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Diagnostics based on the juxta morphology reveals a new species of *Tischeria* Zeller (Lepidoptera, Tischeriidae) from the Caucasus

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We describe a new species, *Tischeria caucasica* Klasiński & Stonis, sp. nov., a trumpet moth (Tischeridae) recently discovered from Georgia, the Caucasus. We briefly discuss the diagnostics of *T. caucasica*, an outstanding new species possessing an extremely long and distally bifurcated juxta. The new species is illustrated with photographs of the adults, male and female genitalia, and the type locality.

Keywords: leaf miners, new species, *Tischeria caucasica*, trumpet moths

INTRODUCTION

Tischeriidae, or trumpet moths, represent a small but important family of leaf-mining Lepidoptera. Trumpet moths are almost cosmopolitan: various species are known from all continents except Australia and Antarctica. They are represented in very diverse terrestrial ecosystems, from the tropics to the temperate regions; however, the family is more abundant in subtropical and tropical areas (Stonis et al., 2018). For morphological and biological characterization of Tischerridae, we recommend the monographs by Braun 1972 and Puplesis, Diškus 2003 and the most recent papers by Lees, Stonis, 2007; Stonis, Diškus, 2007, 2008; Stonis et al., 2008, 2016, 2017, 2018, 2019; Mey, 2010; Diškus et al., 2014; Diškus, Stonis, 2015; and Xu et al., 2017, 2018.

In May 2019, the first author, Adam Klasiński, conducted a fieldwork in central Georgia (Figs. 1–5), Kartli, near Kura River (Fig. 4). The landscape was rather denuded, semiarid, steppe-like (Figs. 2, 5), currently used mostly as pastures, where bushes or young trees were scanty and occurring mostly in ravines (Fig. 3). During the fieldwork, a series of tischeriids were collected among many other moths. Externally, the collected specimens resembled *Tischeria ekebladella*

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Figs. 1–5. Type locality and habitat of *Tischeria caucasica* Klasiński & Stonis, sp. nov. 1, 2, 4, 5 – type locality, Georgia, Kartli, Gomi, 41°54'19.2"N, 44°22'50.7"E; 3 – habitat, a stand of bushes and young trees occurring in a ravine, elevation 570–710 m

(Bjerkander, 1795), a species widely distributed in Europe and reported from the Caucasus (Diškus, Puplesis, 2003). However, our detail examination of the male genitalia showed that the juxta strongly differed from those of *Tischeria ekebladella* or another similar species, *T. ekebladoides* Puplesis & Diškus, 2003 (Fig. 6).

Below we name and describe this new species, *Tischeria caucasica* sp. nov., characterized mostly by a unique juxta in the male genitalia as well as some unique but not so conspicuous characters of the female genitalia. We provide a detail documentation of genital structures of the male genitalia as well as photographs of the adults and the female genitalia.

MATERIALS AND METHODS

The description of the new species is based on the material collected by Adam Klasiński in Georgia in 2019. The majority of the type material, including the holotype and single available female, will be deposited in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia (ZIN). In addition, two male paratypes of *Tischeria caucasica* will be deposited in the collection of the Muzeum Częstochowskie, Częstochowa, Poland (MUZC) and other two in the private collection of Adam Klasiński, Częstochowa, ul. Łukasińskiego 88/8, Poland (PCAK).

Collecting methods and protocols for species identification and description are outlined in Puplesis, Diškus (2003) and Stonis et al. (2014). Permanent preparations on microscope slides were photographed and studied with a Leica DM2500 microscope and Leica DFC420 digital camera. Adults were photographed using a Leica S6D stereoscopic microscope with a Leica DFC290 digital camera attached.

DESCRIPTION OF *TISCHERIA CAUCASICA* KLASIŃKI & STONIS, SP. NOV.

