

# Differentiation of *Paratischeria* and *Neotischeria* gen. nov. (Lepidoptera, Tischeriidae), with a description of new, mostly Asteraceae-feeding species from Central and South America

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We describe a new genus, *Neotischeria* Diškus & Stonis, gen. nov., and four new species of trumpet moths. Three of them are trophically associated with Asteraceae plants: *Neotischeria ochripennata* Diškus & Remeikis, sp. nov. and *N. longa* Diškus & Stonis, sp. nov., discovered from the western part of the equatorial Andes, *N. conexa* Diškus & Stonis, sp. nov., discovered from the eastern part of the central Andes, and *N. poseidonia* Diškus & Stonis, sp. nov., discovered from Guatemala (the host plant is unknown; it is presumed to be a Malvaceae plant). We briefly discuss the diagnostics of *Neotischeria* gen. nov. by differentiating it from the most similar *Paratischeria* Diškus & Stonis and *Astrotischeria* Puplesis & Diškus. We also newly combine seven formerly *Paratischeria* species, including *P. neotropicana* Diškus & Stonis, with *Neotischeria* and designate the latter species as the type species of a new genus. The new species are illustrated with photographs of the male and, if available, the female genitalia and the leaf mines. We also provide the first documentation of the hitherto little-known Peruvian *Neotischeria capnota* (Meyrick) deposited at NHMUK (London).

**Keywords:** host plants, leaf miners, leaf mines, new species, trumpet moths

## INTRODUCTION

Tischeriidae, or trumpet moths, represent a relatively small family of leaf-mining lepidopterans. We expect over 300 species worldwide, but only about 175 Tischeriidae species have been documented so far. Many new species have already been collected and are ready for taxonomic description, but the majority are still awaiting discovery, particularly from the areas of South East Asia, equatorial Africa, and tropical America that are still poorly surveyed (Stonis, Solis, 2020). The adults of trumpet moths possess numerous specialised morphological characters, including long antennal sensillae trichodea on the male antenna, a modified phallus in the male genitalia, or ovipositor lobes covered with thickened peg-like setae along with unique, rod-like or plate-like projections known as prela in the female genitalia. The unique characters of Tischeriidae were overviewed in the monographs by Braun (1972) and Puplesis, Diškus (2003), as well as discussed and variously illustrated in recent papers, including those by Xu et al. (2017, 2018), Stonis et al. (2017, 2018a, 2019a, 2020a, 2020b, 2020c, 2021a, 2021b), and Stonis, Solis (2020).

Initially, the family comprised a single genus, *Tischeria* Zeller. However, before our study, Tischeridae was already comprised of six genera: *Tischeria* Zeller, 1839; *Coptotriche* Walsingham, 1890; *Astrotischeria* Puplesis & Diškus, 2003; *Paratischeria* Diškus & Stonis, 2017 (Stonis et al., 2017); *Dishkeya* Stonis, 2020 (Stonis, Solis, 2020), and *Manitischeria* Diškus & Stonis, 2021 (Stonis et al., 2021b).

In the current paper, we briefly discuss the diagnostics of *Paratischeria*, which is characterised by a distinct dorsal sclerite in the male genitalia and the feeding of their larvae on Urticaceae, occasionally Malvaceae, host plants. Because of the absence of a dorsal sclerite, we exclude seven Asteraceae and Malvaceae-feeding species from *Paratischeria* and describe a new genus, *Neotischeria* Diškus & Stonis, gen. nov.

We also describe four new *Neotischeria* species discovered from Guatemala (Central America) and the equatorial and central Andes (South America): *N. conexa* Diškus & Stonis, sp. nov., *N. ochripennata* Diškus & Remeikis, sp. nov., *N. longa* Diškus & Stonis, sp. nov., and *N. poseidonia* Diškus & Stonis, sp. nov. The host plant of the latter species remains unknown, and three other species are tropically associated with *Liabum* Adans and *Smallanthus* Mack. ex Small (Asteraceae).

Drawing upon our study of the lectotype and paralectotype of *Neotischeria capnota* (Meyrick, 1915) deposited at NHMUK, we provide the first documentation of this little-known species.

## MATERIALS AND METHODS

The documentation of taxa and description of the new species is based on the material deposited in the collections of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia (ZIN); some male and female paratypes of *Neotischeria conexa* sp. nov. and *N. longa* sp. nov. are also deposited at the Nature Research Centre, Vilnius, Lithuania (NRC). Studies into the lectotype and paralectotype of *N. capnota* (Meyrick, 1915) are based on the material deposited at the Natural History Museum, London, United Kingdom (NHMUK).

Protocols regarding the study into Tischeriidae have been previously described: the collecting and rearing of leaf mines by Stonis et al. (2018a), and techniques of specimen dissection and genitalia mounts in Euparal by Stonis et al. (2014). The descriptive terminology, with a few exceptions, follows Puplesis, Diškus (2003).

The identifications of the Asteraceae host plants were undertaken by experts in the taxonomy of the family. Being based exclusively on field photographs (herbarium specimens were not collected and preserved) they should, therefore, be considered with caution.

Permanent preparations on microscope slides were photographed and studied with a Leica DM2500 microscope and a Leica DFC420 digital camera. Adults were measured and studied using Lomo stereoscopic microscopes MBS-10 and photographed using a Leica S6D stereoscopic microscope with an attached Leica DFC290 digital camera.

For molecular analysis, genomic DNA was extracted from hind legs or whole adult specimen stored in 96% ethanol, using the GeneJet Genomic DNA Purification Kit (Thermo Fisher Scientific Baltics) following the manufacturer's specifications. PCR reactions were carried out in an Eppendorf Mastercycler gradient 5331 (Germany). Cycling parameters were an initial denaturation step at 94°C for 2 min, followed by 94°C for 30 s, 50°C for 45 s, and 72°C for 1 min. This cycle was repeated 35 times, followed by 4 min of extension at 72°C. PCR products were visualized on 1.5% agarose gel stained with ethidium bromide and UV light photographs of the gels with DNA bands were taken using 'Herolab' transluminator (Germany). The sequencing of some species was produced by the BigDye® Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems) in Macrogen Inc. (Seoul, South Korea). The divergence was calculated using the Kimura two-parameter distance (Kimura, 1980) model and graphically displayed in a Neighbour-Joining (NJ) tree by the MEGA 7 software (Kumar et al., 2016). The robustness of the inferred tree was evaluated by bootstrapping with 10,000 replicates; distantly related *Pseudopostega bogotensis* Vargas (Opostegidae) was used as an outgroup. Molecular methods used in this paper for a fragment of the NJ tree (Fig. 1) are described in more detail in Stonis et al. (2019b).

#### DIFFERENTIATION OF *PARATISCHERIA* AND *NEOTISCHERIA* GEN. NOV.

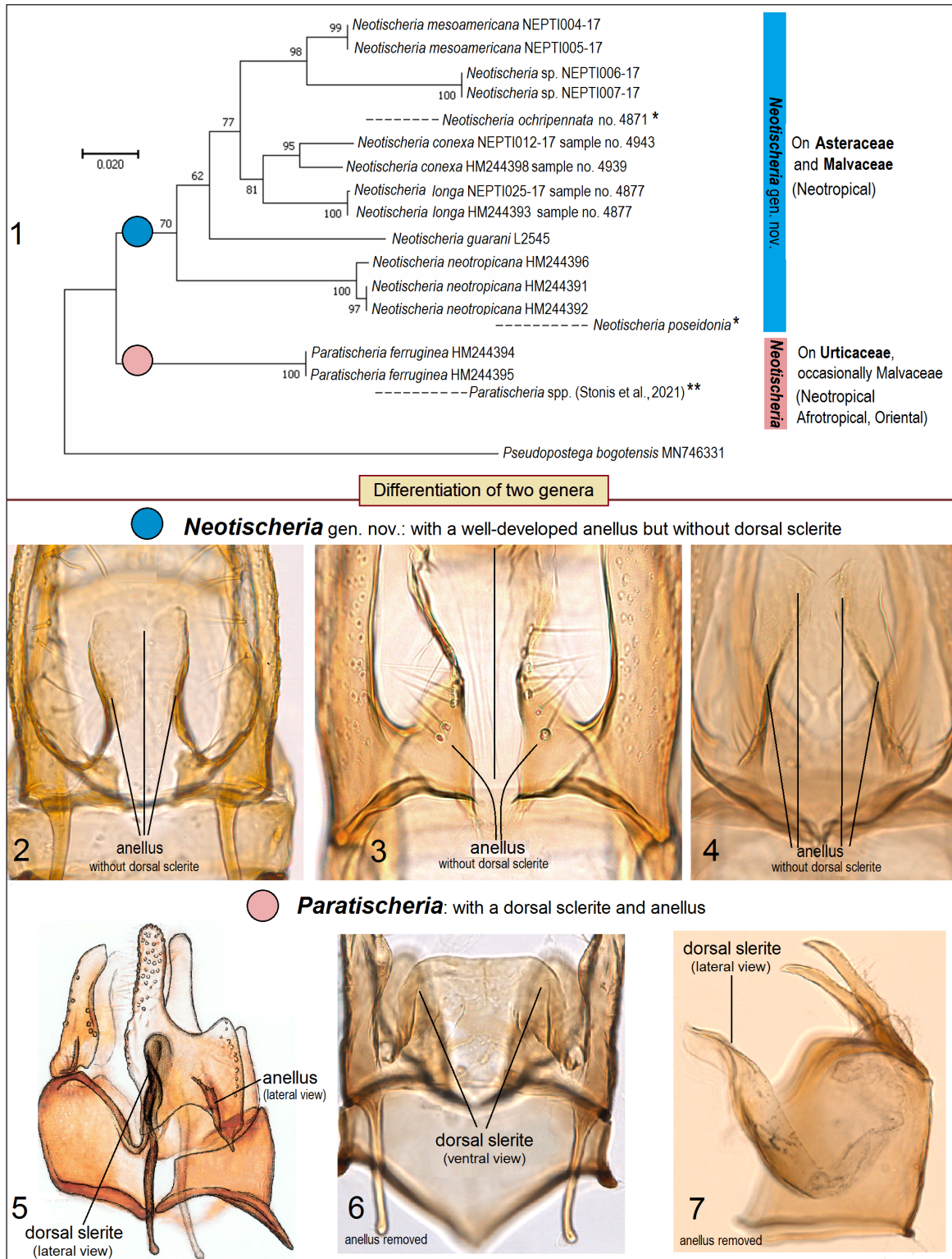
The genus *Paratischeria* Diškus & Stonis was described for the species of specific morphology of the male genitalia (Stonis et al., 2017).

This genus differs from *Astrotischeria* Puplesis & Diškus (described in Puplesis, Diškus, 2003) in the undivided, usually narrow valva (divided in *Astrotischeria*), long undivided uncus (usually short and divided in *Astrotischeria*), and the strongly, though variously, developed anellus (Stonis et al., 2017).

During current molecular studies into Tischeriidae species using fragments of the mitochondrial COI gene that included the standard barcode region and consequent studies on the obtained sequences of *Paratischeria* species, we found that there were two groups of the species which never clustered together in any of our phylogenetic trees but exhibited a clear dichotomy (Fig. 1).

The morphology of the male genitalia also differed significantly: the first group of the species possessed only a well-developed anellus (Figs 2–4), while the species of the second group were characterised by the presence of an anellus and a distinct dorsal sclerite, a unique, derived character within Tischeriidae (Figs 5–7). The feeding preferences also differed among the species of these two groups: the host plants of the first group belong to Asteraceae and Malvaceae, while the species of the second group feed on Urticaceae and occasionally on Malvaceae. By drawing on unpublished molecular data, the morphological characters that are easily applicable for further diagnostics, and differences in host-plant preferences, here we describe a new genus, *Neotischeria* gen. nov.

Because of the absence of a dorsal sclerite in the male genitalia, we exclude seven Asteraceae- and Malvaceae-feeding species from former *Paratischeria*, and provide seven new taxonomic combinations with *Neotischeria*: *N. guarani* (Diškus & Stonis, 2020) (comb. nov.), *N. mesoamericana* (Diškus & Stonis, 2020) (comb. nov.), *N. belizensis* (Remeikis & Stonis, 2020) (comb. nov.), *N. robinsoni* (Diškus & Stonis, 2020) (comb. nov.), *N. tubifex* (Diškus & Stonis, 2020) (comb. nov.), *N. neotropicana* (Diškus & Stonis, 2015) (comb. nov.), and *N. capnota* (Meyrick, 1915) (comb. nov.).



**Figs 1–7.** Differentiation of *Neotischeria* gen. nov. 1 – a fragment of Neighbour-Joining tree of Tischeriidae based on mtDNA COI sequences (\* – species exhibiting a striking morphological similarity with the species with the studied sequences; \*\* – a group of species of those mtDNA COI sequences will be analysed separately, in another paper by Stonis et al., 2021a); 2–7 – differentiation of two related genera (2 – *Neotischeria mesoamericana*; 3 – *N. guarani*; 4 – *N. poseidonia*; 5 – *Paratischeria ferruginea*; 6 – same; 7 – *P. boehmerica*; Stonis et al., 2021a)

## DESCRIPTION OF A NEW GENUS, WITH A REVIEW OF INCLUDED SPECIES

### *Neotischeria* Diškus & Stonis, gen. nov.

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**Type species.** *Neotischeria neotropicana* (Diškus & Stonis, 2015: 457–465).

