



## Collecting in the Northern Andean Páramo revealed purple iridescent pygmy moths of the little known Andean endemic *Brachinepticula* (Nepticulidae)

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### Abstract

This paper describes two new species of *Brachinepticula* Stonis & Diškus: *B. melania* Remeikis, Mey & Stonis, **sp. nov.** and *B. colombica* Remeikis, Mey & Stonis, **sp. nov.** Both the new species were collected in the Northern Andean Páramo (Cundinamarca, Colombia). Since the specimens were caught at night-time with a light trap, the host plants remain unknown. The examination of the morphology of the male genitalia of *B. melania* and female genitalia of *B. colombica* revealed a highly distinctive new taxa of pygmy moths and broadened our knowledge of the morphology and distribution of the recently described endemic genus *Brachinepticula* Diškus & Stonis. The examination of the new findings also allowed us updating the diagnosis of *Brachinepticula*. The new species were illustrated with photographs of the genitalia, adults, and habitats.

**Key words:** Colombia, leaf miners, new species, pygmy moths, the Andes

### Introduction

The inventorying of the Earth's species and mapping of their distribution in the biosphere is important (Vane-Wright 1992, 1996; Wheeler *et al.* 2012a, 2012b); the exploration of the biosphere is much like exploring the Universe (Wheeler *et al.* 2012b).

The Neotropical páramo, a high-altitude ecosystem at an elevation of about 2,800–4,700 m, is a species-rich biome of the relatively recent Miocene origin and is characterized by high species endemism and fast speciation rate (Madriñán *et al.* 2013). By comparing diversification rates of lineages in fast evolving biomes and by using numerous molecular phylogenies, it has been found that average diversification rates of páramo lineages are faster than those of other reportedly fast evolving biodiversity hotspots (Madriñán *et al.* 2013). In the páramo, organisms that populate this ecosystem are a likely product of specific adaptations to an extreme environment that evolved during the Pleistocene or the last three to five million years (Madriñán *et al.* 2013, Stonis *et al.* 2016). Thus, according to Madriñán *et al.* (2013), the páramo represents an ideal model ecosystem for investigating diversification processes. It should also be mentioned that the understanding of processes that cause speciation is among major tasks of evolutionary biology. Unfortunately, the arthropoid fauna of this highly interesting and important ecosystem, the páramo, is still largely unknown.

The summarized data on the discovered Colombian pygmy moths (but not nothing from the Colombian páramo) were published by Stonis *et al.* (2019) and, subsequently, incorporated into the most recent monograph on the Neotropical Nepticulidae by Stonis *et al.* (2022).

*Brachinepticula* Diškus & Stonis, 2018 is a small and still poorly investigated genus of pygmy moths (Nepticulidae) (for the updated generic composition of the Neotropical fauna of pygmy moths see Stonis *et al.* 2022 and some general information on the family Nepticulidae can be found in Scoble 1983; Johansson *et al.* 1989).

Until now, the genus *Brachinepticula* was known only from two publications, the primary description of the genus (Stonis *et al.* 2018) and the pictorial monograph of the Neotropical Nepticulidae (Stonis *et al.* 2022), and was comprised of two species known from Ecuador and Argentina.

Our current examination of the material collected by Wolfram Mey in the Northern Andean Páramo in Cundinamarca, Colombia (Figs 1–5) resulted in the discovery of two more *Brachinepticula* species: *B. melania* Remeikis, Mey & Stonis, **sp. nov.** and *B. colombica* Remeikis, Mey & Stonis, **sp. nov.** These new species are characterized by a distinctive and rather outstanding morphology of the male and female genitalia, and the data on these species morphology and distribution significantly broaden our knowledge of *Brachinepticula* in general. The necessity to update the diagnosis of the genus, along with the difficulty of re-collecting additional specimens in the near future, were the major reasons why the new taxa were described from singletons.

In the current paper, we document and name these two new species and compare their male and female genitalia characters with the morphology of all other known members of the recently erected genus *Brachinepticula*.

## Material and methods

The descriptions of the new species are based on the material currently deposited in the collection of Museum für Naturkunde (MfN), Berlin, Germany, and collected by Wolfram Mey in November 2016 and January 2017 in Colombia. Later, the material (holotypes) will be transferred to Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá (ICN).

Adults were caught at night-time by using a battery (12 V) operated light tower from the F. Weber company, Stuttgart, Germany, equipped with two 15 W super actinic light tubes.

The preparation of the genitalia mounts was done following Stonis *et al.* (2022). Abdomens were macerated in 10% KOH, and genital capsules, as well as the phallus, were mounted in Euparal ventral side uppermost. The genitalia mounts on microscope slides were examined and photographed with a Leica DM2500 microscope and a Leica DFC420 digital camera. Adults were studied and measured with a Lomo10 stereoscopic microscope and photographed with a Leica S6D stereoscopic microscope with an attached Leica DFC290 digital camera.

## Description of the new species

### *Brachinepticula melania* Remeikis, Mey & Stonis, **sp. nov.**

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(Figs 1–3, 6–22, 48)

**Type material.** Holotype: ♂, COLOMBIA, Cundinamarca, Parque Ecológico Matarredonda, Páramo de Cruz Verde, 04°32.937'N, 074°00.0022'W, 3300–3486 m; 11.xi.2016, Wolfram Mey, genitalia slide no. RA1100 (MfN / ICN).

**Diagnosis.** Externally, it is a very distinctive unique species characterized by the short frontal tuft, the large distally dark scape, and fuscous brown and purple iridescent scaling of the thorax and forewing. In the male genitalia, the new species is easily recognizable by the combination of a unique lobate valva, large plate of the gnathos, long and distally widely rounded vinculum, two unique dorsal processes of the valva and the large horn-like sclerite of the phallus.