Type material. Holotype: ♂, GEORGIA, Kartli, Gomi, 41°54'19.2"N, 44°22'50.7"E, elevation 570–710 m, at light, 5–21.v.2019, leg. Adam Klasiński, genitalia slide no. RA1080 (ZIN). Paratypes: 2 ♂, 1 ♀, same label data as holotype, genitalia slide nos. AK5144♂, RA1081♂, RA1082♀ (ZIN); 2 ♂, same label data as

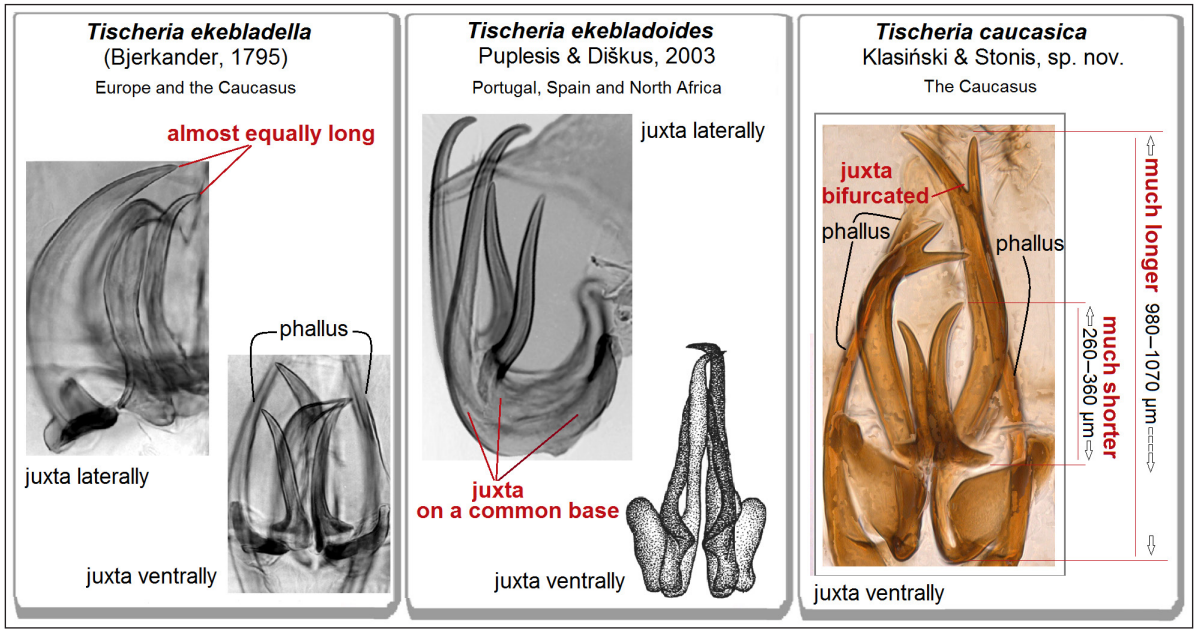


Fig. 6. Diagnostics of *Tischeria caucasica* Klasiński & Stonis, sp. nov. based on the juxta in the male genitalia (a comparison with the most resembling species, *T. ekebladella* and *T. ekebladoides*)

holotype, genitalia slide no. AK5143 (PCAK); 2 ♂, same label data as holotype (MUZC).

Diagnosis. Externally, *Tischeria caucasica* sp. nov. can be confused with many other uniform *Tischeria* species, including *T. ekebladella* (Bjerkander, 1795) and *T. ekebladoides* Puplesis & Diškus. In the male genitalia, the unique, very long and distally bifurcated juxta distinguishes the new species from all known congeneric species, including the most similar *T. ekebladella* and *T. ekebladoides* (Fig. 6). In the female genitalia, this species also differs from all congeneric species, including the most resembling *T. ekebladella*, *T. sichotensis* Ermolaev, 1986, and *T. ekebladoides* by the combination of a weakly chitinized anterior margin of antrum (Fig. 32) with unique membranous part (Fig. 35), and a wide base of the shortest prela (Fig. 33); however, these characters, in comparison to the male genitalia, are far less conspicuous and less useful for species differentiation.