**Diagnosis.** External characters or characters of wing venation are not informative or insufficient for generic differentiation in most cases of Tischeriidae, including this new genus. In the male genitalia, the combination of a slender, undivided, one-lobed valva, presence of a well-developed anellus, and the absence of a dorsal sclerite and transtilla distinguish the new genus from all other genera of Tischeriidae.

**Description.** *Adult.* Medium-small moths: forewing length 2.4–5.4 mm, wingspan 5.4–11.3 mm. Head: frons smoothly scaled; frontal tuft overlapping the frons, comprised of long lamellar scales; collar comprised of slender lamellar scales; antenna longer than one half the length of forewing. Male forewing without a distinctive pattern, from bright yellow-ochre to pale grey cream, irregularly speckled with some darker scales; females often exhibit a remarkable sexual dimorphism and are characterised of a bright, patchy forewing; fringe line usually present. Hindwing slender, from cream or pale ochreous brown to dark grey-brown, without androconia. Male abdomen with anal tufts.

*Male genitalia.* Capsule significantly longer than wide. Uncus with two long or very long latero-ventral lobes and with (or without) small, rounded, dorsal lobes. Socii membranous, not thickened. Valva usually slender, occasionally widened in basal part, always without dorsal lobes, undivided (one-lobed); basal process long; transtilla absent. Juxta absent. Anellus well-developed, thickened, and with some setae laterally. Vinculum with a large or medium large, distally usually rounded or triangular ventral lobe. Phallus slightly or broadly bifurcated apically, without spines or carinae, except for *N. robinsoni* Diškus & Stonis and *N. tubifex* Diškus & Stonis, and *N. mesoamericana* Diškus

& Stonis (those species possess carina-like processes on the phallus).

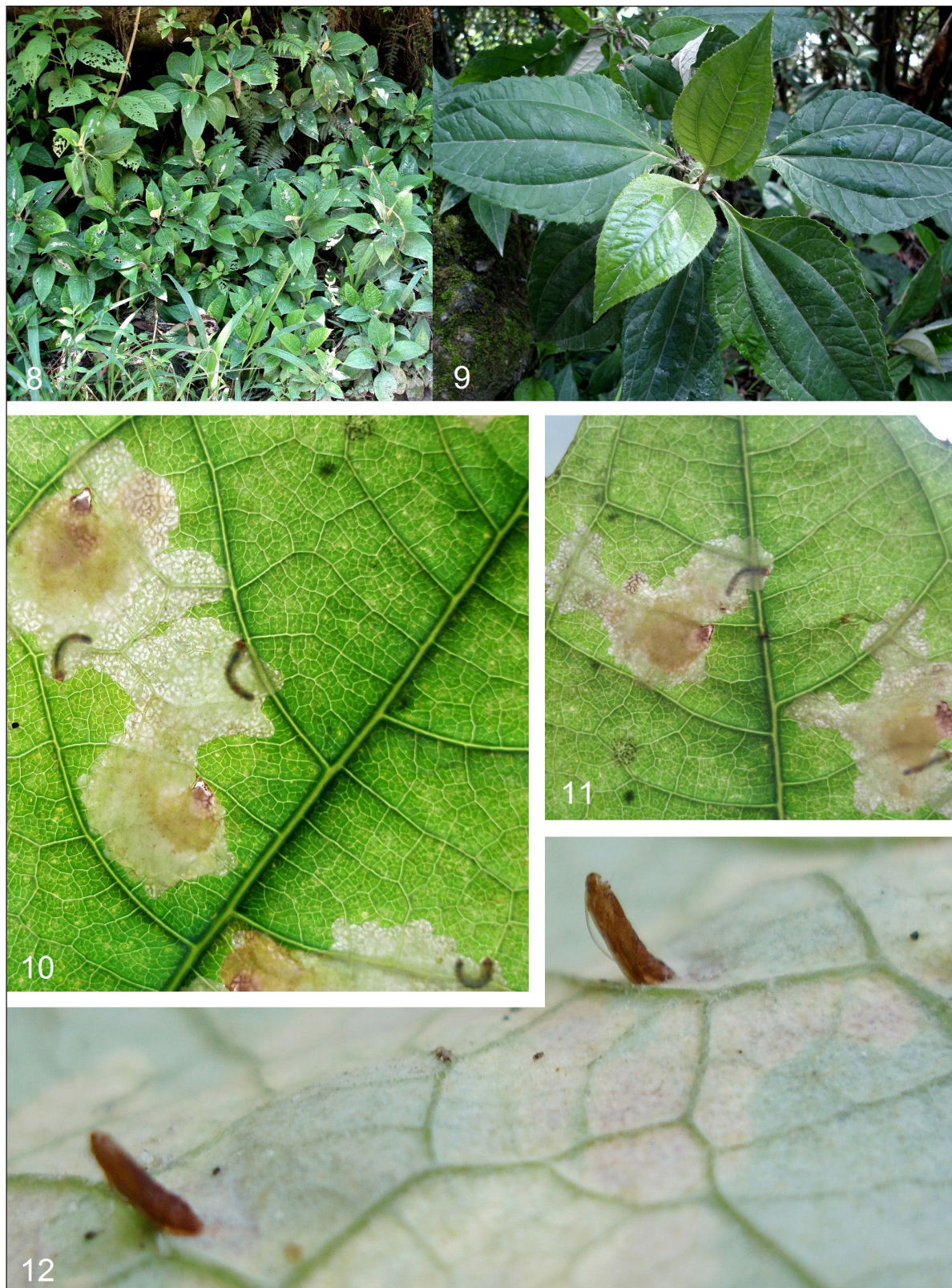
*Female genitalia* with large or medium-large rounded ovipositor lobes densely clothed with short, modified peg-like setae. Anterior and posterior apophyses usually almost equal in length; prela comprised of three pairs of rod-like projections. Corpus bursae with long or very long and very slender caudal part, and relatively small and slender main part; without pectinations or signum. Accessory sac absent or inconspicuous. Ductus spermatahaecae very slender, with many large or often very large coils.

**Bionomics.** Host plants are mainly from the Asteraceae family, including *Liabum* Adans., *Smallanthus* Mack., *Montanoa* Cerv., *Elephantopus* L., *Otopappus* Benth., *Lasianthaea* DC., but in the case of the *N. neotropicana* group, some host plants are from Malvaceae (*Sida* spp.). Larvae mine leaves and produce blotch-like leaf mines, without distorting the mined leaf (i.e., without bending the leaf margin), except for *N. neotropicana*; the larva of the latter species distorts the mined leaf. Pupa in a circular, usually distinctive, nidus.

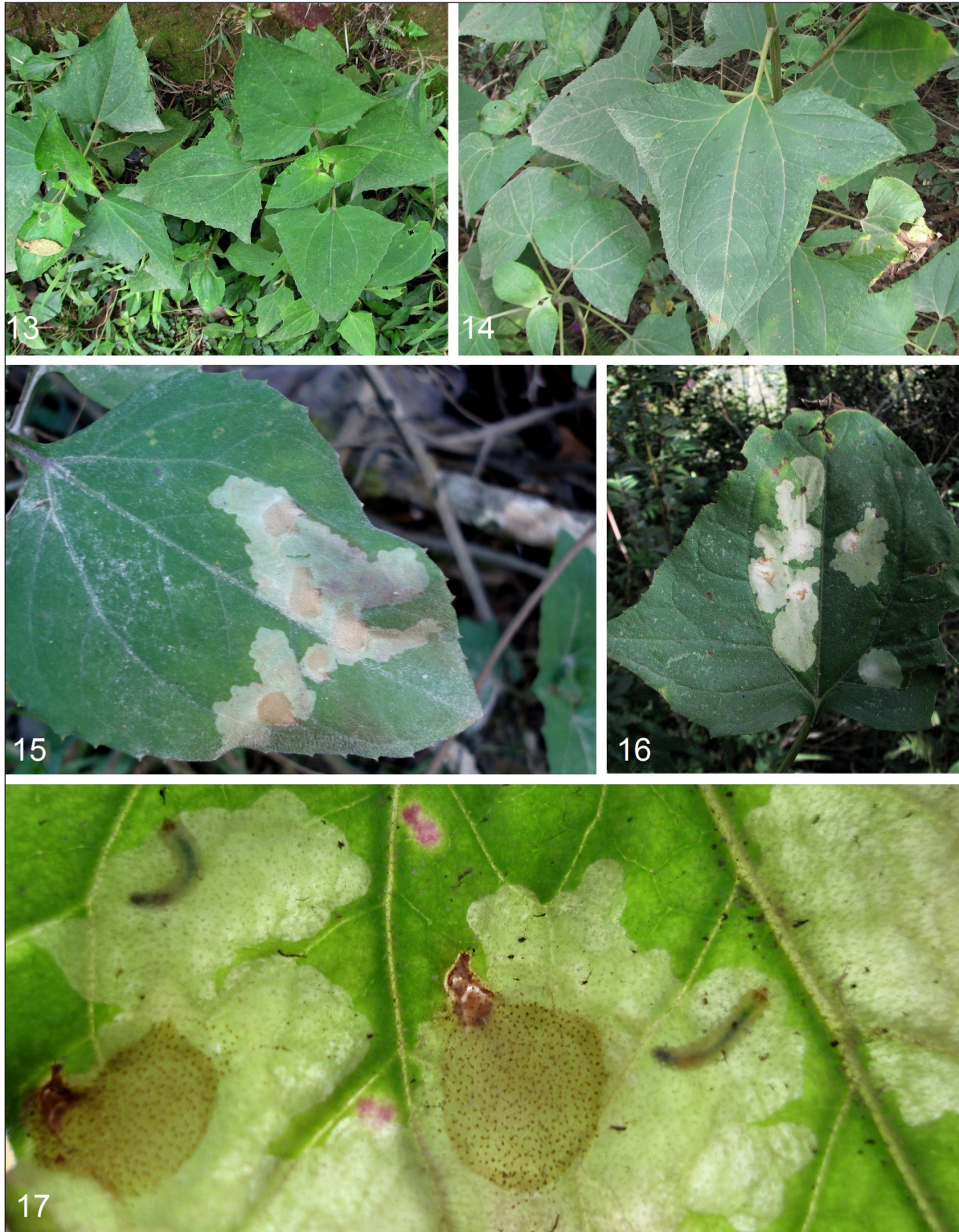
**Distribution.** Exclusively neotropical, endemic. Currently the genus is known from subtropical Mexico to Paraguay and the Yungas biogeographical province of Bolivia, with the majority of species in the tropical habitats of Central America (Belize and Guatemala), occurring at an elevation from just few metres above sea level to 3000–3100 m in the equatorial Andes of South America.

**Etymology.** The name *Neotischeria* (feminine) is a combination of the prefix *neo* (new), here derived from Neotropics where the genus is distributed, and the Latin name of another, iconic, type genus of the trumpet moth family, *Tischeria*.

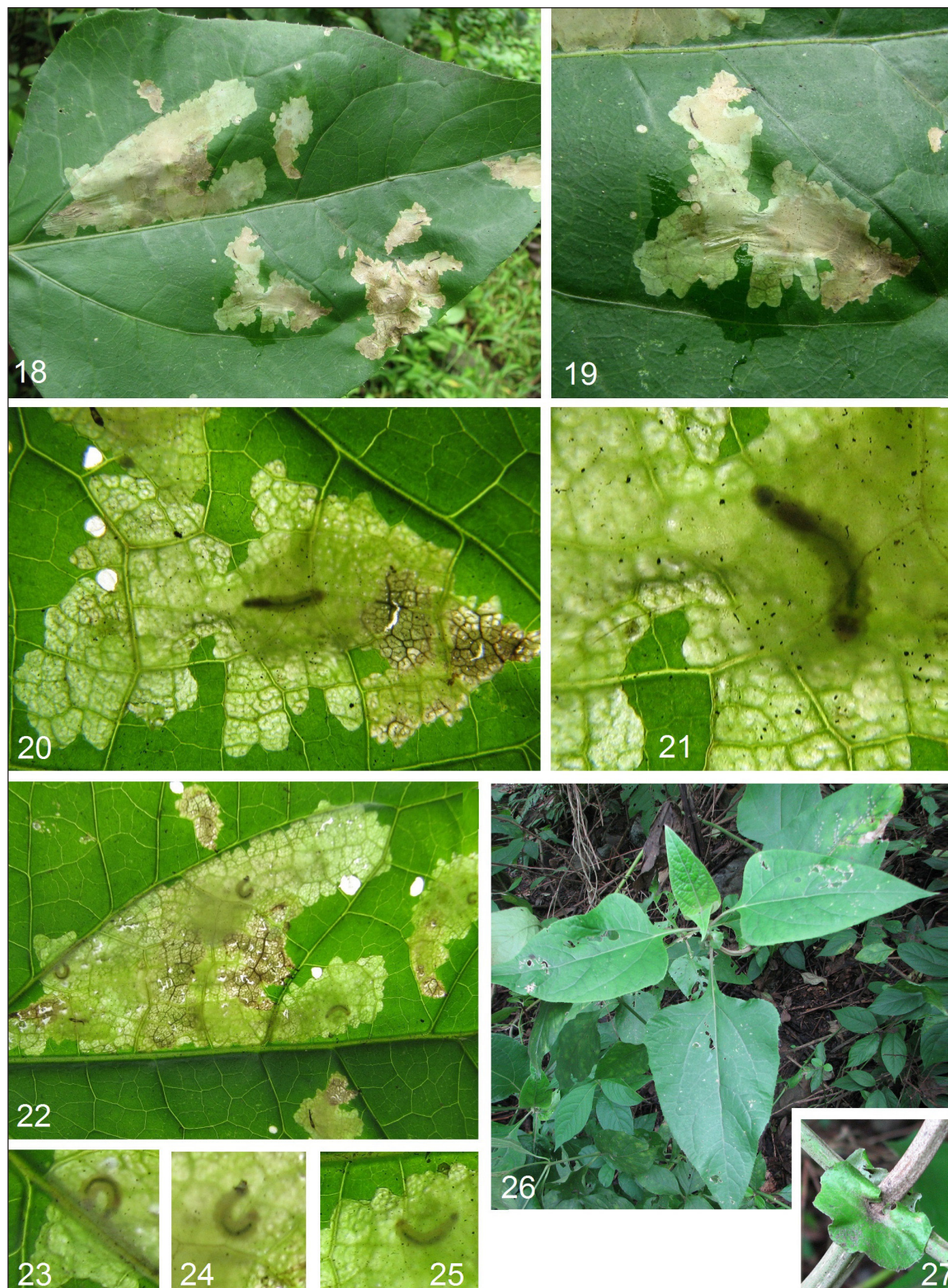
**Remarks.** Unpublished molecular data provides support for this new genus. In our study, all sequences (with a final aligned length of the dataset 657 bp) have been deposited in the GenBank ([www.ncbi.nlm.nih.gov/Genbank](http://www.ncbi.nlm.nih.gov/Genbank)) and BOLD platform ([www.barcodinglife.org](http://www.barcodinglife.org)); they will be published separately with a molecular analysis of all genera of Tischeriidae (Stonis et al., in prep.).