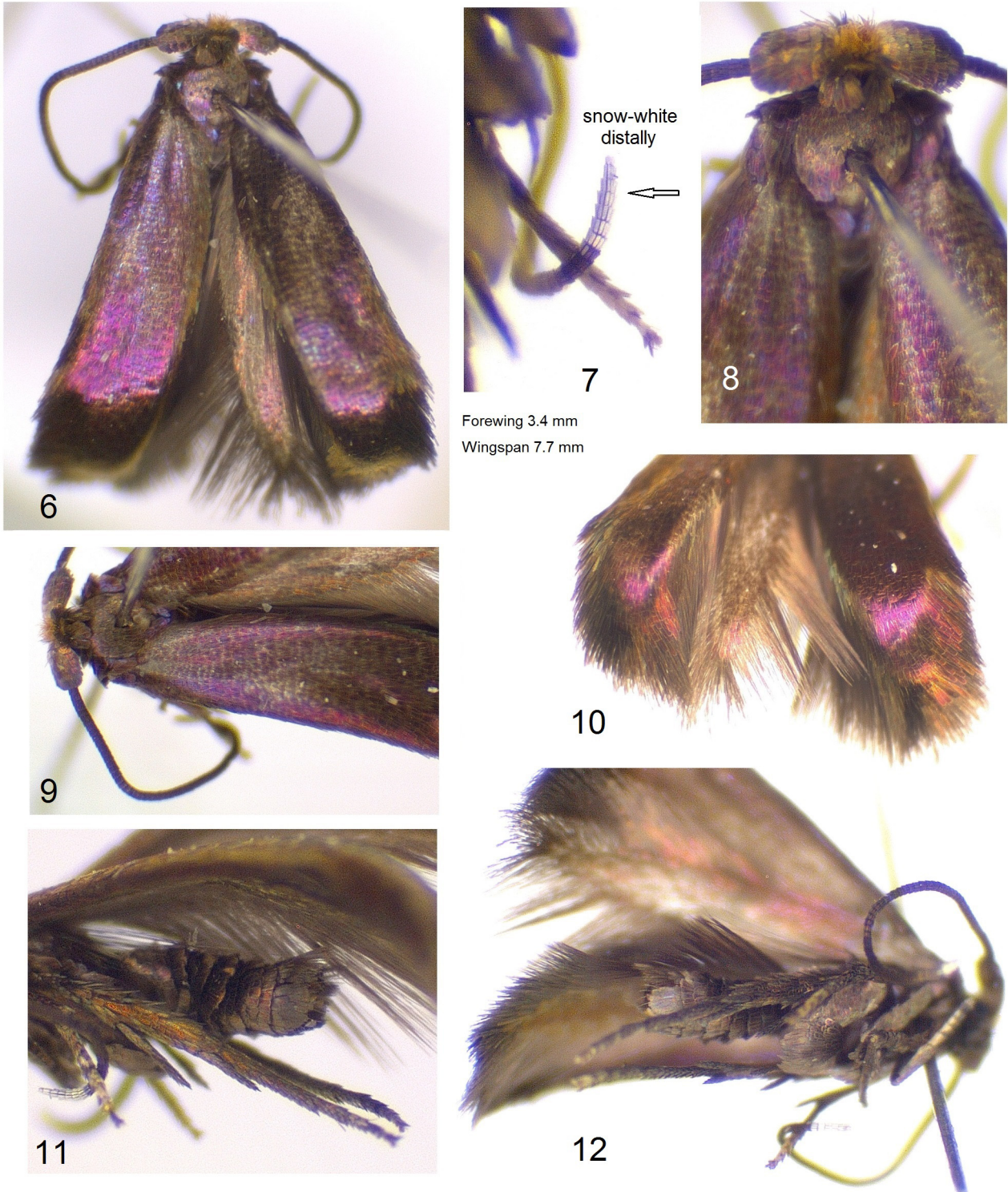
**Male** (Figs 6–12). Forewing length about 3.4 mm; wingspan about 7.7 mm. Head: palpi and frons blackish brown; frontal tuft short, ochre-orange; collar short, weakly paired, comprised of slender lamellar scales, brown; scape large, golden cream proximally, dark brown to black brown, golden glossy, with some purple iridescence distally; antenna significantly longer than one half the length of forewing; flagellum with some purple iridescence, black-brown on upper side, brown on underside except for six distal segments which are snow-white; total number of segments 59. Thorax and tegula dark grey with strong purple iridescence. Forewing uniform, without fascia, blackish brown with some golden gloss and strong purple iridescence; fringe dark brown; underside of forewing blackish brown, golden glossy, without spots or androconia. Hindwing and its fringe brown with some golden gloss and purple iridescence on upper side and underside. Legs dark brown on upper side and underside, with some golden gloss and purple iridescence. Abdomen blackish brown, golden glossy, with some purple iridescence; genital plates wide, dark brown; anal tufts relatively short, lateral, comprised of dark brown piliform scales.



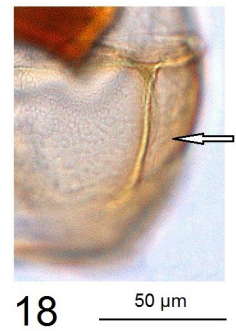
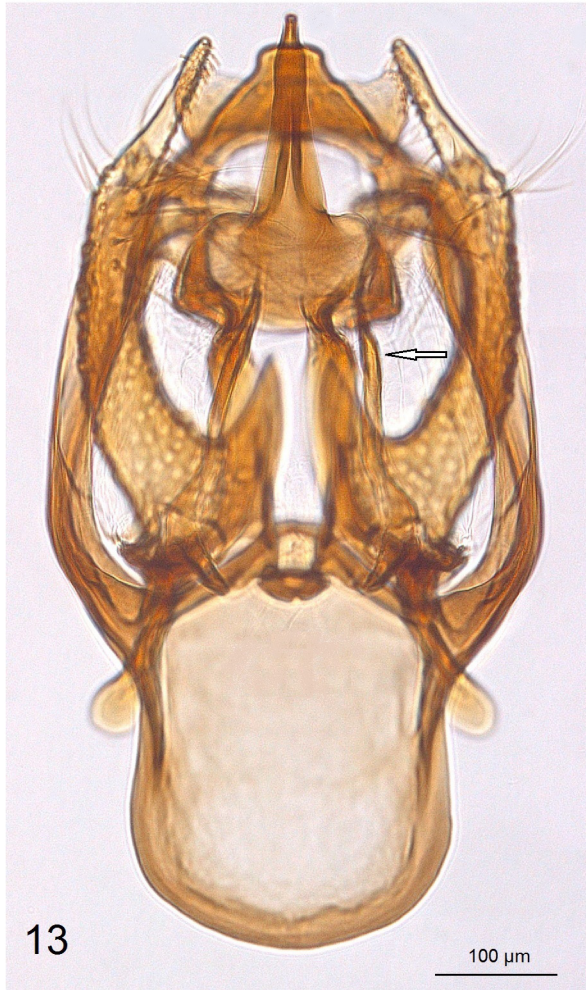
**FIGURES 1–5.** Collecting locality in Colombian páramo. 1–4, *Brachinepticula melania* **sp. nov.**, habitat, Cundinamarca, Parque Ecológico Matarredonda, Páramo de Cruz Verde, 3300 m; 5—*B. colombica* **sp. nov.**, habitat, Cundinamarca, Fómeque, Finca La Laja (near Parque Ecológico Matarredonda, Páramo de Cruz Verde), 3200 m