Male (Figs. 7–12). Forewing length 4.2–4.8 mm; wingspan 9.1–10.1 mm (n = 3). Head: palpi cream; frons golden cream, very glossy; frontal tuft (Figs. 8–10) overlapping the frons, comprised of long, lamellar, yellowish ochre or ochre cream scales; collar (Fig. 8) ochre cream to yellowish ochre, comprised of lamellar scales; antenna much longer than one half the length of forewing; flagellum ochre cream on upper side, dark brown on underside. Thorax ochre cream; tegula ochre cream to yellowish ochre, proximally densely covered with grey scales. Forewing (Figs. 11, 12) densely covered with yellowish ochre to ochre cream scales, apically with some darker, ochre scales; fringe yellowish ochre; fringe line absent; underside of forewing densely covered with dark grey scales. Hindwing dark grey on upper side and underside, however, may look greyish cream depending from the angle of view; fringe grey to ochre cream depending from the angle of view. Legs ochre cream, covered with pale grey scales laterally; forelegs with blackish to grey scales on upper side. Abdomen glossy, with inconspicuous purple iridescence, pale yellowish brown basally, dark grey distally; underside of abdomen predominantly dark yellow-brown; genital plates ochreous cream; anal tufts indistinctive (or partially rubbed), ochreous cream.

Female (Figs. 13, 14). Forewing length about 4.5 mm; wingspan about 9.5 mm (n = 1). Abdomen without anal tufts; otherwise, similar to male.

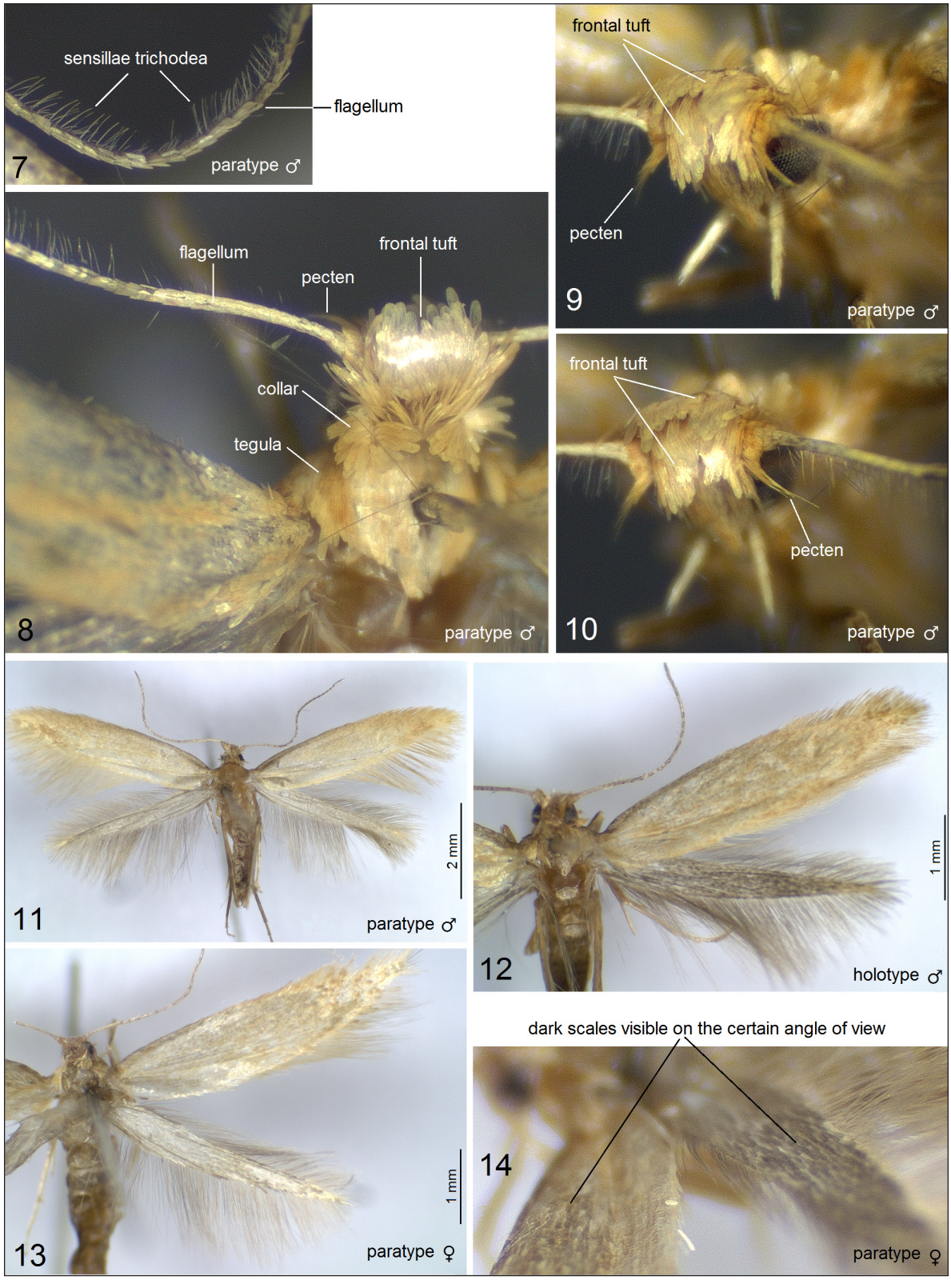
Male genitalia (Figs. 15–31). Capsule significantly longer (1395–1570 μm) than wide (755–780 μm). Uncus (Fig. 16) with two large lateral lobes. Socii membranous (Fig. 17). Valva (Figs. 18, 29, 30) 940–1035 μm long, narrowing distally; transtilla absent. Juxta (Figs. 15, 18, 21–25, 27, 28, 31) comprised of two shorter (260–360 μm) and two very long (980–1070 μm) horn-like processes (Fig. 6); the latter bifurcated distally and bent basally (see Figs. 21–25). Vinculum with a triangularly-shaped, slender ventral plate (Figs. 15, 16). Phallus (Figs. 19, 20, 26) 1190–1215 μm long, basally 80–150 μm wide, but broadly bifurcated in apical half (Fig. 20), with weakly chitinized plates on the top of each branch (Fig. 19).