**Figs 8–12.** Bionomics of *Neotischeria conexa* Diškus & Stonis, sp. nov., sample no. 4939 from *Liabum vargasii* H. Rob. (or *L. solidagineum* (Kunth) Less. 8, 9 – host plant; 10, 11 – leaf mines with feeding larvae; 12 – pupal exuviae

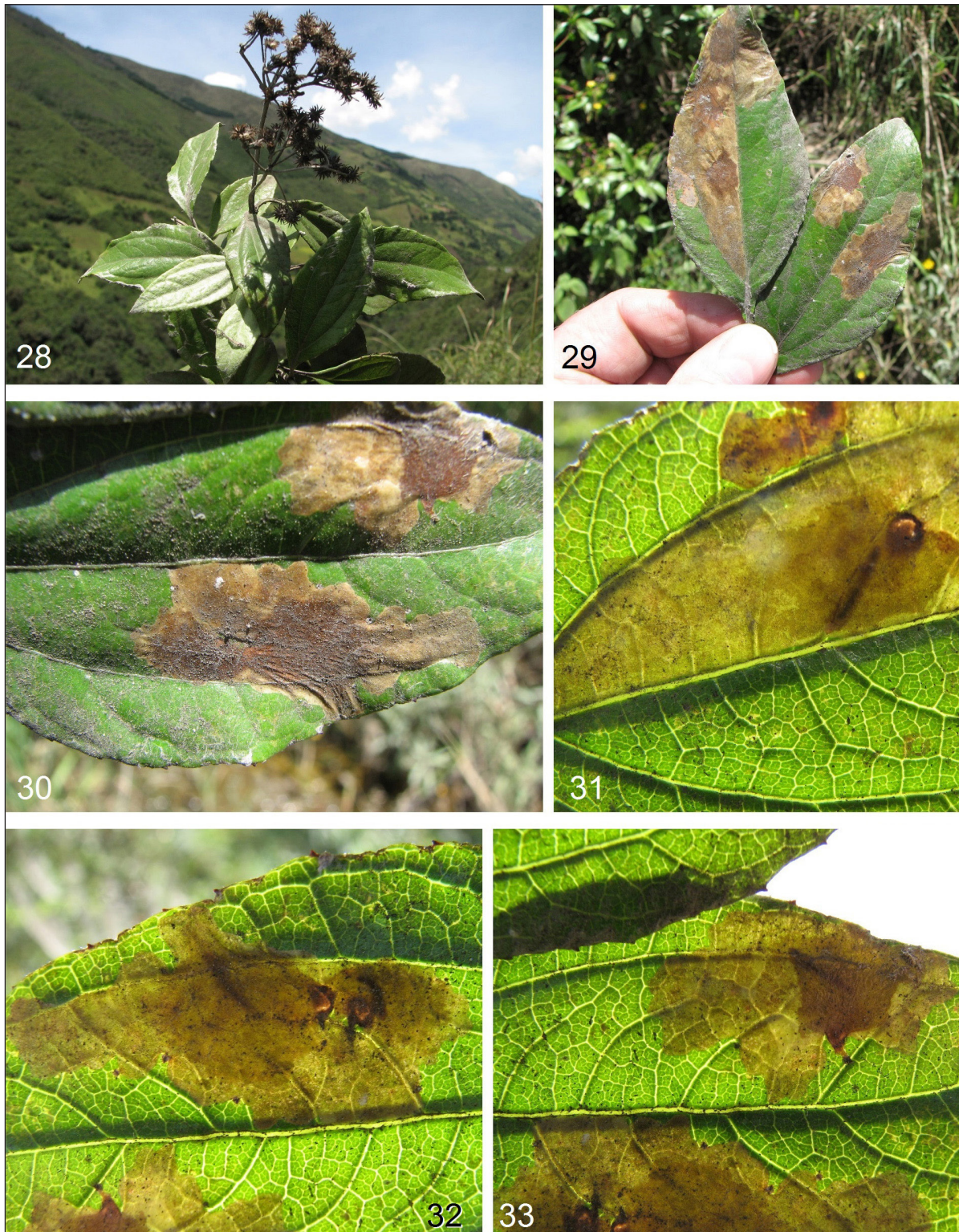


**Figs 13–17.** Bionomics of *Neotischeria conexa* Diškus & Stonis, sp. nov.; 13, 14 – collecting sample no. 5239 from *Liabum* sp.; 15 – collecting sample on no. 4943 from *Smalanthus sonchifolius* (Poepp.) H. Rob.; 16 – collecting sample no. 5239, leaf mines; 17 – collecting sample no. 4943, feeding larvae and pale brown, circular nidus



**Figs 18–27.** Bionomics of *Neotischeria ochripennata* Diškus & Remeikis, sp. nov.; sample no. 4871 from *Liabum floribundum* Less. or *L. stipulatum* Rusby; 18–25 – leaf mines with feeding larvae; 26, 27 – host plant





**Figs 28–33.** Bionomics of *Neotischeria longa* Diškus & Stonis, sp. nov., sample no. 4877 from *Liabum* sp., possibly *L. dillonii* D. G. Gutiérrez & Katinas or *L. igniarium* (Humb. & Bonpl.) Less.; 28 – host plant; 29–33 – leaf mines

**1. *Neotischeria conexa* Diškus & Stonis,  
sp. nov.**

urn:lsid:zoobank.org:act:F5215674-D97A-4952-AEF5-53CE4AFD983C

**Type material.** Holotype: 1 ♂, BOLIVIA, Nor Yungas Province, Coroico, 16°12'26"S, 67°43'54"W, elevation ca. 1650 m, mining larva on *Liabum* sp., Asteraceae, 7–12.vi.2018, ex pupa vi.–vii.2018, field card no. 5239, leg. A. Diškus, J. R. Stonis, genitalia slide no. AD1085 (ZIN). Paratypes (16 ♂, 18 ♀): 6 ♂, 7 ♀, BOLIVIA, same label data as holotype, genitalia slide no. AD1084♀ (ZIN). Paratypes: 1 ♂, 1 ♀, same label data as holotype (NRC); 4 ♂, 6 ♀, PERU, Urubamba Province, near Machu Picchu, 13°9'35"S, 72°31'58"W, elevation ca. 2010 m, mining larvae on *Liabum* sp., Asteraceae, 19.x.2008, ex pupa xi.2008, field card no. 4939, leg. A. Diškus, genitalia slides nos. AD842♂, AD1080♂, AD886♀, AD1081♀ (ZIN); 5 ♂, 3 ♀, PERU, Urubamba Province, near Machu Picchu, 13°9'44"S, 72°32'29"W, elevation ca. 2190 m, mining larvae on *Smallanthus* sp., 19.x.2008, ex pupa xi.2008, field card no. 4943, leg. A. Diškus, genitalia slides nos. AD844♂, AD1078♂, AD1079♀ (ZIN); 1 ♀ same label data (NRC).

**Diagnosis.** From the most similar *Neotischeria longa* sp. nov. and *N. ochripennata* sp. nov. (described below) it differs in the smaller size of the adults and male genitalia. Additionally, from *N. longa* sp. nov. it differs in the white leaf mines (dark brown in *N. longa*); from *N. ochripennata* it differs in the blackish brown darkenings on male forewing (forewing ochre-yellow in *N. ochripennata*) and the slender phallus (basally widened in *N. ochripennata*).

**Male** (Figs 34–36). Forewing length 3.3–3.9 mm; wingspan 7.6–8.4 mm ( $n = 14$ ).

**Head.** Frons, palpi, and pectens ochreous cream; frontal tuft and collar comprised of brownish grey, cream-tipped lamellar scales; sometimes collar grey-black; antenna significantly longer than one half the length of forewing; flagellum dark grey-brown, with the first antennal segment ochreous yellow; at certain angle of view, flagellum ochre cream basally; sensilla rather long, distinctive.

**Thorax.** Tegula densely covered with grey-brown, cream-tipped scales or entirely dark grey-black. Thorax glossy, pale brownish grey to dark grey. Forewing dark yellow-ochre, densely speckled with grey-brown or blackish grey brown scales along the costal margin and apically; fringe grey to dark grey, without a fringe line; forewing underside dark brown-grey to black-grey, with small scaleless spots and grey-black special scales along costa basally. No androconia. Hindwing grey to dark grey on upper side and underside, without androconia; fringe grey. Legs pale yellow-ochre, dark brown-grey to black-grey on the upper side.

**Abdomen.** Glossy, black-grey or grey, sometimes with some purple iridescence on upper side; paler, glossy grey, usually with some ochre scales on underside; anal tufts dorsal, long, dark grey but not always distinctive; genital segments dark grey to grey. Genitalia (Figs 50, 55–59) with capsule 420–430 µm long (or 435–500 µm long if measured from vinculum to valval tips), 225–250 µm wide. Uncus (Figs 50, 58) comprised of two long latero-ventral lobes and two short rounded dorsal lobes (Fig. 56). Valva (Figs 55, 58) 300–350 µm long (excluding the basal process), undivided, slender, basally fussed with anellus (Figs 50, 55). Anellus (Fig. 55) strongly thickened laterally, with two long, membranous lobes caudally. Vinculum triangular (Figs 50, 55, 57). Phallus about 375 µm long, slender, apically divided, without lobes or spines (Figs 57, 59).

