, setae 3 times longer than antenna stem in diameter. Thorax and abdomen densely covered with brown scales. Fore wing brown, with poorly expressed pattern of dark-brown strokes throughout all wing area except for basal portion, light-brown portion basally, more expressed at cubital area, fringe brown. Hind wing light-brown, with poorly expressed pattern of dark-brown strokes on all wing, fringe brown.

Female genitalia. Papillae anales lobe-like, wide; apophyses posteriores short, tapered; apophyses anteriores thin, short, almost equal to apophyses posteriores in length; ostium slit-like; ductus bursae long, wide; ductus seminalis narrow, passing from ductus bursae in medium third; bursa bag-like without signa.

Distribution. Laos, Thailand.

Discussion

The genus *Psychidarbela* is the most specialized genus of the family: unlike the others, having an expressed sexual dimorphism and probably represents a separate tribe, which will be studied in the further research using molecular marker. Additionally, *Psychidarbela* is the most widely spread genus among the oriental Metarbelidae. Its species are found from Indochina to the island of Timor.

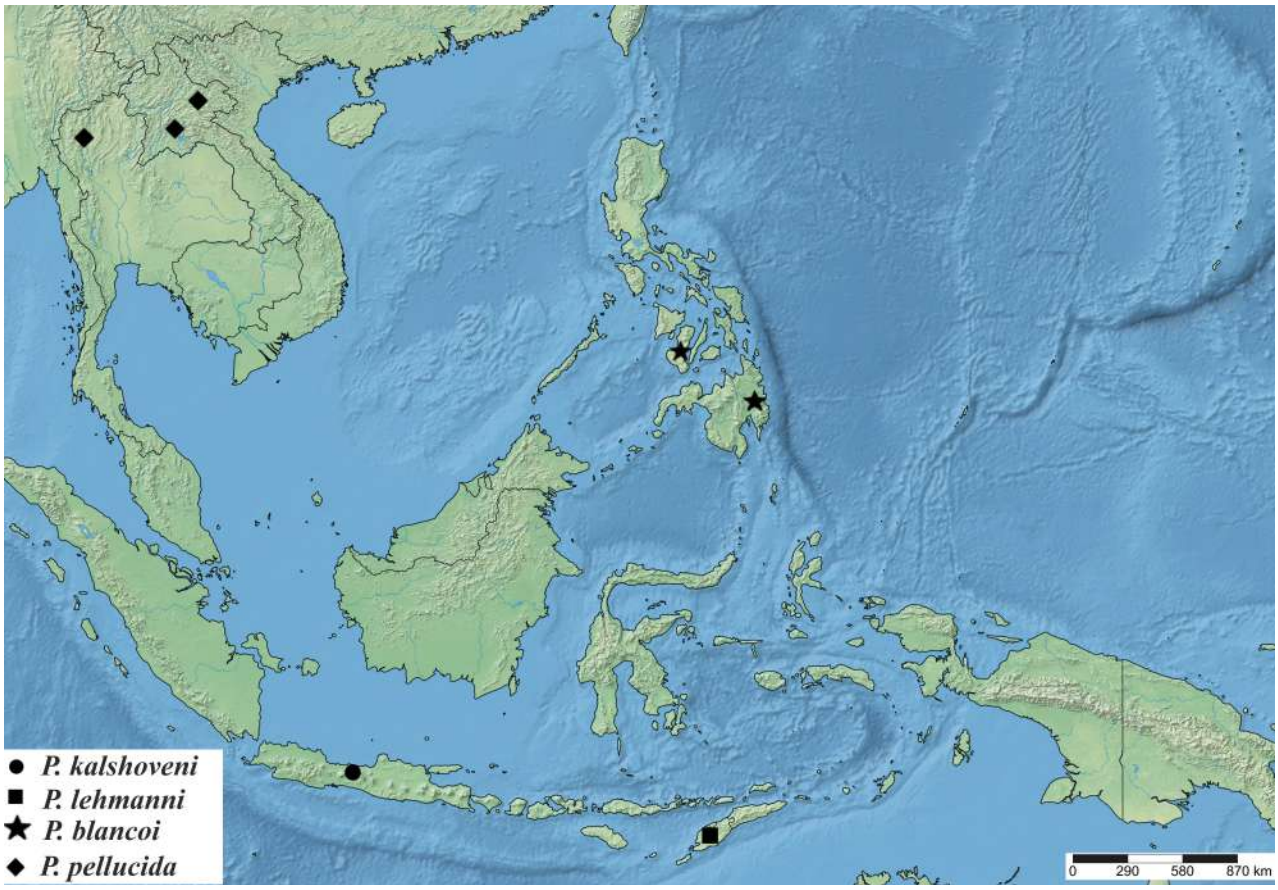


Figure 17. Geographical distribution of *Psychidarbela.*

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