**Female.** Unknown.

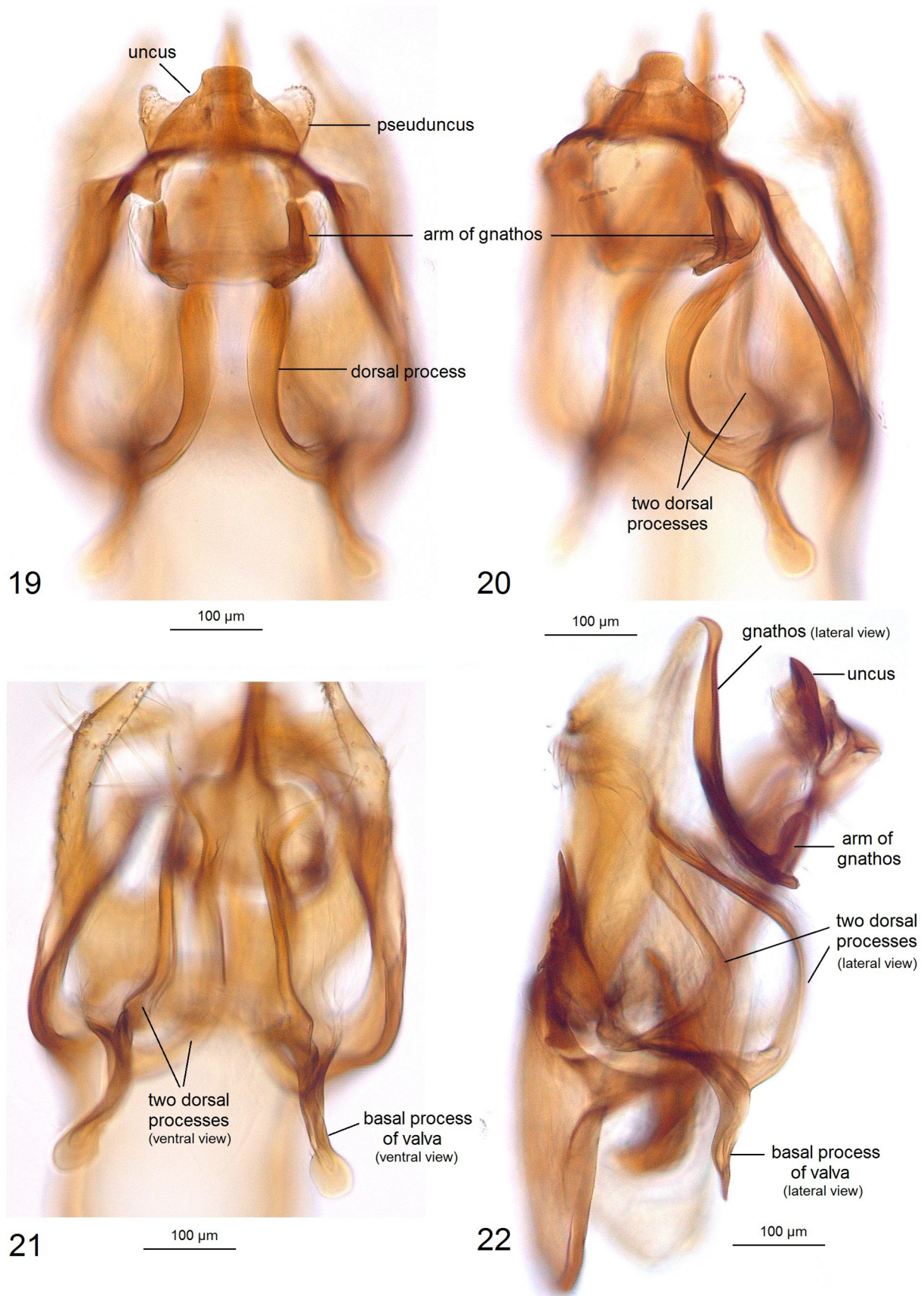
**Male genitalia** (Figs 13–22). Capsule significantly longer (715  $\mu\text{m}$ ) than wide (395  $\mu\text{m}$ ). Pseuduncus short, band-like, with extended lateral lobes. Uncus wide, distinctly truncated distally. Gnathos with one large caudal process and large central plate. Valva 435–440  $\mu\text{m}$  long, with a long slender apical process and two lobes: subapical and basal; transtilla absent; basal processes of valva very long, distally widened. There are two long dorsal processes on each valva forming a pseudoanellus (or juxta). Vinculum long, distally widely rounded, without lateral lobes. Phallus (Figs 15–18) 430  $\mu\text{m}$  long, 140  $\mu\text{m}$  wide medially, 130  $\mu\text{m}$  basally, without cornuti on vesica; cathrema with one large, slightly curved horn-like sclerite.



**FIGURES 6–12.** Male adult of *Brachinepticula melania* Remeikis, Mey & Stonis, **sp. nov.**, holotype, Colombia, Cundinamarca, Parque Ecológico Matarredonda, Páramo de Cruz Verde, 3300 m (MfN / ICN)



**FIGURES 13–18.** Male genitalia of *Brachinepticula melania* Remeikis, Mey & Stonis, **sp. nov.**, holotype, genitalia slide no. RA1100 (MfN / ICN). 13, 14, capsule with phallus removed; 15–18, phallus



**FIGURES 19–22.** Male genitalia of *Brachinepticula melania* Remeikis, Mey & Stonis, **sp. nov.**, holotype, genitalia slide no. RA1100 (MfN / ICN). 19, 21, dorsal view; 20, 22, lateral view