**Female** (Figs 38–42). Forewing length 2.9–4.0 mm; wingspan 6.5–8.7 mm ( $n = 13$ ).

**Head.** Similar to male but tends to be darker.

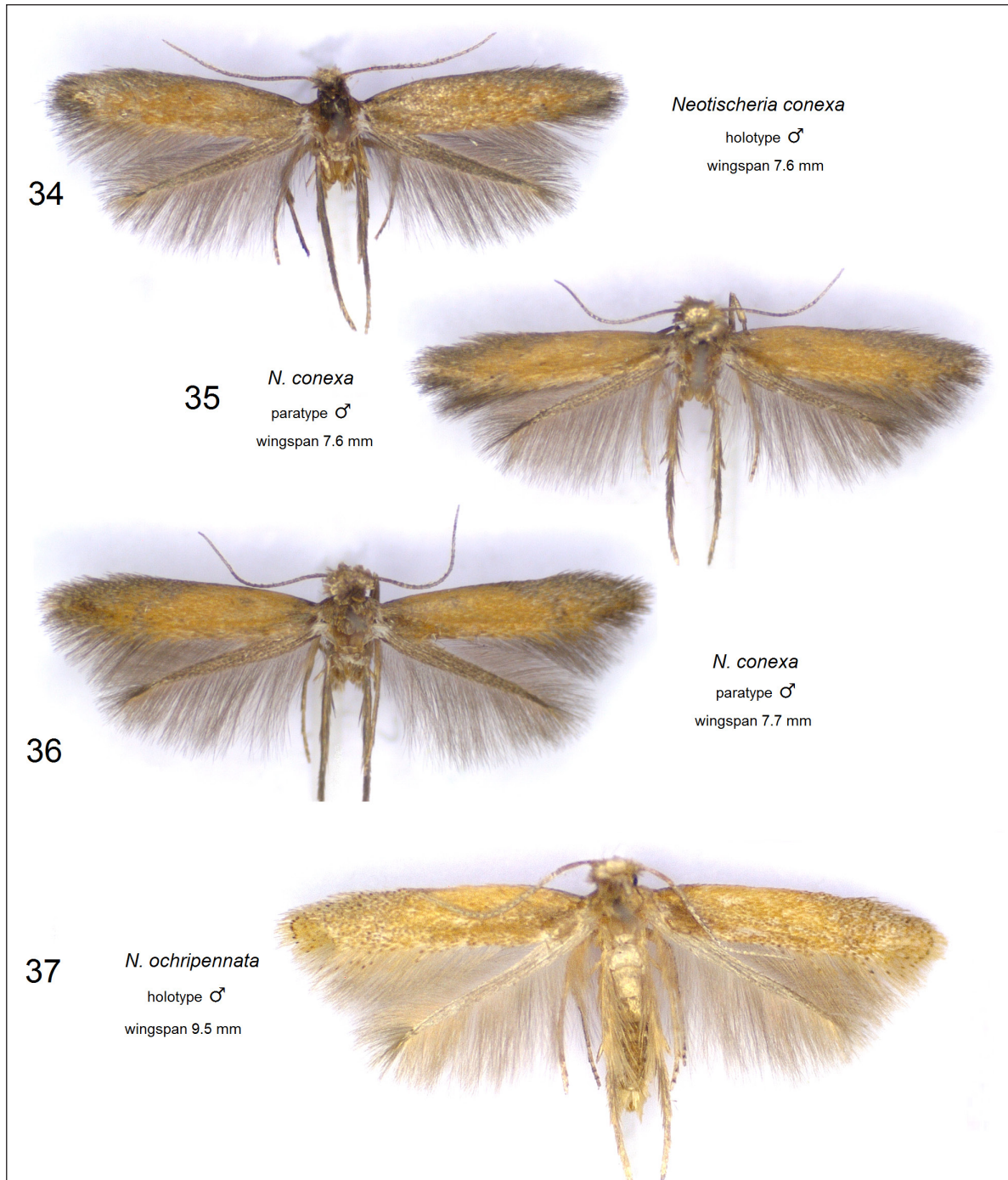
**Thorax.** Usually darker than in male. Forewing with large, irregular, ochre spots.

**Abdomen.** Genitalia (Figs 53, 54, 81–86) about 1465 µm long. Ovipositor lobes (Fig. 85) relatively large, rounded, densely clothed with peg-like setae; area between ovipositor lobes relatively wide, with tiny papillae usually collected in two rows (Fig. 53). Second pair of lobes, lateral and anterior to the ovipositor lobes, twice smaller than ovipositor lobes and bearing very long slender lamellar and piliform setae. Anterior and posterior apophyses almost

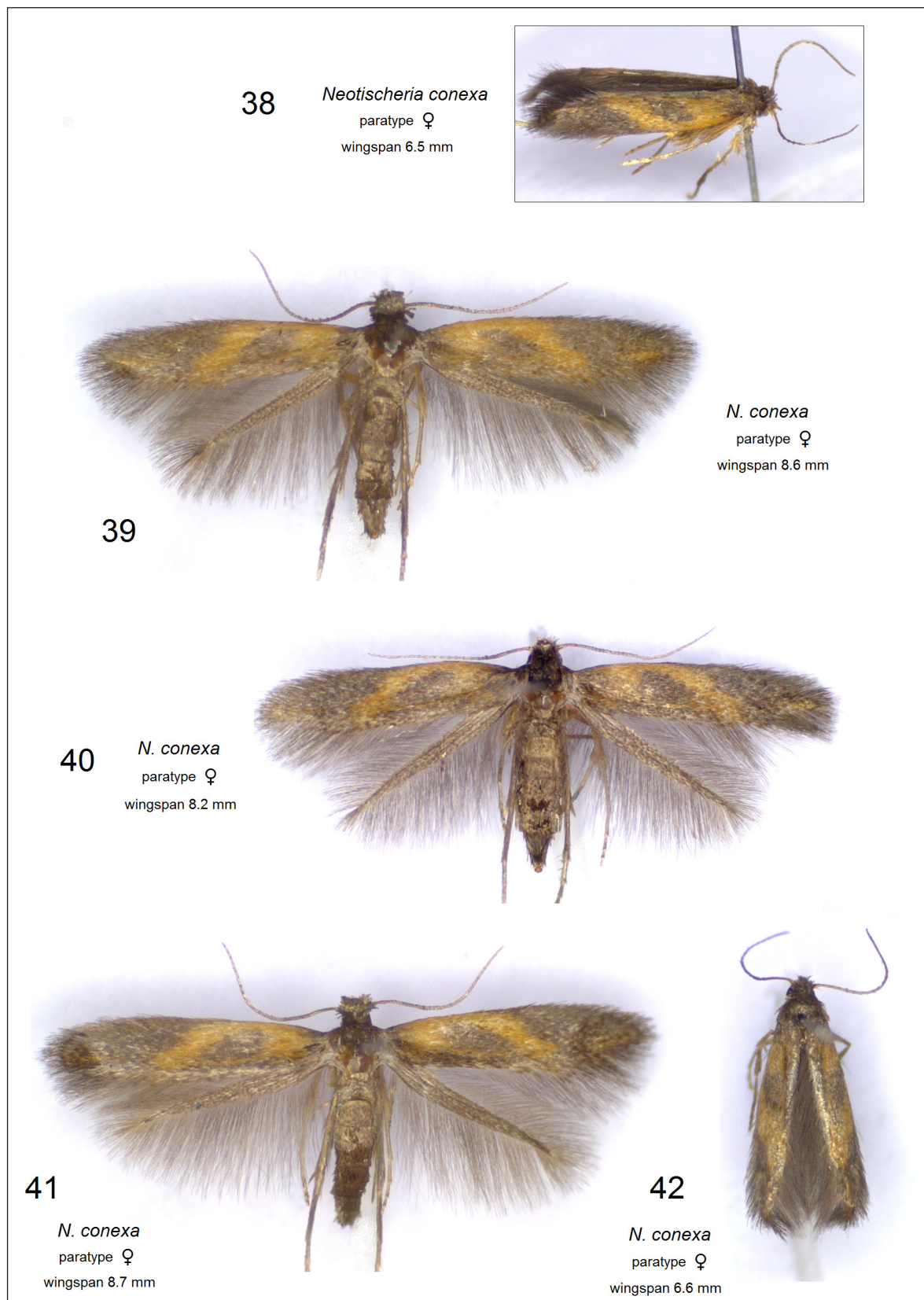
equal in length; prela comprised of three pairs of rod-like projections (Fig. 86). Corpus bursae (Fig. 81) relatively short, basally oval-shaped, without pectinations or signum. Accessory sac absent or indistinctive. Ductus spermathecae

very slender, with about 8–10 very large coils (Figs 82, 83).

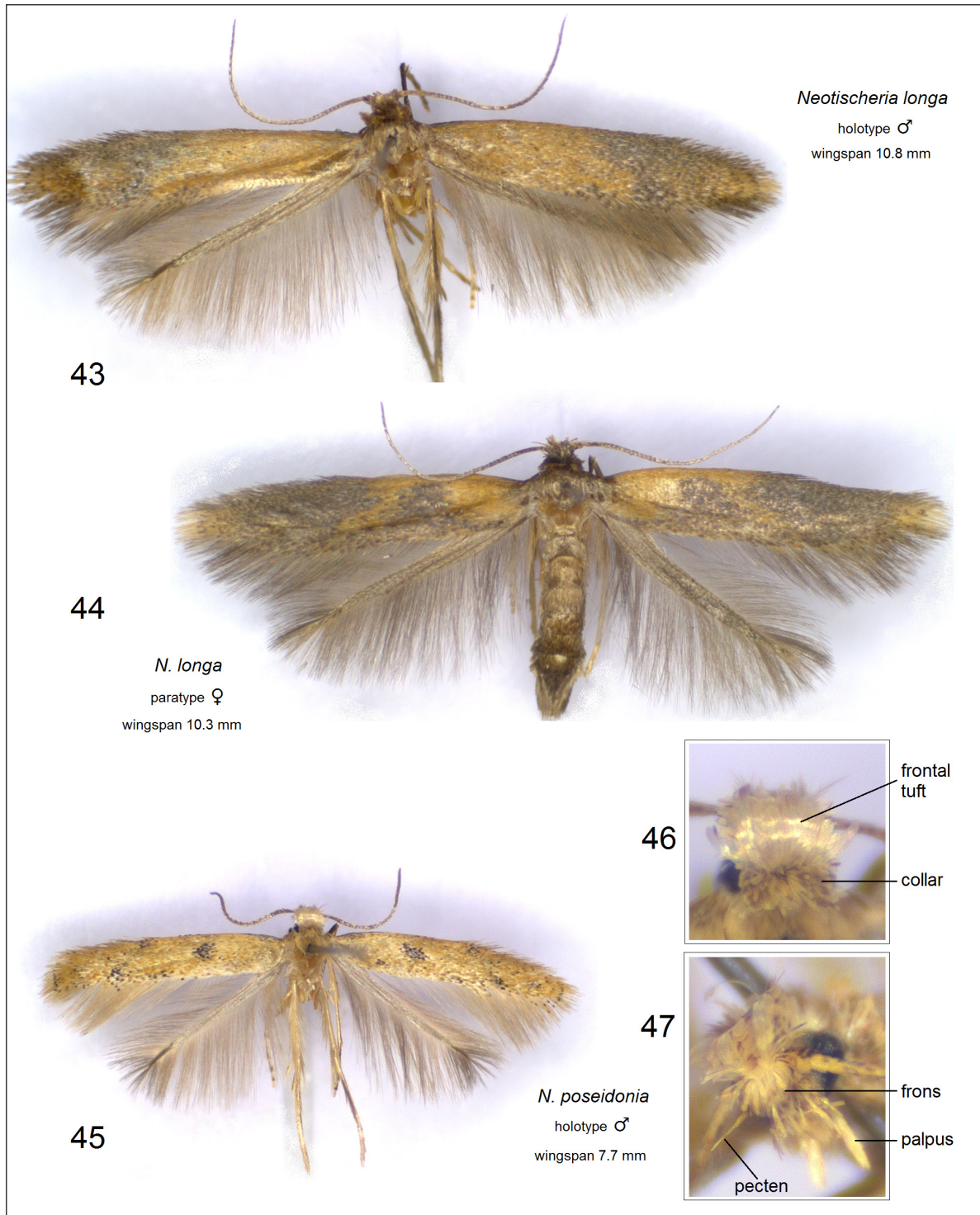
**Bionomics** (Figs 8–17). Host plants (Figs 8, 9, 13, 14) are Asteraceae plants: *Liabum* spp. (Figs 8, 9, 13, 14), including *L. vargasii* H. Rob.



**Figs 34–37.** Male adults of new *Neotischeria* species. 34 – *N. conexa* Diškus & Stonis, sp. nov., holotype, sample no. 5239; 35 – same, paratype, sample no. 4943; 36 – same, paratype, sample no. 4939; 37 – *N. ochripennata* Diškus & Remeikis, sp. nov., holotype, sample no. 4871



**Figs 38–42.** Female adults of *Neotischeria conexa* Diškus & Stonis, sp. nov., paratypes. 38 – sample no. 5239; 39 – sample no. 4939; 40 – sample no. 5239; 41 – sample no. 4943; 42 – sample no. 5239



**Figs 43–47.** Adults of new *Neotischeria* species. 43 – *N. longa* Diškus & Stonis, sp. nov., male holotype; 44 – same, female paratype; 45 – *N. poseidonia* Diškus & Stonis, sp. nov., holotype, host plant unknown; 46, 47 – same, details of head

or *L. solidagineum* (Kunth) Less. and *Smalanthus sonchifolius* (Poepp.) H. Rob. (Fig. 15). Larvae mine in leaves in June and October and

produce blotch-like leaf mines (Figs 10, 11, 15–17). Pupation in a circular distinctive nidus inside the leaf mine (Figs 10, 15, 17); colour of

the nidus varies from transparent white to pale brown. Adults fly in late June–July and November. Otherwise, the biology is unknown.

**Distribution.** The species is known from the tropical or subtropical habitats in the eastern part of the Peruvian and Bolivian Andes, at an elevation of about 1600–2200 m.

**Etymology.** The species name is derived from the Latin *conexa* (combined), in reference to the combined rearing samples from different host plants.

## 2. *Neotischeria ochripennata* Diškus & Remeikis, sp. nov.

urn:lsid:zoobank.org:act:3929E91F-D190-4613-A9FC-9ECDBFB832DA

**Type material.** Holotype: 1 ♂, ECUADOR: Chimborazo Province, 15 km NE Bucay (Cumanda), 2°11'5"S, 79°4'14"W, elevation ca. 810 m, mining larva on *Liabum* sp., Asteraceae, 18.ii.2007, field card no. 4871, leg. A. Diškus, J. R. Stonis, genitalia slide no. RA1090♂ (ZIN). Paratypes (2 ♂): 1 ♂, same label data as holotype, genitalia slide no. AD1086♂ (ZIN); 1 ♂, ECUADOR: Pichincha Province, 31 km NW Alóag, 0°26'37"S, 78°42'57"W, elevation ca. 2220 m, from feeding larva, 25.ii.2007, field card no. 4898, leg. A. Diškus, J. R. Stonis, genitalia slide no. AD1089♂ (ZIN) (also see Remarks).