Female genitalia (Figs. 32–35). Total length about 2700 μm. Antrum elaborated (Fig. 32) but little chitinized anteriorly. The shortest process of prela with a wide, plate-like base (Fig. 33). Ductus bursae with spines. Corpus bursae heavily folded but without signum or pectinations (Fig. 34). Ductus spermathecae with about 4–5 large coils.

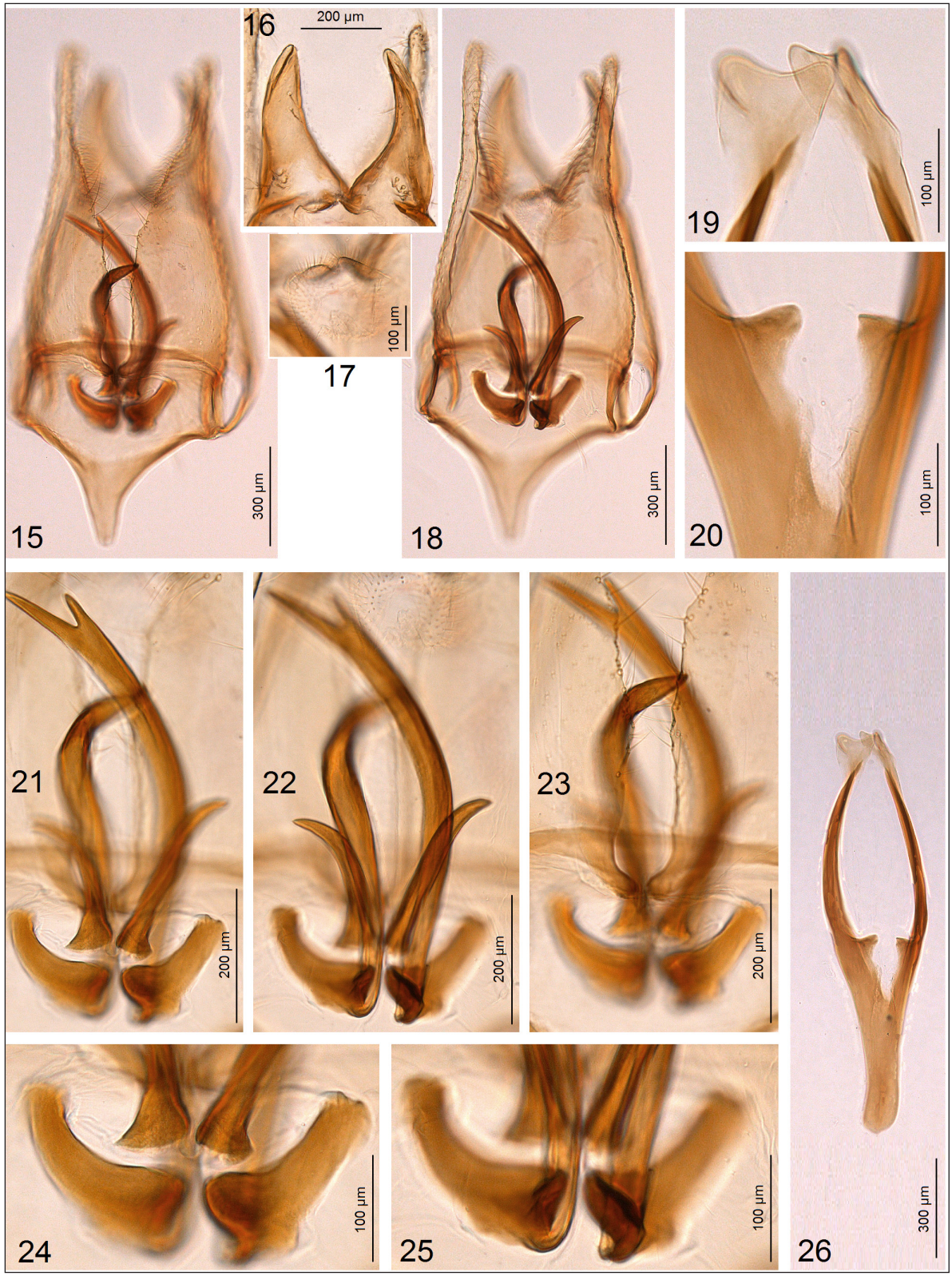
Bionomics (Figs. 2–5). Host plant is unknown, probably *Quercus* sp. as the closely related *Tischeria ekebladella* is an oak-feeding species (also see Discussion). Larva and leaf mine are unknown; however, as in the case of all other *Tischeria* species, *T. caucasica* is supposed to be a leaf-mining insect. Adults were collected at light in May. Otherwise, biology is unknown.

Distribution. Currently known from a single locality in Georgia (the Caucasus), at an elevation of about 570–710 m (Fig. 1).