**Bionomics.** Adults fly in November. Otherwise, biology is unknown.

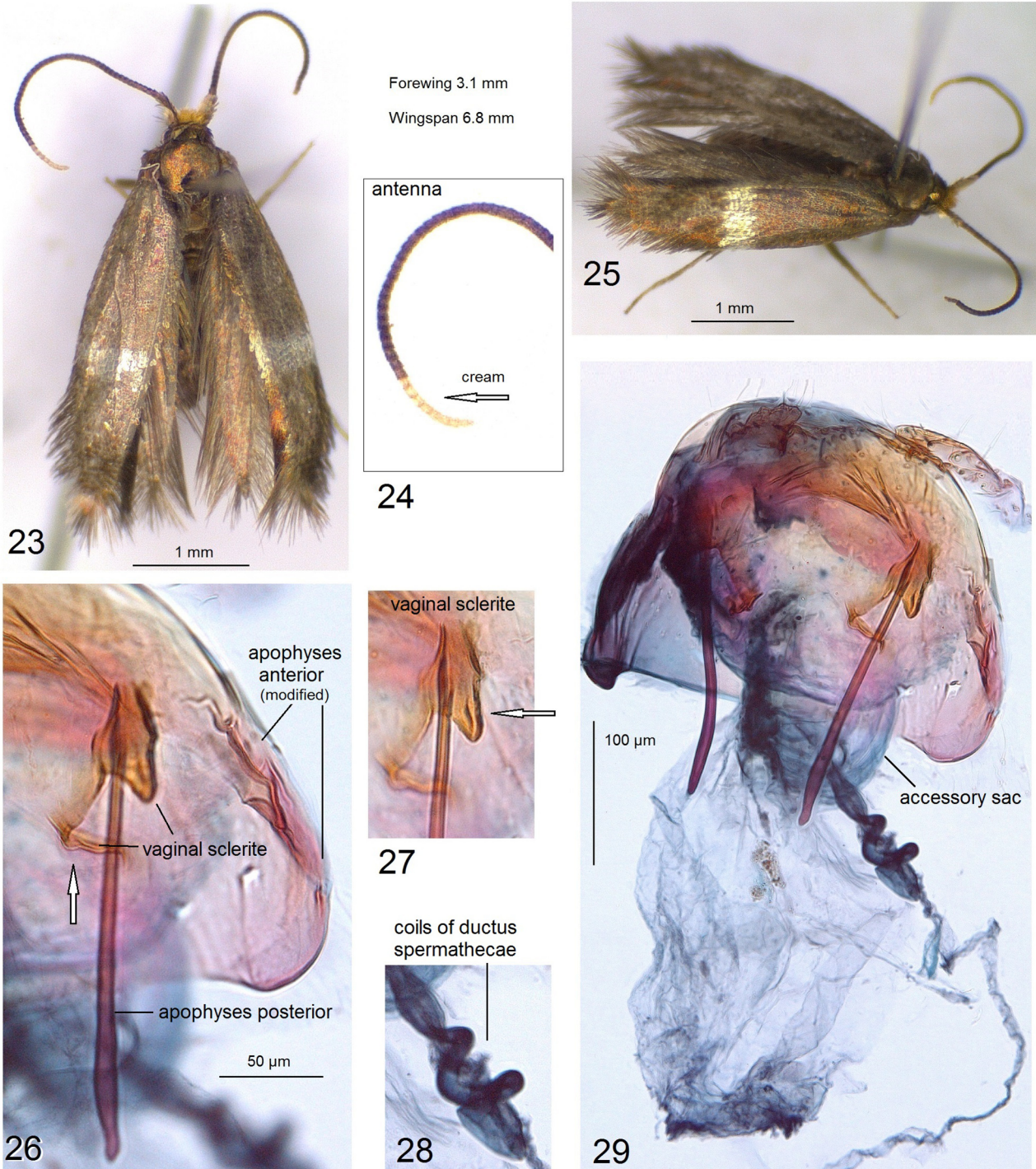
**Distribution** (Figs 1–3, 48). This species occurs in Colombia in Northern Andean Páramo (Cundinamarca), at an elevation about 3,300–3,490 m.

**Etymology.** The species name derived from the Greek *μελαινα* (*melaina*) meaning black, dark or dark-skinned with reference to the dark colour of the new species (not after Mrs Melania Trump, USA).

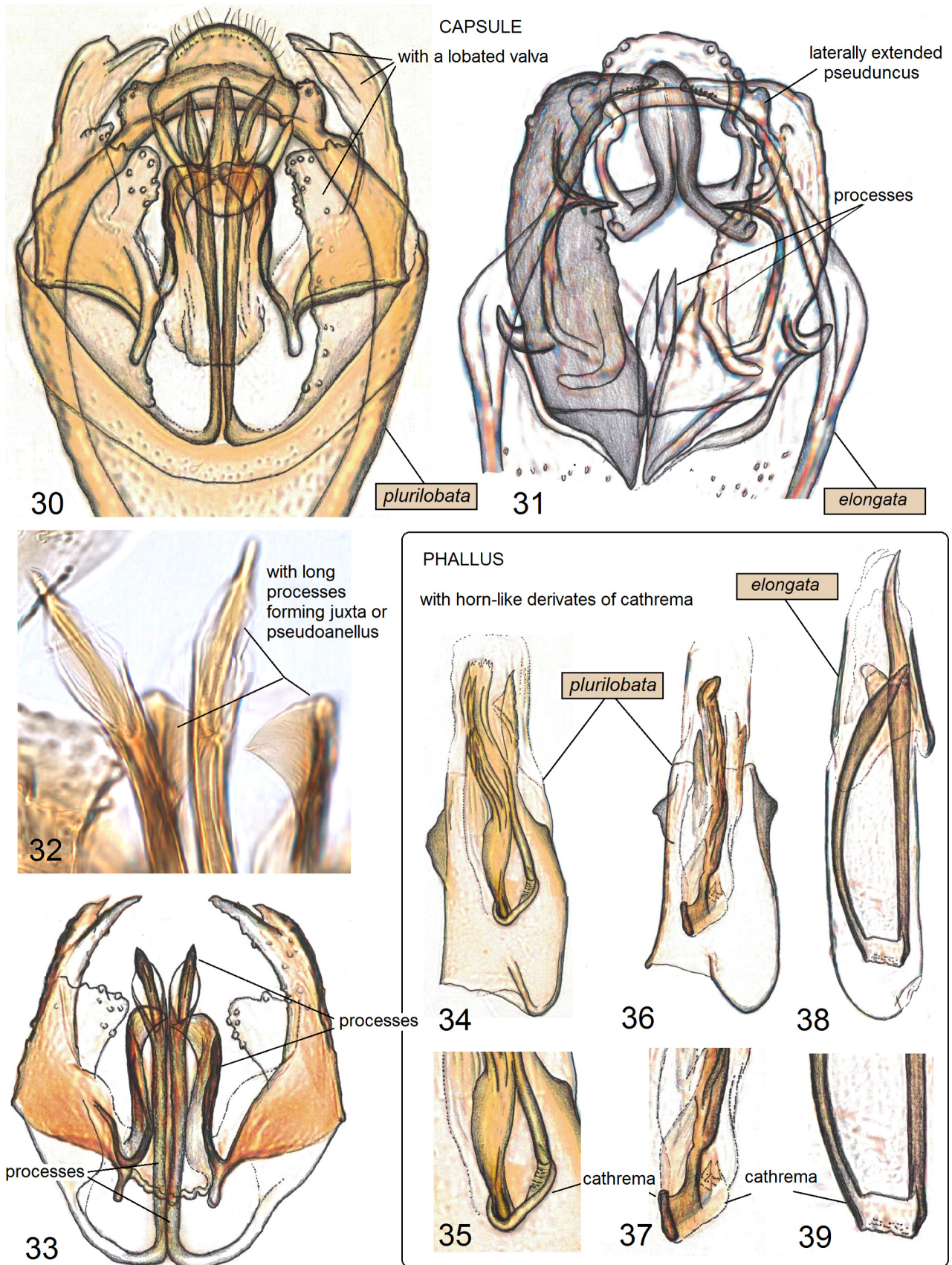
***Brachinepticula colombica* Remeikis, Mey & Stonis, sp. nov.**