**Diagnosis.** From the most similar *Neotischeria conexa* sp. nov. and *N. longa* sp. nov. (described in the current paper) it differs in the bright ochre-yellow male forewing and fringe (fringe grey and forewing densely speckled with dark scales in *N. conexa* and *N. longa*). In the male genitalia, *N. ochripennata* sp. nov. differs in the distinctive, clearly visible basal extensions of the valva (Figs 49, 62, 67). Additionally, *N. ochripennata* differs from *N. longa* in the white leaf mines (dark brown in *N. longa*).

**Male** (Fig. 37). Forewing length 3.8–4.2 mm; wingspan 8.5–9.5 mm (n = 2).

**Head.** Frons, palpi, and pectens ochre cream to pale ochre-yellow; frontal tuft and collar glossy, comprised of golden cream or pale ochre-yellow lamellar scales; antenna slightly

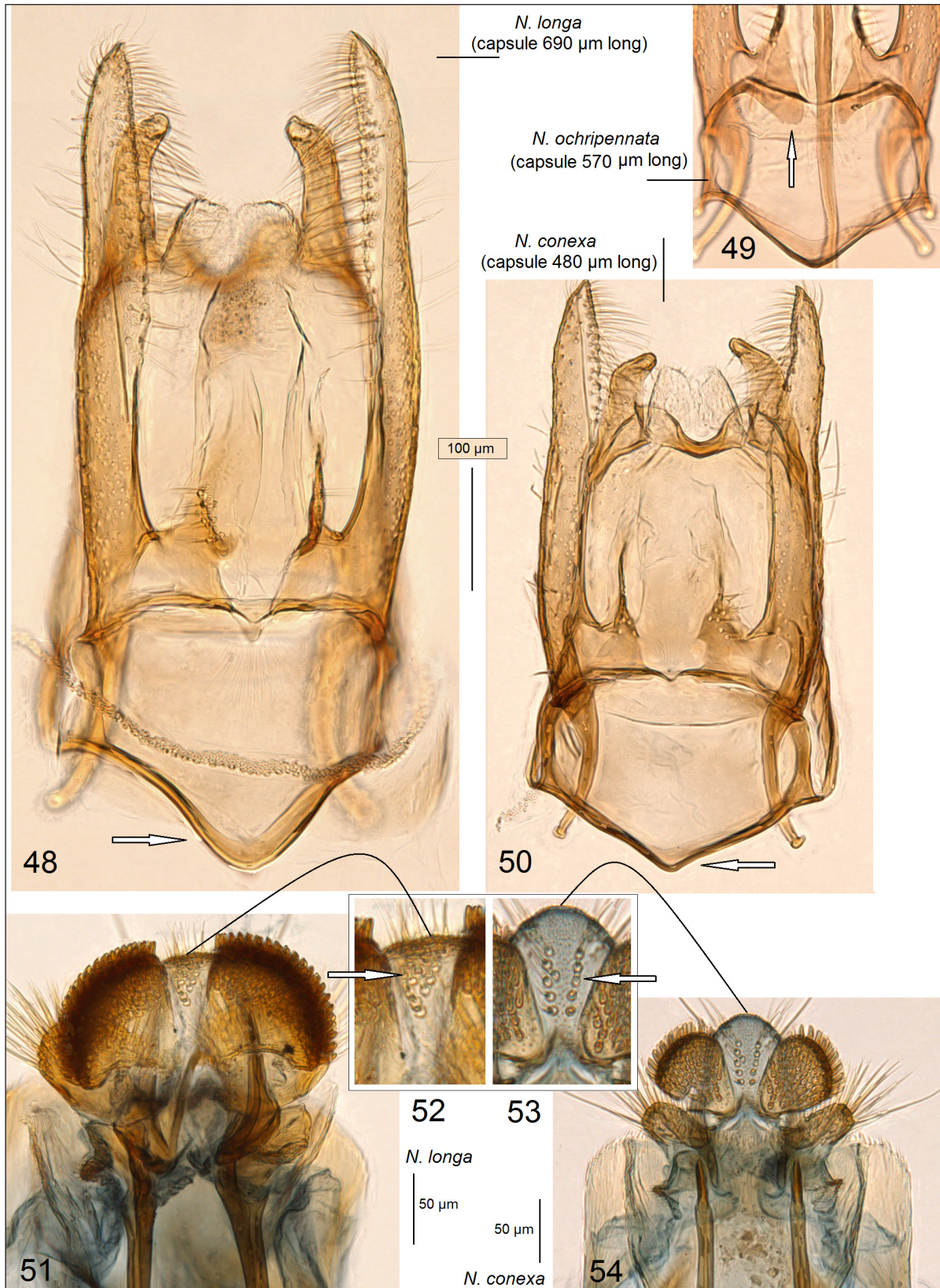
longer than one half the length of forewing; flagellum pale yellowish grey, basally ochre-yellow; sensilla whitish cream, rather distinctive but very fine.

**Thorax.** Tegula covered with ochre-brown, cream-tipped scales, distally cream. Thorax ochre cream, speckled with some ochre-brown scales. Forewing bright ochre-yellow, sparsely speckled with some pale brown scales in apical third; fringe bright ochre-yellow to pale ochre-yellow, with a fringe line of brown-black scales; forewing underside dark ochre-brown, with small scaleless spots and brown-black special scales along costa basally. No androconia. Hindwing grey to pale grey-brown on upper side, pale grey on underside, without androconia; fringe pale grey, ochre glossy. Legs ochre-yellow on underside, dark grey-brown on upper side, with or without some purple iridescence.

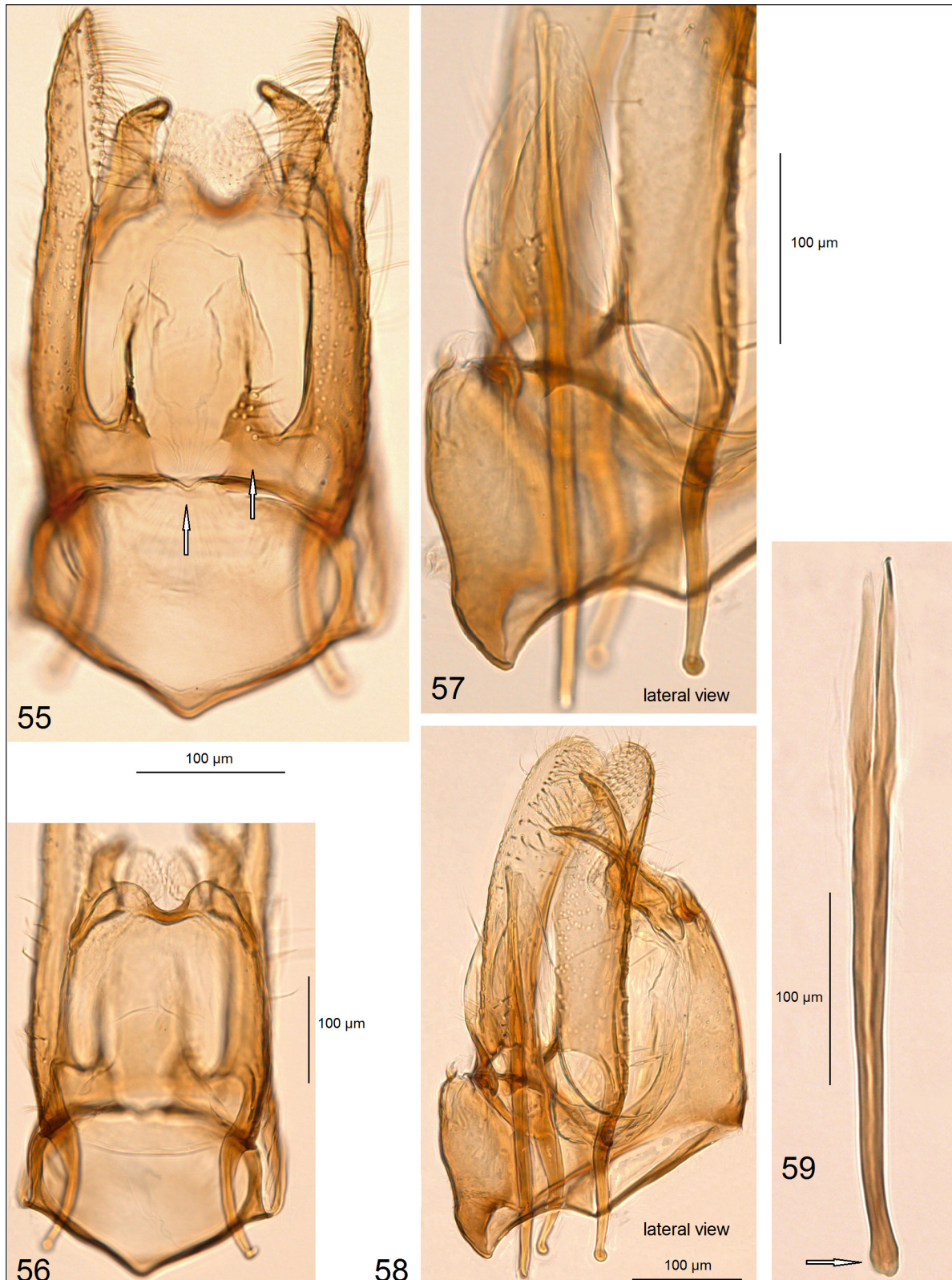
**Abdomen.** Golden ochreous yellow, densely speckled with dark ochre-brown scales on upper side and underside; anal tufts lateral and dorsal (the latter longer), pale ochreous yellow; genital segments golden glossy, ochreous cream. Genitalia (Figs 49, 60–67) with capsule about 490 µm long (or 570 µm long if measured from vinculum to valval tips), 245–250 µm wide. Uncus comprised of two long lateroventral lobes (Fig. 60) and two short, rounded dorsal lobes (Fig. 61). Valva (Figs 62, 66) about 390 µm long (excluding the basal process), undivided, slender, basally fussed with anellus (Fig. 66) and with a distinctive basal extension (Figs 62, 67). Anellus (Fig. 63) long, strongly thickened laterally, with two long, membranous lobes caudally. Vinculum triangular distally (Figs 66, 67). Phallus about 450 µm long, basally widened (Fig. 67), apically divided, without spines (Figs 62–67).

**Female.** Unknown (see Remarks).

**Bionomics** (Figs 18–27). Host plant is *Liabum floribundum* Less. (or *L. stipulatum* Rusby), Asteraceae (Figs 26, 27). Larvae mine in leaves in February and produce blotch-like leaf mines (Figs 18–25). Pupation in a circular nidus inside the leaf mine (Fig. 20); the nidus is transparent, rather indistinctive. Adults fly in March. Otherwise, the biology is unknown.

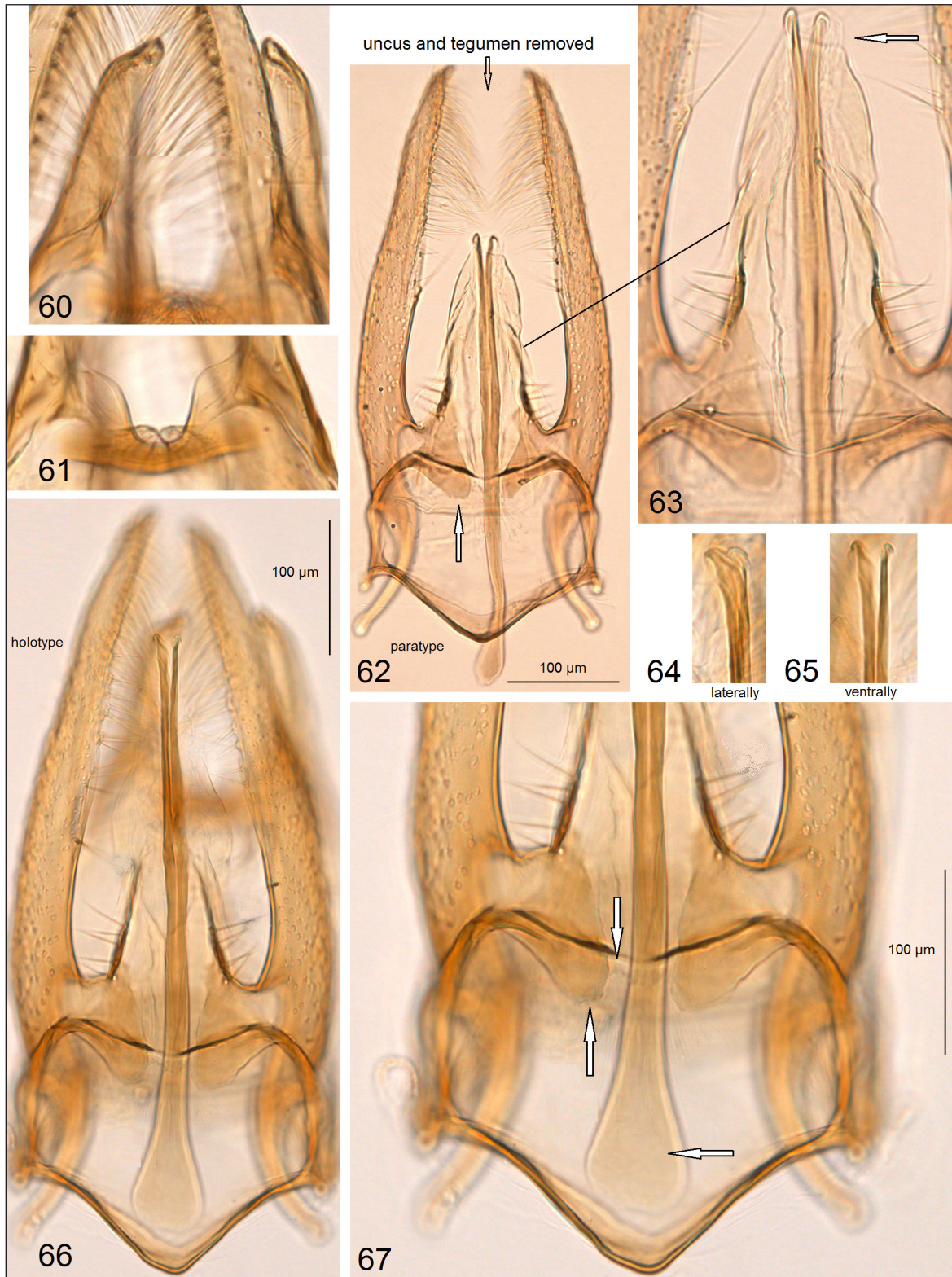


**Figs 48–54.** Differentiation of related *Neotischeria* species. 48 – *N. longa* Diškus & Stonis, sp. nov., male genitalia with phallus removed; 49 – same, *N. ochripennata* Diškus & Remeikis, sp. nov.; 50 – same, *N. conexa*; 51, 52 – details of female genitalia, ovipositor lobes, *N. longa*; 53, 54 – same, *N. conexa*