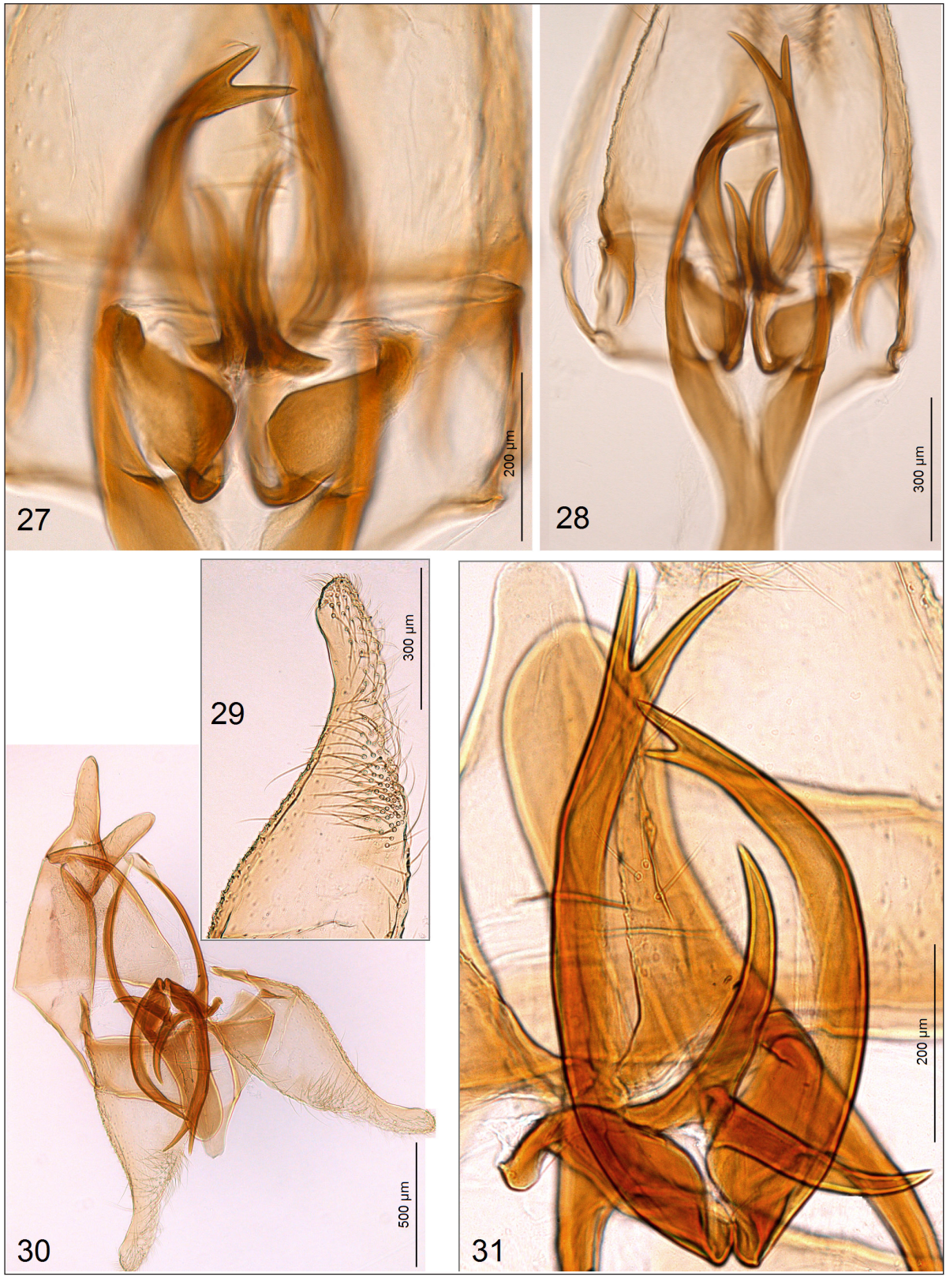
Etymology. This species is named after the Caucasus where it occurs.