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(Figs 4, 5, 23–29, 48)

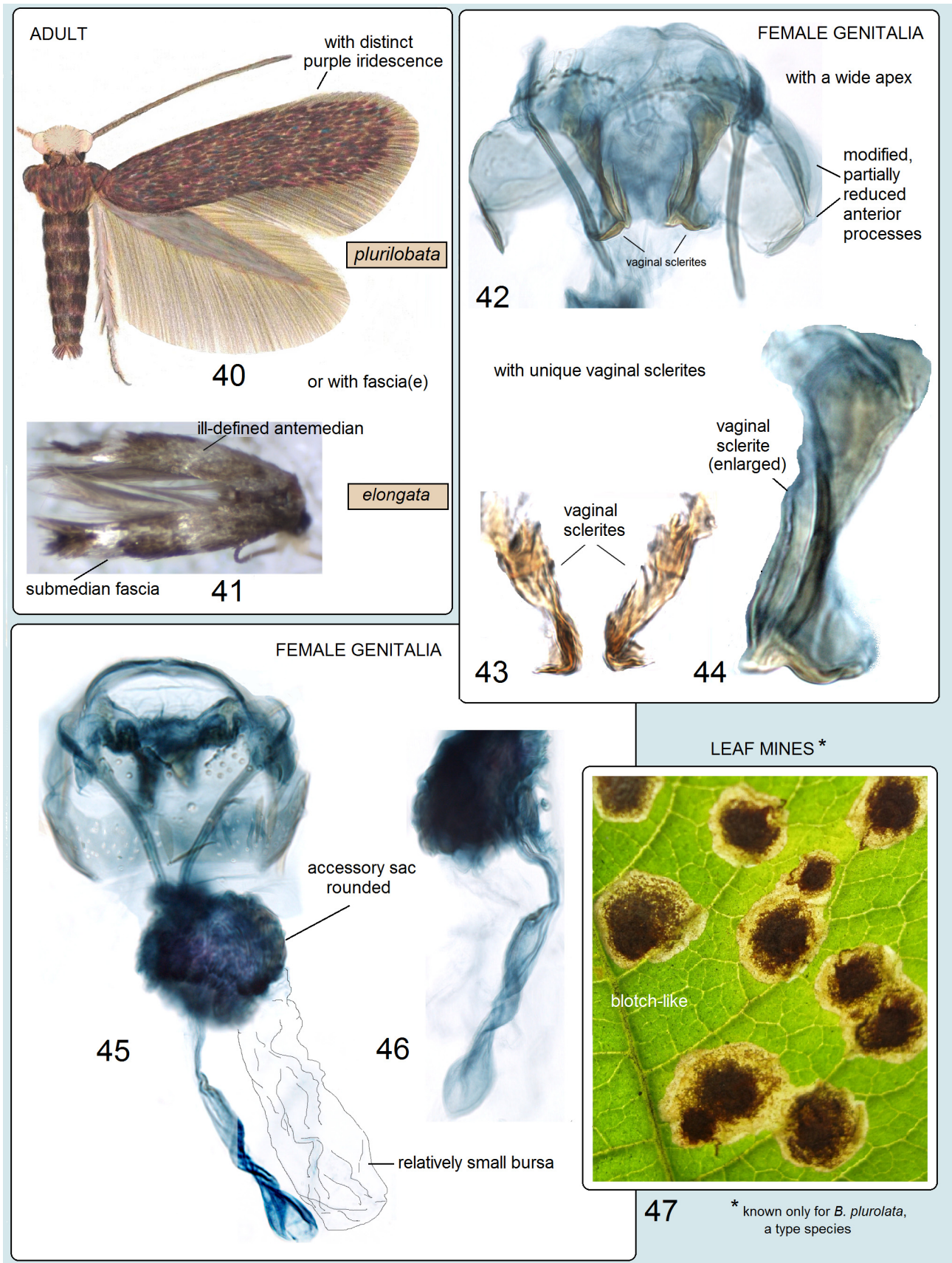


**FIGURES 23–29.** *Brachinepticula colombica* Remeikis, Mey & Stonis, sp. nov., holotype (MfN / ICN). 23–25, adult female; 26–29, female genitalia, slide no. RA1101



**FIGURES 30–39.** The genus *Brachinepticula* Diškus & Stonis, major diagnostic characters of the male genitalia (after Stonis *et al.* 2018). 30, 32–37, *B. plurilobata* Diškus & Stonis; 31, 38, 39, *B. elongata* Remeikis & Stonis