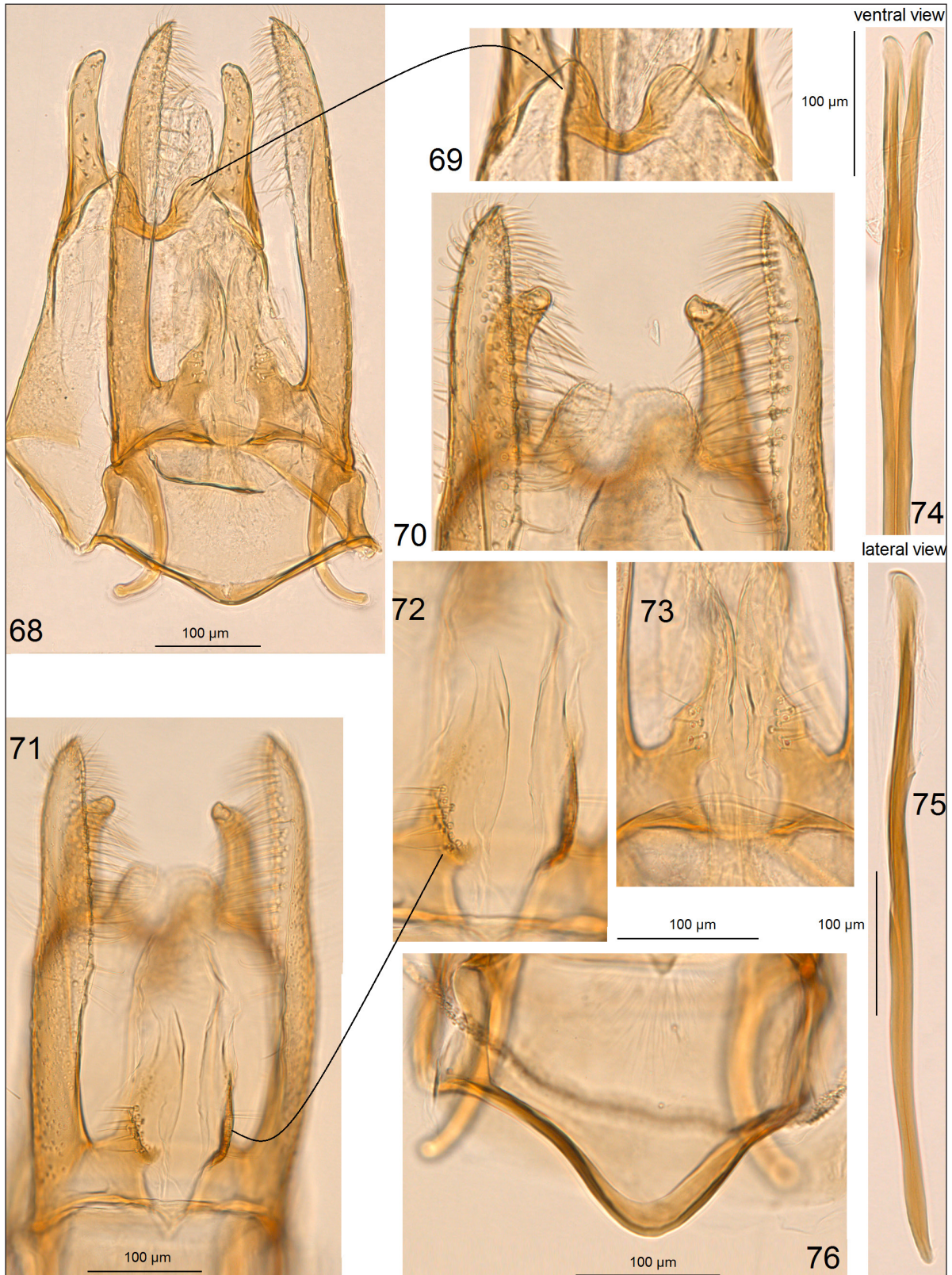


**Figs 55–59.** Male genitalia of *Neotischeria conexa* Diškus & Stonis, sp. nov.; 55, 56 – capsule with phallus removed, holotype, genitalia slide no. AD1085 (ZIN); 57, 58 – capsule with phallus inside, lateral view, paratype, genitalia slide no. AD844 (ZIN); 59 – phallus, holotype, genitalia slide no. AD1085 (ZIN)

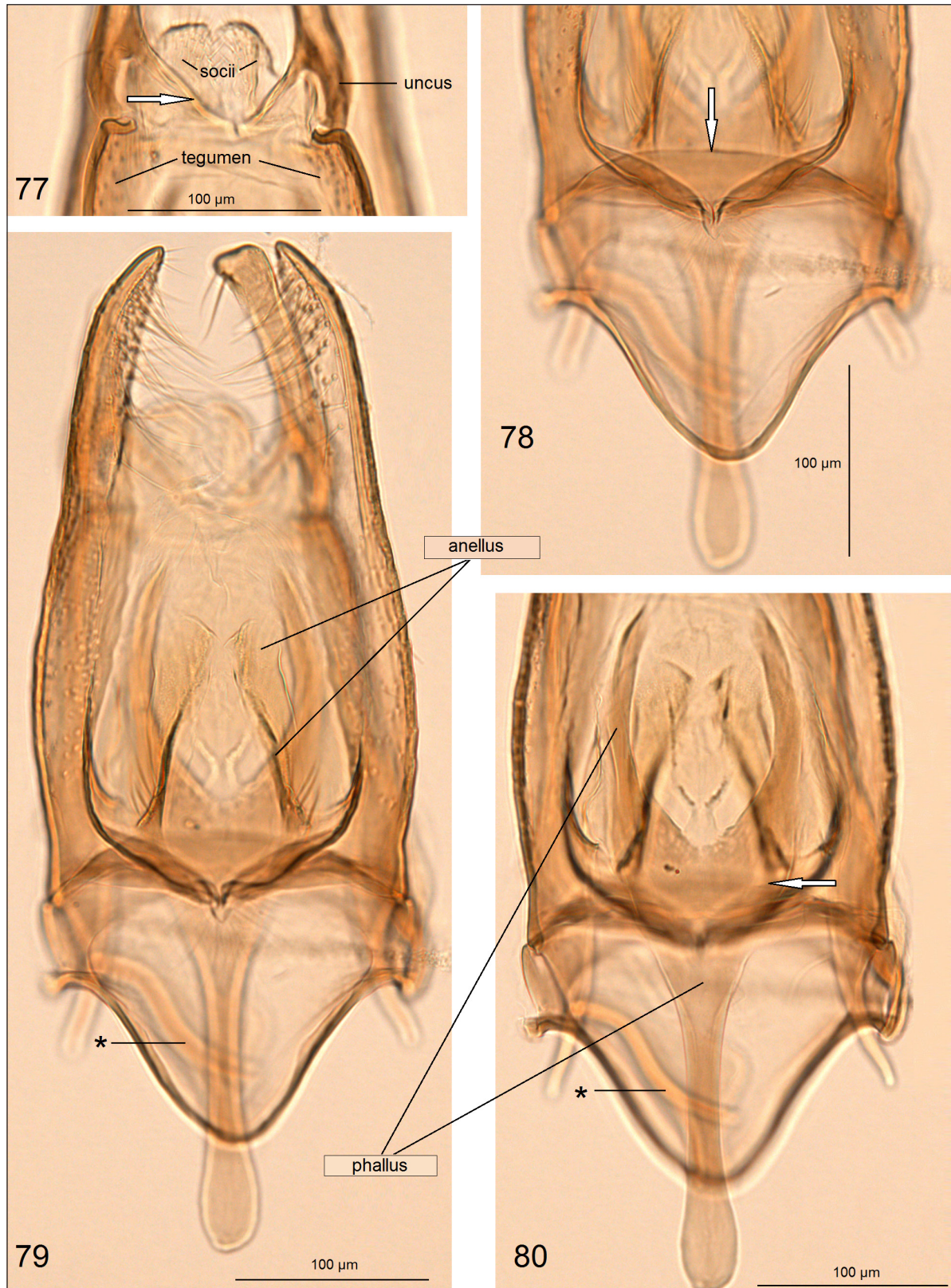




**Figs 60–67.** Male genitalia of *Neotischeria ochripennata* Diškus & Remeikis, sp. nov.; 60 – holotype, slide no. RA1090, uncus, dorsal lobes; 61 – same, ventral lobes; 62, 63 – paratype, slide no. AD1086, capsule with uncus and tegumen removed; 64 – apex of phallus, lateral view, temporary slide no. RA1090; 65 – same, ventral view, permanent slide no. RA1086; 66, 67 – capsule with phallus inside, lateral view, holotype, slide no. RA1090 (ZIN)



**Figs 68–76.** Male genitalia of *Neotischeria longa* Diškus & Stonis, sp. nov.; 68, 69 – capsule with phallus removed, paratype, slide no. AD843 (ZIN); 70–71 – details of capsule, holotype, slide no. AD1082 (ZIN); 73 – same, paratype, slide no. AD843; 74 – phallus, holotype, slide no. AD1082; 75 – same, paratype, slide no. AD843; 76 – vinculum, holotype, slide no. AD1082



**Figs 77–80.** Male genitalia of *Neotischeria poseidonia* Diškus & Stonis, sp. nov., capsule with phallus inside, holotype, genitalia slide no. AD1090 (ZIN). 77 – uncus and socii; 78 – vinculum; 79 – general view of capsule; 80, same, focused on phallus

**Distribution.** The species is known from tropical and subtropical western part of the equatorial Andes (Ecuador), at an elevation of about 810–2220 m.

**Etymology.** The species name is derived from the Ancient Greek *ochra* (ochre colour) combined with the Latin *pennatus* (winged), in reference to the bright, ochre-yellow colour of the forewing.

**Remarks.** One female specimen with a label as the holotype (genitalia slide no. RA1089, NRC) was studied and photographed, but excluded from the type series. Because the dark scaling and small size of the specimen and our doubts about its belonging to *N. ochripennata*, this specimen was left unpublished here.

### 3. *Neotischeria longa* Diškus & Stonis, sp. nov.

urn:lsid:zoobank.org:act:9FB2AC43-4197-41DD-9174-B92BD5D1385B

**Type material.** Holotype: 1 ♂, ECUADOR, Chimborazo Province, 30 km NE Pallatanga, 1°52'41"S, 78°54'11"W, elevation ca. 3020 m, from feeding larvae on *Liabum* sp., 21.ii.2007, field card no. 4877, leg. A. Diškus, J. R. Stonis, genitalia slide no. AD1082♂ (ZIN). Paratypes (4 ♂, 4 ♀): 3 ♂, 3 ♀ same label data as holotype, genitalia slides nos AD843♂, AD1083♀ (ZIN). Paratypes: 1 ♂, 1 ♀, same label data as holotype (NRC).

**Diagnosis.** From the most similar *Neotischeria conexa* sp. nov. (described above) it differs in the larger size of the adults and male genitalia. Additionally, from the central Andean *N. conexa* sp. nov., the equatorial Andean *N. longa* differs in the dark brown leaf mines (white in *N. conexa*); from the similar equatorial Andean *N. ochripennata* it differs in the blackish brown darkening on male forewing (forewing ochre-yellow in *N. ochripennata*) and the slender phallus (basally widened in *N. ochripennata*).

**Male** (Fig. 43). Forewing length 3.7–5.0 mm; wingspan 8.0–10.8 mm ( $n = 5$ ).

**Head.** Frons, palpi, and pecten yellowish cream to pale ochreous yellow or pale ochre;

frontal tuft pale brown basally, pale ochreous yellow distally; collar large, comprised of pale brown and brown, ochre-tipped scales; sometimes collar comprised of pale grey, cream tipped scales; antenna slightly longer than one half the length of forewing; flagellum pale grey-brown, basally ochre cream; sensilla very fine but distinctive.