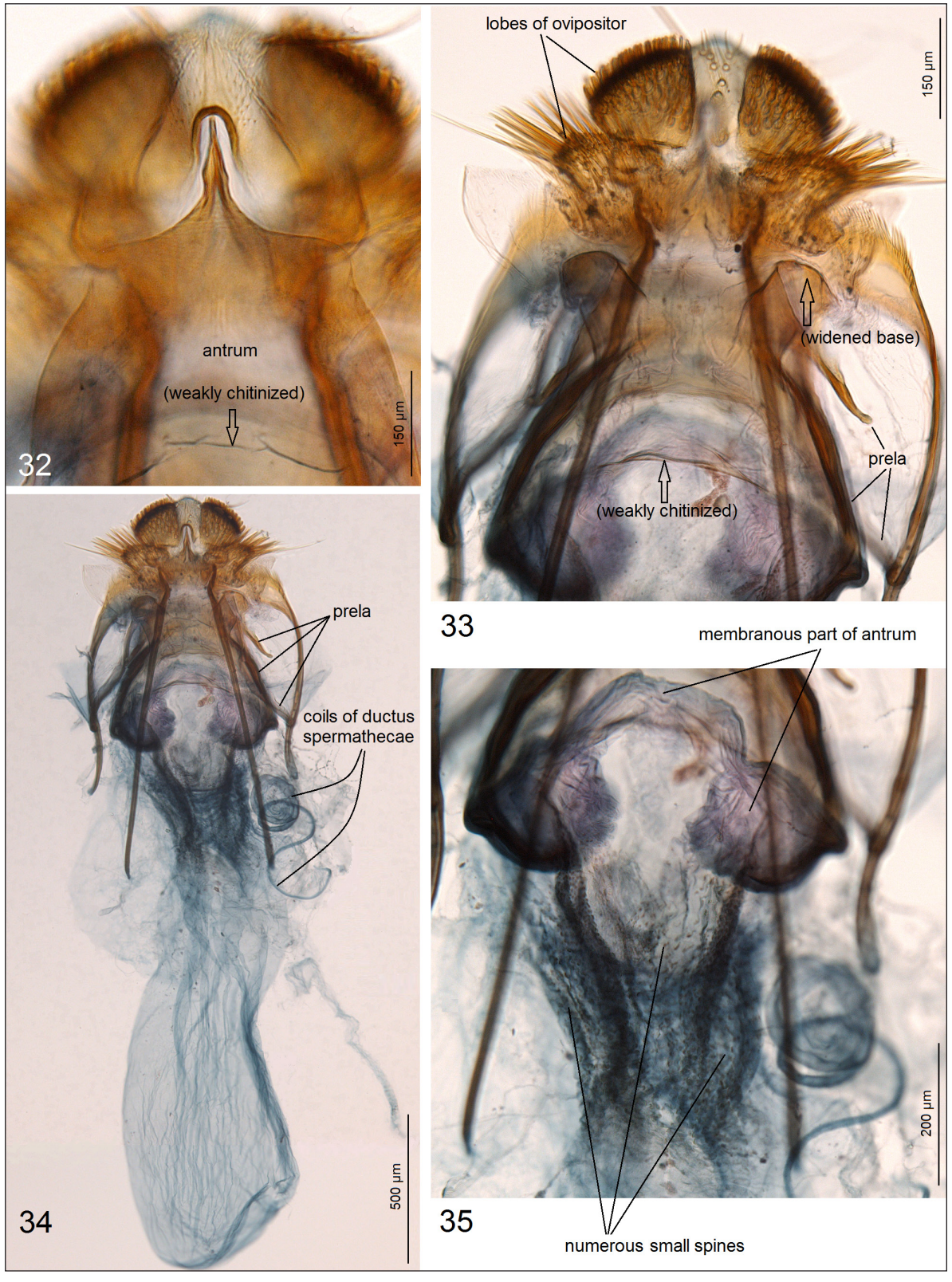
Figs. 7–14. Adult of *Tischeria caucasica* Klasiński & Stonis, sp. nov. 7 – male antenna with sensillae trichodea; 8 – frontal tuft, dorsal view; 9, 10 – same, frontal view; 11 – general view of adult, male paratype (ZIN); 12 – right side of the adult, male holotype (ZIN); 13 – same, female paratype (ZIN); 14 – same, details of scaling at different angle of view



Figs. 15–26. Documentation of the male genitalia of *Tischeria caucasica* Klasiński & Stonis, sp. nov., holotype, genitalia slide no. RA1080 (ZIN). 15, 18 – general view, with phallus removed; 16 – uncus; 17 – socii; 19, 20 – details of phallus; 21–25 – details of juxta; 26 – phallus, general view



Figs. 27–31. Documentation of the male genitalia of *Tischeria caucasica* Klasiński & Stonis, sp. nov. 27, 28 – fragment of capsule with phallus inside, paratype, genitalia slide no. RA1081 (ZIN); 29, 30 – capsule with phallus inside, paratype, genitalia slide no. AK5144 (ZIN); 31 – same, juxta



Figs. 32–35. Documentation of the female genitalia of *Tischeria caucasica* Klasiński & Stonis, sp. nov., paratype, genitalia slide no. RA1082 (ZIN). 32 – antrum, without a membranous part; 33 – prela and ovipositor; 34 – general view; 35 – membranous part of antrum and spines on ductus bursae