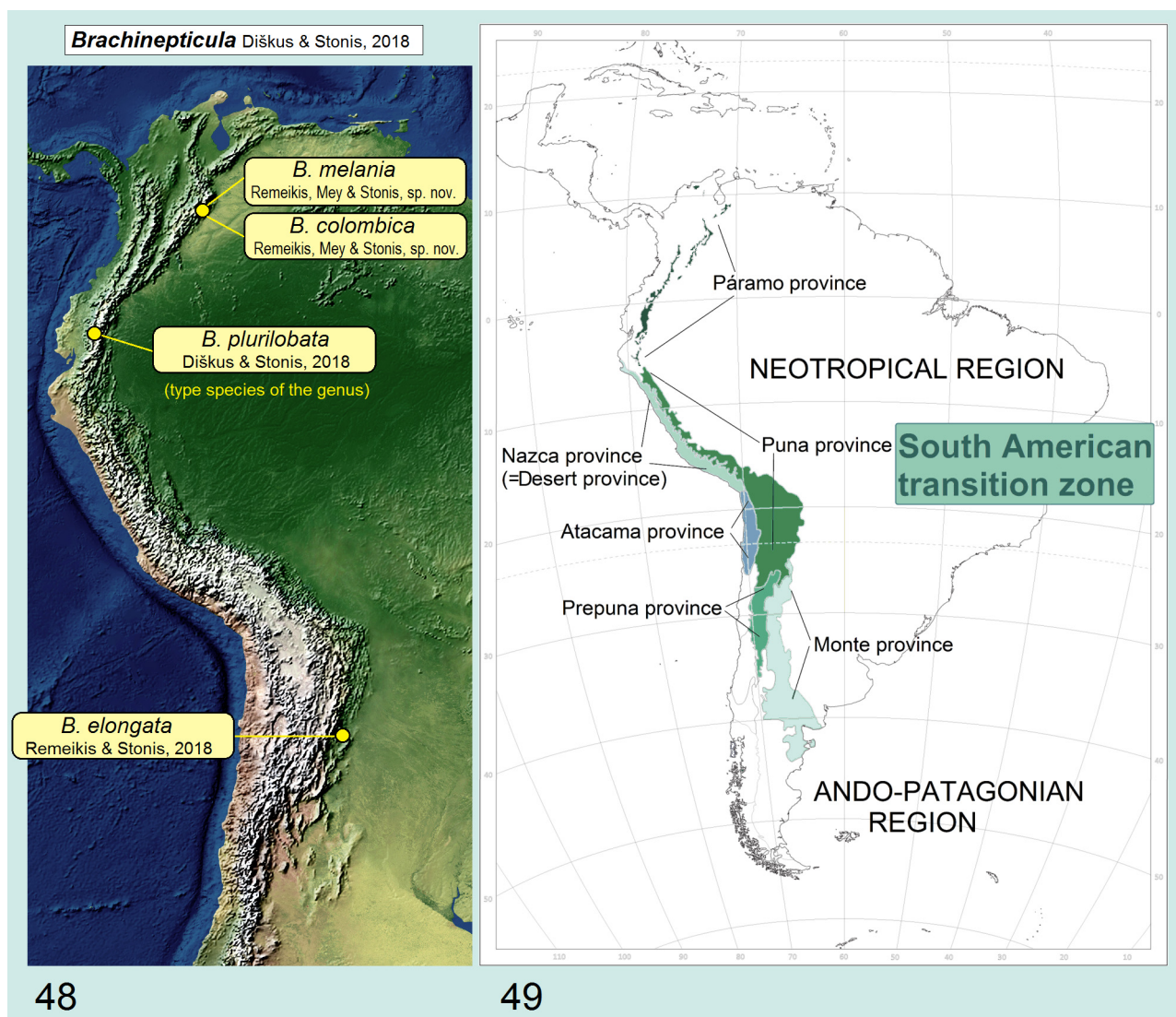
FIGURES 40–47. The genus *Brachinepticula* Diškus & Stonis, major diagnostic characters (after Stonis *et al.* 2018). 40, 42–47, *B. plurilobata* Diškus & Stonis; 41, *B. elongata* Remeikis & Stonis

**Type material.** Holotype: ♀, COLOMBIA, Cundinamarca, Fómeque, Finca La Laja (near Parque Ecológico Matarredonda, Páramo de Cruz Verde), 04°34.181'N, 073°49.577'W, 29–31.i.2017, Wolfram Mey, genitalia slide no. RA1101 (MfN / ICN).

**Diagnosis.** In the female genitalia, the shape of the modified anterior processes and presence of vaginal sclerites indicate the belonging of this species to *Brachinepticula*. From the congeneric species, *B. colombica* **sp. nov.** differs by a distinctive golden shiny fascia on a grey-brown forewing with purple iridescence. The unusual shape of vaginal sclerites in the female genitalia might also be highly diagnostic.

**Male.** Unknown.

**Female** (Figs 23–25). Forewing length about 3.1 mm; wingspan about 6.8 mm. Head: palpi and frons grey-brown to blackish brown; frontal ochreous orange; collar distinctive, comprised of rather slender lamellar scales, greyish brown, golden glossy; scape large, golden shiny; antenna slightly longer than half of the length of forewing; flagellum grey-brown, distal 1/5 (8–9 segments) cream. Thorax, tegula and forewing greyish brown, golden glossy, with purple iridescence. Fascia of forewing slightly postmedian, golden shiny; fringe greyish brown; underside of forewing greyish brown, slightly golden glossy, with strong purple iridescence, without spots or androconia. Hindwing relatively wide, grey-brown on upper side and underside, without spots or androconia; its fringe greyish brown. Legs greyish brown. Abdomen grey-brown, golden glossy, with purple iridescence; anal tufts absent (or rubbed).



**FIGURES 48, 49.** Geographical distribution of the genus *Brachinepticula* Diškus & Stonis. 48, distribution map of all currently known species; 49, South American transition zone of the Neotropical Region (after Stonis *et al.* 2016 and Morrone 2014, 2015, modified)

**Female genitalia** (Figs 26–29). Total length about 575  $\mu\text{m}$ . Anterior apophyses lobe-like, significantly shorter than posterior apophyses. Genitalia with two short but rather complex vaginal sclerites (Figs 26, 27). Corpus bursae small, oval-shaped; signum or pectinations absent. Accessory sac distinctly rounded, weakly folded; ductus spermathecae chitinized in proximal part, with about 2.5 coils. Abdominal tip very wide, rounded.

**Bionomics.** Adults fly in January. Otherwise, biology is unknown.

**Distribution** (Figs 4, 5, 48). This species occurs in Colombia in Northern Andean Páramo (Cundinamarca), at an elevation about 3,200 m.

**Etymology.** This species is named after the country, Colombia.

## Discussion

**The discovery providing novel data.** The discovery of *Brachinepticula melania* Remeikis, Mey & Stonis, sp. nov. and *B. colombica* Remeikis, Mey & Stonis, sp. nov., two distinctive and morphologically interesting new species, is important because it provides novel morphological, chorological, and diversity data about the rare and endemic Andean genus *Brachinepticula* Diškus & Stonis. The first diagnosis of *Brachinepticula* (Figs 30–47) was based on two species: *B. plurilobata* Diškus & Stonis, a type species of the genus from Ecuador, and *B. elongata* Remeikis & Stonis from Argentina (Stonis *et al.* 2018). According to this primary diagnosis, *Brachinepticula* was characterized by the presence of well-developed processes forming a pseudoanellus and long lateral process(es) of the cathrema, as well as a lobate valva in the male genitalia, and vaginal sclerites in the female genitalia. The forewing venation of *Brachinepticula* was described as possessing a separate vein CuA (Stonis *et al.* 2018). As far as it was known, blotch-like leaf mines also made this genus distinctive (Fig. 47); however, this feature was (and still is) recorded from a single species, *B. plurilobata*; leaf mines and other details of the biology of the remaining species have not been investigated.