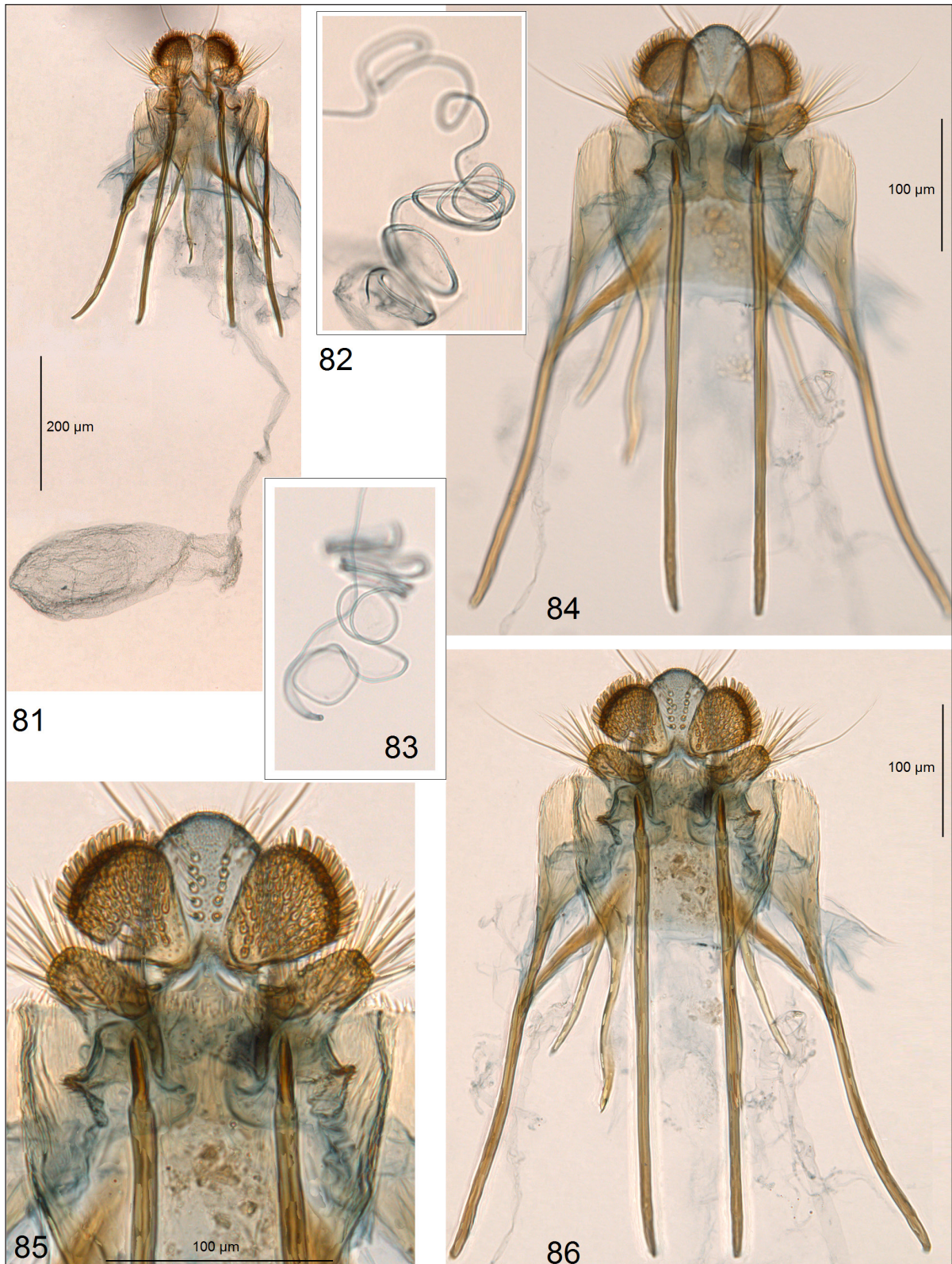
**Thorax.** Tegula grey-brown, distally pale ochre-brown. Thorax brownish cream to yellow cream. Forewing yellow-ochre, densely speckled with blackish brown scales in apical half; fringe mostly grey but apically pale yellowish ochre, with a fringe line of blackish brown scales; forewing underside grey-brown to dark grey-brown, with small scaleless spots and brown-black special scales along costa basally. No androconia. Hindwing dark grey on upper side, grey-brown on underside, without androconia; fringe pale grey, ochre glossy. Legs ochre cream, dark brown-grey on upper side.

**Abdomen.** Ochre-brown on upper side; paler, yellow-ochre, speckled with brown scales on underside; anal tufts dorsal, pale yellow-ochre; genital segments pale yellow-ochre. Genitalia (Figs 48, 68–76) with capsule about 610 µm long (or 690 µm long if measured from vinculum to valval tips), 280–290 µm wide. Uncus comprised of two long latero-ventral lobes (Fig. 68) and two short, rounded dorsal lobes (Fig. 69). Valva (Fig. 71) about 460 µm long (excluding the basal process), undivided, slender, basally fussed with anellus (Figs 68, 71). Anellus (Figs 72, 73) strongly thickened laterally, with two long, membranous lobes caudally. Vinculum triangular but rounded distally (Figs 68, 76). Phallus (Fig. 75) about 485 µm long, slender, apically divided (Fig. 74), without lobes or spines.

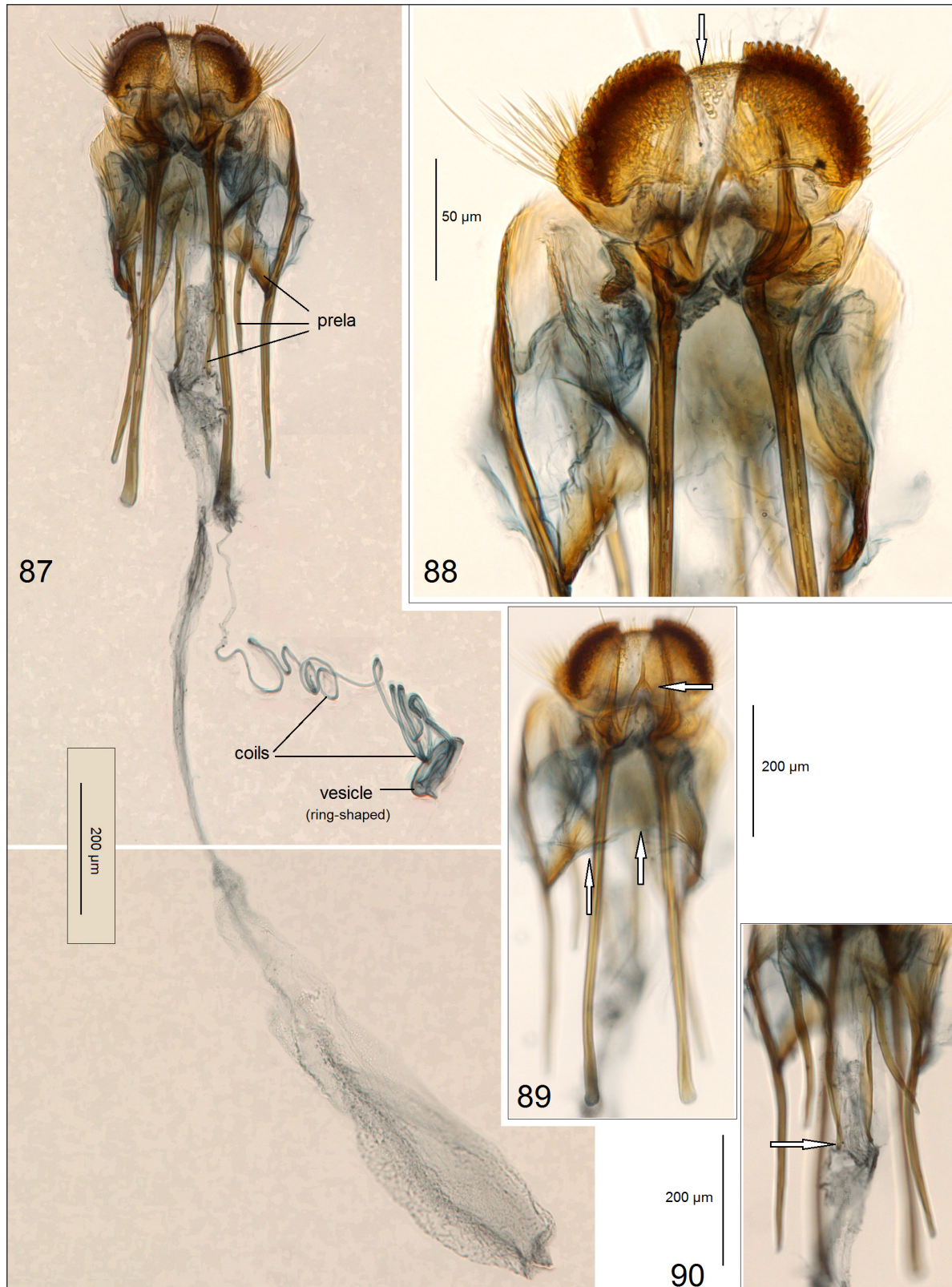
**Female** (Fig. 44). Forewing length 4.0–5.4 mm; wingspan 8.8–11.3 mm ( $n = 4$ ).

**Thorax.** Similar to male but forewing with bright yellow-ochre spots, thorax brown.

**Abdomen.** Bright yellow-ochre on underside. Genitalia (Figs 51, 52, 87–90) about 2110 µm long. Ovipositor lobes (Figs 51, 88) very large, rounded, densely clothed with peg-like setae; area between ovipositor lobes moderately wide,



**Figs 81–86.** Female genitalia of *Neotischeria conexa* Diškus & Stonis, sp. nov., paratypes. 81, 83 – genitalia slide no. AD1081 (ZIN); 82, 84–86 – genitalia slide no. AD1084 (ZIN)



**Figs 87–90** Female genitalia of *Neotischeria longa* Diškus & Stonis, sp. nov., paratype, genitalia slide no. AD1083 (ZIN)

with tiny papillae usually not collected in two rows (Fig. 51). Second pair of lobes, lateral and anterior to the ovipositor lobes, very small, indistinctive. Anterior apophyses slightly shorter than posterior ones; prela comprised of three pairs of rod-like projections (Figs 87, 89, 90). Corpus bursae (Fig. 87) very long and slender, basally wider, without pectinations or signum. Accessory sac absent or indistinctive. Ductus spermathecae very slender, with about 10 very large coils.

**Bionomics** (Figs 28–33). Host plant is *Liabum* sp., possibly *L. dillonii* D. G. Gutiérrez & Katinas or *L. igniarium* (Humb. & Bonpl.) Less., Asteraceae (Figs 28, 29). Larvae mine in leaves in February and produce dark brown, irregular blotch-like leaf mines (Figs 29–33). Pupation in a circular, indistinctive nidus inside the leaf mine. Adults fly in March. Otherwise, the biology is unknown.

**Distribution.** The species is known from the subtropical western part of the equatorial Andes (Ecuador), at an elevation of about 3020 m.

**Etymology.** The species name is derived from the Latin *longus* (long), in reference to the very large size of the adults and their genitalia.

#### 4. *Neotischeria guarani* (Diškus & Stonis, 2020) (comb. nov.)

*Paratischeria guarani* Diškus & Stonis, in Stonis et al., 2020b: 127–129, 142.

Host plant. *Elephantopus mollis* Kunth (Asteraceae).

Distribution. This species is known from the single locality in Paraguay, Departamento de Itapúa, Hohenau.

Remarks. *Neotischeria guarani* was illustrated by Stonis et al., 2020b: Figs 44–45 (adult), Figs 92–94 (male genitalia), Figs 95–97 (female genitalia).

#### 5. *Neotischeria mesoamericana* (Diškus & Stonis, 2020) (comb. nov.)

*Paratischeria mesoamericana* Diškus & Stonis, in Stonis et al., 2020b: 129, 130–132, 134, 143, 144.

Host plant. *Montanoa hibiscifolia* Benth. (Asteraceae).

Distribution. Guatemala.

Remarks. *Neotischeria mesoamericana* was illustrated by Stonis et al., 2020b: fig. 46 (adult), Figs 98–104 (male genitalia), Figs 105–110 (female genitalia).

#### 6. *Neotischeria belizensis* (Remeikis & Stonis, 2020) (comb. nov.)

*Paratischeria belizensis* Remeikis & Stonis, in Stonis et al., 2020a: 64–66.

Host plant. Unknown.

Distribution. This species is known from the single locality in Belize, Chiquibul Forest Reserve, Las Cuevas.

Remarks. *Neotischeria belizensis* was illustrated by Stonis et al., 2020a: Figs 24–25 (adult), Figs 124–127 (male genitalia).

#### 7. *Neotischeria robinsoni* (Diškus & Stonis, 2020) (comb. nov.)

*Paratischeria robinsoni* Diškus & Stonis, in Stonis et al., 2020a: 55–59.

Host plant. *Otopappus verbesinoides* Benth. (Asteraceae).