DISCUSSION

As regards the male genitalia, *Tischeria caucasica* sp. nov. appears to be an outstanding taxon: a species possessing a very unusual, long and distally bifurcated juxta. In general, the male genitalic characters of Tischeriidae are well-known for their great taxonomic and systematic value since in *Tischeria*, the adult scaling or wing venation is only rarely useful because its uniformity. The male genitalia of tischeriids exhibit some diversity and modification across genera and some structures (characters) appear particularly informative and important for species delimitation: a shape of the dorsal processes of the valva and phallus in *Astrotischeria* Puplesis & Diškus, various modifications of the anellus in *Paratischeria* Diškus & Stonis, or spines on the "tulip"-shaped phallus in *Coptotriche* Walsingham. In the genus *Tischeria* Zeller, a male genitalic structure widely known as the "juxta" is present in all species (but absent in all other Tischeriidae genera) and, therefore, various modifications of this character are especially useful for species diagnostics and probably for some phylogenetical treatments. It is widely known that the organs of the genitalia of insects are under strong reproductive and evolutionary pressures and, therefore, they hold a wide range of informative morphological characters for taxa at different levels (Nakahara et al., 2019). The long and distally bifurcated juxta of *Tischeria caucasica* sp. nov. (Fig. 6) appears to be highly derived in comparison with the related species, including the most similar *T. ekebladella* and *T. ekebladoides*.

The host plant of *Tischeria caucasica* sp. nov. was not detected during our study and, therefore, remains unknown. However, it should be noted that all other morphologically similar tischeriids from Europe or East Asia and North America are oak-feeding and associated with various species of *Quercus* L. In the locality where *T. caucasica* sp. nov. was collected (Fig. 3), the following *Quercus* species occur: *Q. petraea* (Matt.) Liebl., *Q. macranthera* Fisch. & C. A. Mey. ex Hohen., and *Q. robur* L. The larvae of the new species may feed at least on one of them.

CONTRIBUTIONS TO THE RESEARCH

Contributions to this research are as follows: Adam Klasiński – fieldwork and collecting of all adult specimens of the type series, photographic documentation of the type locality and habitat, proving information and photographs (Figs. 2–5), preparation of genitalia slides of two male paratypes; Jonas Rimantas Stonis – the concept and design of the research, diagnostics and identification of the new species, writing the manuscript, and technical preparation of all tables of illustrations; Andrius Remeikis – dissection, photographic documentation, and measuring of *T. caucasica* sp. nov., providing scales on all tables of illustrations, some additional labelling of the material collected by Adam Klasiński, discussion on diagnostics of *Tischeria*, compiling the list of references.

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PAGAL GENITALINIŲ STRUKTŪRŲ MORFOLOGIJĄ IDENTIFIKUOTA MOKSLUI NAUJA *TISCHERIA* ZELLER GENTIES RŪŠIS (LEPIDOPTERA, TISCHERIIDAE), APTINKAMA KAUKAZE

Santrauka

Straipsnyje aprašoma mokslui nauja *Tischeria caucasica* Klasiński & Stonis rūšis, 2019 m. aptikta Centrinėje Gruzijoje. Trumpai aptariami esminiai diagnostiniai požymiai, leidžiantys identifikuoti šeriuotaūsių (Tischeriidae) taksonus. Pagal genitalinių struktūrų (ypač *juxta*) morfologiją identifikuota nauja rūšis dydžiu ir forma ženkliai skiriasi nuo anksčiau žinomų giminiškų *Tischeria ekebladella* ir *T. ekebladoides* morfologinių struktūrų. Straipsnyje pateikiama išsami naujos rūšies suaugėlių patino ir patelių genitalinių struktūrų morfologijos dokumentacija. Nors naujos rūšies mitybos augalas nėra nustatytas, tačiau manoma, kad *T. caucasica* lervos, kaip ir kitų artimų *Tischeria* rūšių, yra ąžuolų lapų minuotojai, mitybos ryšiais galbūt susiję su tyrimų vietovėje aptiktais *Quercus petraea* (Matt.) Liebl., *Q. macranthera* Fisch. & C. A. Mey. ex Hohen. arba *Q. robur* L.

Raktažodžiai: lapų minuotojai, nauja rūšis, šeriuotaūsiai, *Tischeria caucasica*