Both the newly discovered species possess purple to strong purple iridescence of the scaling (Figs 6–10, 23, 25) and white or cream-tipped antenna (Figs 7, 24). *B. colombica* possesses a distinctive fascia of the forewing, while *B. melania* is uniform, without fascia. Nevertheless, we were very curious if the male of *B. melania* and female of *B. colombica* could belong to a single species, i.e., could they represent a case of distinctive sexual dimorphism. However, the external comparison of the habitus showed that these specimens are two separate species. Unfortunately, our attempt to analyse the specimens molecularly from broken dry hindlegs failed: it was impossible to amplify DNA; therefore, no sequences were received.

The newly discovered *B. melania* possesses very distinctive male genitalia with a wide rounded vinculum, a robust gnathos, an elaborated valva with two lobes and a long apical process. However, the dorsal processes of the valva (Figs 19, 21) make *B. melania* especially unique; they do not resemble those of *B. plurilobata* and *B. elongata* but only at first look. When studied from the lateral view (Figs 20, 22), the dorsal lobes of *B. melania* were found to be probably functioning as the so-called pseudoanellus or juxta. Moreover, in the lateral view, there is a wide gap between the first dorsal and the second processes; the latter is attached to the basal process of the valva (Fig. 22). Transtilla is absent in *B. melania*, like it is lacking in all other *Brachinepticula* species. However, it was found that there were stronger extended lateral corners of pseudouncus in *B. melania* (Fig. 13). This character might also be a distinctive feature of the genus. The larger, horn-like structure in the phallus of the newly discovered *B. melania* does not represent a loose cornutus on vesica but is a lateral extension of the cathrema (Fig. 17).

In the female of *B. colombica*, the vaginal sclerites are distinctive but, unlike the sclerites of the type species *B. plurilobata*, are modified and comprised of two elements: a shorter lobe-like part and a sinuous slender part (Figs 26, 27). In addition, the accessory sac of *B. colombica* is rounded, like it is characteristic for another *Brachinepticula* species, *B. plurilobata*, but, unlike the accessory sac of the type species, only little folded (compare Figs 29 and 45).

Such additional information allows us updating the diagnosis of *Brachinepticula*.

**Updated diagnosis of the genus *Brachinepticula*: major diagnostic characters.** External characters: frontal tuft very short (Fig. 8) to relatively long (Fig. 40); scape very large (Figs 8, 23) to medium large (Fig. 40); antenna white to cream distally (Figs 7, 24) or dark; forewing with fascia(e) (Figs 23, 25, 41) or uniform (Figs 6, 40); purple iridescence light (Figs 23, 25, 40) to intense (Figs 6, 10) or absent (Fig. 41).

Male genitalia: pseudouncus band-shaped with caudally extended corners (Figs 19, 30, 31); uncus large, with one

widely rounded (Figs 30, 31) or a trapezoid lobe (Fig. 9); valva with various lobes (Figs 14, 30, 31); dorsal processes of valva forming a pseudoanellus (or juxta) (Figs 21, 22, 30–33); vinculum large, distally rounded (Figs 13, 14, 30); phallus without cornuti, with basal opening (Figs 16, 34–38); cathrema with large, extended horn-like sclerite(s) (Figs 15–18, 34–39).

Female genitalia: abdominal tip (ovipositor) widely rounded (Figs 29, 42, 45); anterior apophyses modified, short, partially lobe-like (Figs 29, 42); posterior apophyses long, rod-like (Figs 29, 42); vaginal sclerites present (Figs 26, 27, 42–44); accessory sac rounded (Figs 29, 45, 46), weakly (Fig. 29) or strongly folded (Figs 45, 46); corpus bursae relatively small, without pectinations (Figs 29, 45).

Biology (based solely on the type species): larvae feeding on Polygonaceae host plant; leaf mines blotch-like (Fig. 47).

**Differential diagnosis of the genus** (after Stonis *et al.* 2018; updated). From *Johanssoniella* Koçak, 1981 (= *Johanssonia* Borkowski, 1972), the genus *Brachinepticula* differs by a unique cathrema with well-developed process(es) laterally (cathrema indistinctive or stick-shaped in *Johanssoniella*), the presence of strongly developed dorsal processes forming a pseudoanellus and a widely rounded or trapezoid uncus (usually triangular in *Johanssoniella*), a complex lobate valva (usually simple, triangular in *Johanssoniella*), and the presence of distinctive vaginal sclerites in the female genitalia (absent in *Johanssoniella*).

From *Enteucha* Meyrick, 1915, *Brachinepticula* differs by a cathrema with well-developed process(es) laterally, the presence of a distinct large uncus (reduced or partially reduced in *Enteucha*), a gnathos with a stout caudal process (gnathos usually transverse in *Enteucha*), the presence of strongly developed dorsal processes forming a pseudoanellus or juxta (absent in *Enteucha*), less reduced forewing venation, and the presence of distinctive vaginal sclerites in the female genitalia (absent in *Enteucha*).

From *Manoneura* Davis, 1979 (= *Oligoneura* Davis, 1978), *Brachinepticula* differs by a widely rounded or trapezoid uncus, a gnathos with a stout caudal process (in *Manoneura*, the unique uncus and gnathos form a lock-shaped structure), the absence of a thickened apodeme of the vinculum (present in *Manoneura*), the phallus without carinae (with a distinct carinae in *Manoneura*), a cathrema with long process(es) (without lateral process, half-tubular in *Manoneura*), the presence of unique vaginal sclerites in the female genitalia (absent in *Manoneura*), and less reduced forewing venation with a separate CuA (Stonis *et al.* 2018).

**Distribution and biology of *Brachinepticula*.** The discovery of *Brachinepticula* in the páramo of Colombia was rather unexpected because it was believed that *Brachinepticula* occurs in lower altitudes and predominantly tropical habitats. Now it would not be surprising if more species of *Brachinepticula* were discovered, especially if the search were done in higher altitudes.

Despite the fact that, currently, the genus is known from a few geographically separated areas (Fig. 48), all of them belong to the South American transition zone (Fig. 49). It can be expected that the genus might have an almost continuous distribution along the Andes.