Distribution. This species was described from Belize but recently five specimens (3 ♂, 2 ♀) have also been discovered in Guatemala (ZIN).

Remarks. *Neotischeria robinsoni* was illustrated by Stonis et al., 2020a: Figs 18–20 (adult), Figs 90–106 (male and female genitalia).

#### 8. *Neotischeria tubifex* (Diškus & Stonis, 2020) (comb. nov.)

*Paratischeria tubifex* Diškus & Stonis, in Stonis et al., 2020a: 59–64.

Host plant. *Lasianthaea fruticosa* (L.) K. M. Becker (Asteraceae).

Distribution. This species is known from the single locality in Belize, Chiquibul Forest Reserve, Las Cuevas.

Remarks. *Neotischeria tubifex* was illustrated by Stonis et al., 2020a: Figs 21–23 (adult),

Figs 107–117 (male genitalia), Figs 118–123 (female genitalia).

### The *neotropicana* group

#### 9. *Neotischeria neotropicana* (Diškus & Stonis, 2015) (comb. nov.), a type species of the genus

*Astrotischeria neotropicana* Diškus & Stonis, 2015: 457–465.

*Paratischeria neotropicana* (Diškus & Stonis), in Stonis et al., 2017: 14; 2020a: 66–68; 2020b: 135, 147.

Host plants. *Sida rhombifolia* L., *S. spinose* L., and *S. acuta* Burm.f. (Malvaceae).

Distribution. *Paratischeria neotropicana* is a tischeriid species with the broadest distribution range yet documented in the Neotropics, having been recorded from various localities in Belize, Mexico, Guatemala, Ecuador, Peru and Bolivia (Diškus, Stonis, 2015; Stonis et al., 2020b).

Remarks. *Neotischeria neotropicana* was illustrated by Diškus, Stonis, 2015: figs: 12–13 (adult), Figs 14–21 (male genitalia), Figs 22–27 (female genitalia).

#### 10. *Neotischeria capnota* (Meyrick, 1915) (comb. nov.)

*Tischeria capnota* Meyrick, 1915: 247.

*Paratischeria capnota* (Meyrick, 1915), Xu et al., 2017: 331.

Host plant is unknown.

Distribution: Peru (Lima).

Remarks. Male genitalia of the lectotype and paralectotype (deposited at the NHMUK) was studied and documented for the first time (see Figs 91–98).

#### 11. *Neotischeria poseidonia* Diškus & Stonis, sp. nov.

urn:lsid:zoobank.org:act:B128F35A-A762-47A7-8457-5C2357C4ABDF

**Type material.** Holotype: ♂, GUATEMALA: Antigua Guatemala, San Juan del Obispo, 14°31'7"N, 90°43'50"W, elevation ca. 1680 m,

from feeding larva, 25.ii.2012, field card no. 5113, A. Diškus, genitalia slide no. AD1090♂ (ZIN).

**Diagnosis.** *Neotischeria poseidonia* sp. nov. belongs to the *N. neotropicana* group. In the male genitalia, *N. poseidonia* from the most similar *N. neotropicana* and all other congeneric species differs in the strongly developed, broadly bifurcated and wide phallus (Fig. 80), caudally well-thickened vinculum (Fig. 78), and the distally membranous anellus (Fig. 79).

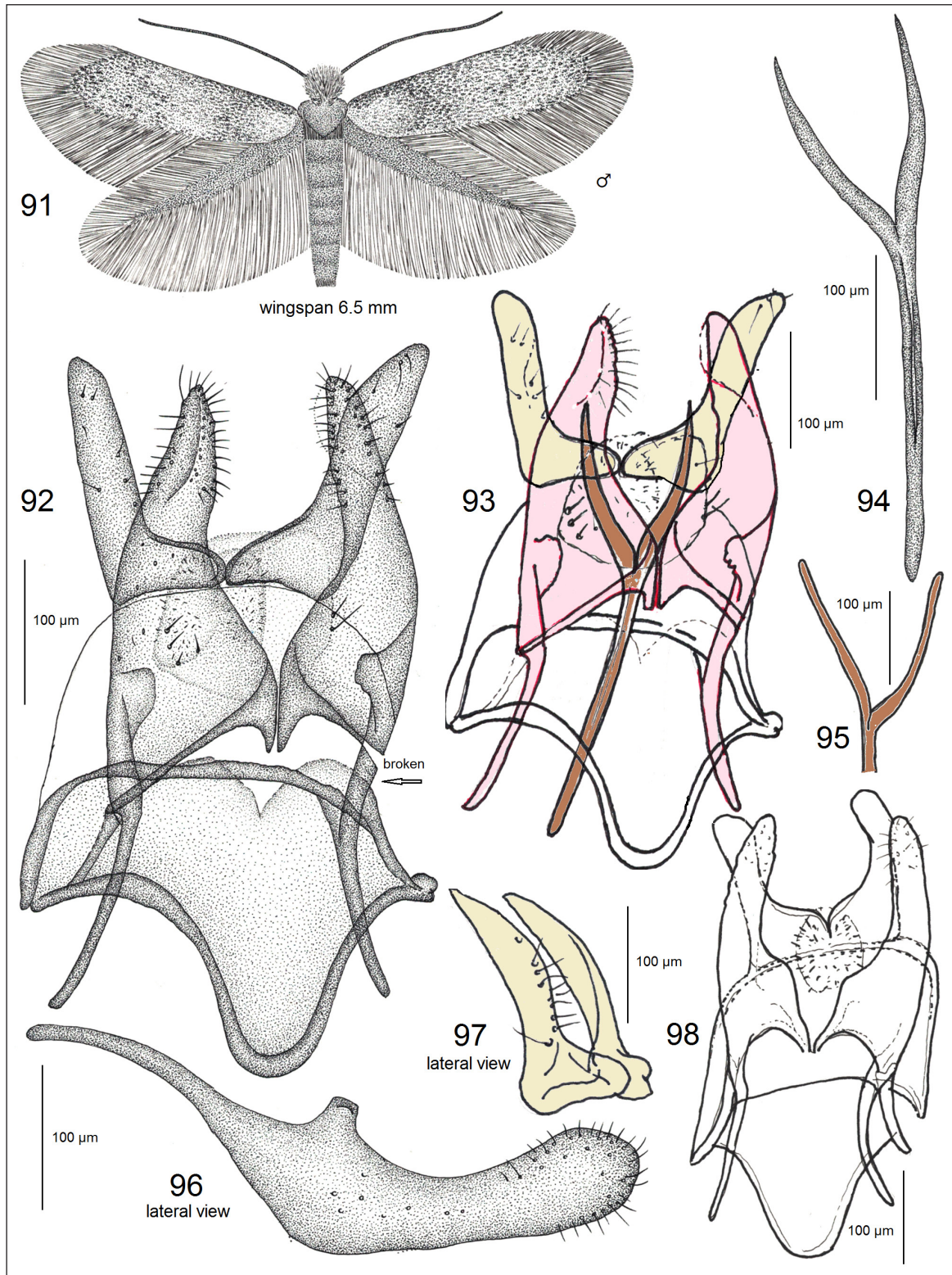
**Male** (Figs 45–47). Forewing length about 3.5 mm; wingspan about 7.7 mm ( $n = 1$ ).

**Head.** Frons and palpi yellowish cream; frontal tuft comprised of lamellar scales, glossy yellowish cream; collar comprised of lamellar scales, yellowish cream with some pale grey scales; antenna only slightly longer than one half the length of forewing; flagellum glossy pale grey with some purple iridescence, basally yellowish cream; sensilla medium long, very fine, rather inconspicuous.

**Thorax.** Tegula speckled with dark grey scales, distally yellow-ochre; thorax yellow-ochre. Forewing golden glossy, cream, densely speckled with pale yellow-ochre scales, with irregular pattern of black scales; fringe pale yellow-ochre, with a fringe line of black scales; forewing underside grey-brown, with brown-black scales along costa margin basally. No androconia. Hindwing and fringe brownish cream to pale grey depending on the angle of view. Legs golden cream, densely speckled with blackish grey scales on upper side.

**Abdomen.** Grey, with blue and purple iridescence on upper side; ochreous cream, distinctly annulated with dark grey-brown scales on underside; anal tufts dorsal, long, ochreous cream; genital segments ochreous cream. Genitalia (Figs 77–80) with capsule 470 µm long, 200 µm wide. Uncus (Figs 77, 79) comprised of two long and slender lateral lobes. Valva (Fig. 79) about 340 µm long (excluding the basal process), slender, undivided, basally fused with anellus (Fig. 79). Anellus thickened only laterally, distally membranous, comprised of two indistinctive membranous lobes. Vinculum triangular but widely rounded distally





**Figs 91–98.** First documentation of *Neotischeria capnota* (Meyrick, 1915). 91 – male adult, reconstructed, after the lectotype and paralectotype (combined); 92 – lectotype, slide no. 28671, with phallus removed; 93 – same, with phallus inside; 94 – same, phallus; 95 – paralectotype, slide no. 29629, apex of phallus; 96, 97 – lectotype, lateral view of valva and uncus before permanent mount; 98 – paralectotype, slide no. 29629, capsule with phallus removed (NHMUK)

(Figs 78, 79). Phallus 360  $\mu\text{m}$  long, very wide, robust, broadly bifurcated distally, without spines (Fig. 80).

**Female.** Unknown.

**Bionomics.** Host plant is unknown; it is expected to be a Malvaceae plant. Adults fly in March. Otherwise, the biology is unknown.

**Distribution.** The species is known from the single locality in Guatemala (Antigua Guatemala), at an elevation of about 1700 m.

**Etymology.** The species name *poseidonia* (feminine, arbitrary created) is derived from Poseidon, one of the Twelve Olympians, a god of the sea, earthquakes, and horses in the Ancient Greek mythology, in reference to the colossal, fork-like phallus in the male genitalia of *Neotischeria poseidonia* sp. nov.

**Note.** Two other new *Neotischeria* species from Guatemala are already recognized but still undescribed (Stonis et al., in prep.). They do not belong to the *neotropicana* group.

## DISCUSSION

The majority of the currently known *Neotischeria* species, along with the majority of *Astrotischeria*, are trophically associated with Asteraceae, and only some utilize plants from Malvaceae. It is not known why Tischeriidae have been so successfully utilizing Asteraceae in the Americas (Stonis et al., 2020b). However, the estimation of the richness and taxonomic diversity of Asteraceae by Katinas et al. (2007) indicates that Central and South America are characterised by the globally highest generic diversity. Moreover, according to Barreda et al. (2010, 2012), the earliest fossils confidently assigned to Asteraceae suggest a South American-Antarctican origin of the Asteraceae family.

Recently it was shown that plants from Asteraceae are the most diverse hosts for many species of *Stigmella* Schrank, Nepticulidae in South America (Stonis et al., 2018b), and important host plants for other lepidopteran leaf miners (e.g. Vargas et al., 2012). It is surprising, but there are no Asteraceae-feeding Tischeriidae outside the Americas.

The new genus appears to be almost endemic to Central and South America (the Neotropical region) with a couple of species discovered further to the North: Arizona and California (USA). The *Liabum* host plants of the species described in this paper are characterised by a specific distribution from Central America to the central Andes (see Gutiérrez, Katinas, 2015) or, in the case of *Smallanthus*, to the Atlantic Coast of Brazil (see Vitali et al., 2015).

Two other species of this genus have been dissected, studied, and recognised, but not published yet (Stonis et al., in prep.). We expect that this genus may comprise almost the double number of species compared with 13 provided in the checklist. Most likely, more species of *Neotischeria* will be discovered in future in the heavily undersampled Brazil and perhaps all other areas.

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DIFERENCINĖ PARATISCHERIA IR NEO-  
TISCHERIA GEN. NOV. DIAGNOSTIKA IR  
NAUJOS, ASTERACEAE ŠEIMOS AUGALUS  
MINUOJANČIOS, TISCHERIIDAE (LEPI-  
DOPTERA) RŪŠYS IŠ CENTRINĖS BEI PIETŲ  
AMERIKOS

*Santrauka*

Straipsnyje aprašoma nauja mokslui *Neotischeria* gentis ir keturios naujos rūšys; trys iš jų yra trofiškai susijusios su *Liabum* Adans. arba *Smallanthus* Mack. (Asteraceae) augalais: *Neotischeria ochripennata* Diškus & Remeikis, sp. nov., *N. conexa* Diškus & Stonis, sp. nov. ir *N. longa* Diškus & Stonis, sp. nov. Šios rūšys yra paplitusios Andų kalnuose: Ekvadore, Peru ir Bolivijoje. Dar viena nauja rūšis – *N. poseidonia* Diškus & Stonis, sp. nov. – buvo aptikta Gvatemaloje, tačiau jos mitybinis augalas iki šiol lieka nežinomas. Straipsnyje taip pat pateikiamas visų šiuo metu žinomų *Neotischeria* rūšių taksonominis sąvadas ir pirmą kartą dokumentuojamas iki šiol mažai žinomos rūšies – *Neotischeria capnota* (Meyrick) – lektotipas bei paralektotipas, kurie saugomi Londono gamtos muziejuje (Jungtinė Karalystė).

**Raktažodžiai:** lapų minos, minuotojai, mitybiniai augalai, nauja gentis, naujos rūšys, šeriuotaūsiai