Unfortunately, the host plants of the majority of *Brachinepticula* species are unknown, but the type species, *B. plurilobata*, is trophically associated with *Muehlenbeckia* with distinctive blotch-like leaf mines (Stonis *et al.* 2018). Therefore, it can be assumed that other *Brachinepticula* species also feed on Polygonaceae. It should be mentioned that some Polygonaceae have been reported from the páramo of Cundinamarca: *Muehlenbeckia tamnifolia* (Kunth) Meisn., *M. volcanica* (Benth) Endl., *Rumex acetosella* L., and *R. tolimensis* Wedd. (Vargas-Ríos & Pedraza 2003).

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## References

- Davis, D.R. (1978) New leaf-mining moths of the family Nepticulidae from Florida. *Florida Entomologist*, 61 (4), 209–224.  
<https://doi.org/10.2307/3494210>
- Davis, D.R. (1979) *Manoneura*, a new name to replace the generic homonym *Oligoneura* Davis (Lepidoptera: Nepticulidae). *Florida Entomologist*, 62 (3), 276.  
<https://doi.org/10.2307/3494067>
- Johansson, R., Nielsen, E.S., Nieuwerkerken, E.J. van & Gustafsson, B. (1990) The Nepticulidae and Opostegidae (Lepidoptera) of north west Europe. *Fauna Entomologica Scandinavica*, 23 (1/2), 1–739.
- Borkowski, A. (1972) Studien an Nepticuliden (Lepidoptera). Teil IV. Bemerkungen zur Nomenclatur und Systematik der Familie Nepticulidae. *Polskie Pismo Entomologiczne*, 42 (3), 689–709.
- Koçak, A.Ö. (1981) On the nomenclature of some genera of Lepidoptera. *Priamus*, 1: 97–109.
- Madriñán S., Cortés, A.J. & Richardson, J.E. (2013) Páramo is the world's fastest evolving and coolest biodiversity hotspot. *Frontiers in Genetics*, 4, 192.  
<https://doi.org/10.3389/fgene.2013.00192>
- Meyrick, E. (1915) Descriptions of South American Micro-Lepidoptera. *The Transactions of the Entomological Society of London*, 48 (2), 201–256.  
<https://doi.org/10.1111/j.1365-2311.1915.tb02527.x>
- Morrone, J.J. (2014) Biogeographical regionalisation of the Neotropical region. *Zootaxa*, 3782 (1), 1–110.  
<https://doi.org/10.11646/zootaxa.3782.1.1>
- Morrone, J.J. (2015) Biogeographical regionalisation of the Andean region. *Zootaxa*, 3936 (2), 207–236.  
<https://doi.org/10.11646/zootaxa.3936.2.3>
- Scoble, M.J. (1983) A revised cladistic classification of the Nepticulidae (Lepidoptera) with descriptions of new taxa mainly from South Africa. *Transvaal Museum Monograph*, 2 (1), 1–105.  
[https://hdl.handle.net/10520/AJA090799001\\_83](https://hdl.handle.net/10520/AJA090799001_83)
- Stonis, J.R., Diškus, A., Remeikis, A., Gerulaitis, V. & Karsholt, O. (2016) Leaf-mining Nepticulidae (Lepidoptera) from record high altitudes: documenting an entire new fauna in the Andean páramo and puna. Monograph. *Zootaxa*, 4181 (1), 1–94.  
<https://doi.org/10.11646/zootaxa.4181.1.1>
- Stonis, J.R., Diškus, A., Remeikis, A. & Solis, M.A. (2018) The American *Brachinepticula* gen. nov. and *Manoneura* Davis (Nepticulidae): a new generic concept based on a reinforced cathrema in the phallus. *Biologija*, 64 (2), 99–128.  
<https://doi.org/10.6001/biologija.v64i2.3735>
- Stonis, J.R., Remeikis, A. & Diškus, A. (2022) *Neotropical Nepticulidae (a pictorial monograph introducing an electronic identification tool)*. Nature Research Centre, Vilnius, 363 pp. [[https://www.researchgate.net/publication/361649792\\_Neotropical\\_Nepticulidae](https://www.researchgate.net/publication/361649792_Neotropical_Nepticulidae)]
- Stonis, J.R., Remeikis, A., Vargas, S. (2019) Colombian Nepticuloidea and Tischerioidea: a small step out of obscurity? *Biologija*, 65 (2), 48–55.  
<https://doi.org/10.6001/biologija.v65i2.4023>
- Vane-Wright, R.I. (1992) Systematics and global biodiversity strategy. *Antenna*, 16, 49–56.
- Vane-Wright, R.I. (1996) Systematics and the Conservation of Biological Diversity. *Annals of the Missouri Botanical Garden*, 83 (1), 47–57.  
<https://doi.org/10.2307/2399967>
- Vargas-Ríos, O. & Pedraza, P. (2003) *El Parque Nacional Natural Chingaza. Colciencias, Parques Nacionales Naturales*. Universidad Nacional de Colombia, Empresa de Acueducto de Bogotá, Bogotá, 226 pp.
- Wheeler, Q., Bourgoïn, T., Coddington, J., Gostony, T., Hamilton, A., Larimer, R., Polaszek, A., Schauff, M. & Solis, M.A. (2012a) Nomenclatural benchmarking: the role of digital typification and telemicroscopy. *ZooKeys*, 209, 193202.  
<https://doi.org/10.3897/zookeys.209.3486>
- Wheeler, Q.D., Knapp, S., Stevenson, D.W., Stevenson, J., Blum, S.D., Boom, B.M., Borisy, G.G., Buizer, J.L., de Carvalho, M.R., Cibrian, A., Donoghue, M.J., Doyle, V., Gerson, E.M., Graham, C.H., Graves, P., Graves, S.J., Guralnick, R.P., Hamilton, A.L., Hanken, J., Law, W., Lipscomb, D.L., Lovejoy, T.E., Miller, H., Miller, J.S., Naeem, S., Novacek, M.J., Page, L.M., Platnick, N.I., Porter-Morgan, H., Raven, P.H., Solis, M.A., Valdecasas, A.G., van der Leeuw, S., Vermeulen, N., Vogel, J., Walls, R.L., Wilson, E.O. & Woolley, J.B. (2012b) Mapping the biosphere: exploring species to understand the origin, organization, and sustainability of biodiversity. *Systematics & Biodiversity*, 10 (1), 120.  
<https://doi.org/10.1080/14772000.2012.665095>