

***Vadimas* Volkova, gen. n., a new genus of Megalopygidae (Insecta: Lepidoptera)**

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Summary

A new Neotropical genus of Megalopygidae, *Vadimas* Volkova, gen. n., is described. Two newly described species are included: the type species *Vadimas zolotuhini* Volkova, sp. n. (Ecuador) and *V. radogast* Volkovas, sp. n. (Colombia). The diagnosis of the genus and a list of generic autapomorphies are given.

KEY WORDS: Insecta, Lepidoptera, Megalopygidae, *Vadimas*, new species, taxonomy, systematics, Neotropical.

***Vadimas* Volkova, gen. n., un nuevo género de Megalopygidae (Insecta: Lepidoptera)**

Resumen

Se describe un nuevo género Neotropical de Megalopygidae, *Vadimas* Volkova, gen. n. Se incluyen dos nuevas especies tipo descritas: *Vadimas zolotuhini* Volkova, sp. n. (Ecuador) y *V. radogast* Volkovas, sp. n. (Colombia). Se dan la diagnosis del género y una lista de autapomorfías.

PALABRAS CLAVE: Insecta, Lepidoptera, Megalopygidae, *Vadimas*, nuevas especies, taxonomía, sistemática, Neotropical.

Introduction

Megalopygidae is a family of mostly Neotropical moths with only few species penetrating the Nearctic zone, poorly investigated taxonomically. System of this family has not been actually developed so far, the species composition is not analyzed as well as a status of some taxa and score of genera are not identified. As a result, a taxonomic scheme of the family is incomprehensible, and many genera look therefore polyphyletic. The only modern article dealing with biology and phylogeny of Megalopygidae is a publication of EPSTEIN (1996). However, this work does not contain taxonomic revisions. In the current classification the family includes two subfamilies and 23 genera (HEPPNER, 1995). The aim of the present study is to describe a new genus and two new species of Megalopygidae.

Material and Methods

All the specimens listed in this paper, including the holotypes, are deposited in the Museum Witt, Munich, Germany (MWM) - later it will be assigned into Bavarian State Collection of Zoology, Munich, Germany. Further abbreviation used is: GU - genitalia slide number. For the holotypes the label data are listed in their original spelling.

The genitalia preparations illustrated here were made using standard dissecting techniques and

mounted in Euparal on glass slides. Letters "GU" combined with a number refer to genitalia slide number. Photographs of adult specimens and male genitalia were taken by a Nikon D-750 camera, and the photo of mouthparts was made at the Natural History Museum, University of Oslo (Norway) using Axio Cam color 506 Camera mounted on a compound microscope Zeiss Axio Imager M2. Genetics studies conducted at the University of Guelph, Ottawa, Canada personally by Dr. Reza Zahiri.

Taxonomy

Vadimas Volkova, gen. n. (Figs 1-12)

Type species: *Vadimas zolotuhini* Volkova, sp. n., here designated.

Description: Medium sized moths, wingspan 30-37 mm in males and 48-52 mm in females; length of forewing 19-22 and 26-29 mm, correspondingly (Figs 1-6). Head with raised hairs. Antennae bipectinate in male and filiform in female. Galea almost completely reduced to non-functioning short lobes fused basally. Labial palpi strongly reduced, probably not functioning, consisting of 2-3 small fused segments, with apical segment strongly reduced; maxillary palpi completely reduced (Fig. 9). Forewing ground color dark grey or black, wing pattern strongly modified and consists of golden elongated teardrop tracery and golden clear spot on discal vein; medial stem in the R-Cu cell of female and veins of both sexes also covered with golden scales. Hindwing monochromatic dark, slightly protruded apically, with undulating wing margin. Wing scales narrow and slightly raised, making the wing translucent, especially in females. Veins black, clearly visible and contrasting with wing membrane, and they divide fore wing pattern onto separate teardrop strokes.

Venation (Fig. 10): Forewing. Sc almost parallel to wing margin and joins costal margin above the branching of radial sector. Small oblong tongue-shaped process with unknown function lies basally between costal and subcostal veins; it may be covered with androconial scales. R1 free, diverging from apex of R-Cu cell. Other veins of radial stem and M1 extend from common stem. R2 and R3 almost parallel, R4 and R5 forming fork. Medial stem in R-Cu cell reduced almost completely (better developed in females) and visible only in its outer third. M1 diverges from basal quarter of radial stem. M2 and M3 on common branch originating in postero-apical corner of R-Cu cell. Both Cu veins present, clearly visible, almost parallel to each other. A1 strongly reduced and represented by thin fold. A2 and A3 well developed and making anastomosis in most of their length, forming fork apically; A3 distally of the anastomosis forms thin and poorly visible crease. No additional cells present.

Hindwing: Frenulum unpaired curved. Radial vein clearly visible along its entire length and joins costal margin just behind Sc. Medial stem in R-Cu cell strongly reduced and visible as membranous fold slightly thickened caudally. Veins M1, M2 and M3 nearly parallel to each other and clearly visible. $\text{Nu}1$ forming acute angle with M3; Cu2 parallel to Cu1. A1 hardly noticeable and almost completely reduced forming thin membranous fold. A2 well visible basally but weaker and then membranous toward wing margin. A3 substantially shortened and visible only in basal part.

All legs with the joint and equal in size apical spurs which are shorter on the hind legs. Spur formula 2:2:2. Fore leg epiphysis absent.

Sexual dimorphisms: Females are larger than males, abdomen apically with hair pillow formed by densely packed hair-like scales. Female antennae pale grey, male antennae completely black. Female forewings more elongate than in male. Strokes of golden scales in female monochromatic, in male centered with black scales. Female thorax black with admixture of pale gray scales, male thorax monochrome black. Female abdomen with admixture of reddish or brownish scales.

Male genitalia (Figs 11, 13): Uncus slender, delicate, conical, with small hook on dorsal side. Gnatos absent. Tegumen band-shaped, without modifications. Valves divided into elongate slender clavate cucullus and rudimentary saccular part fused annularly at base. Vinculum with two distal finger-shaped processes, one on each side. Saccus weakly expressed, represented by small plate.

Aedeagus short, wide, with caudal opening of vesica. Vesica without lobes, bag-shaped basally and with conical elongated apical part. Cornuti absent. Pre genital segments unmodified.

Female genitalia (Figs 12, 14): Papillae anales rounded, with protruding triangular irregular tips, densely covered with short setae. Fore apophysis stronger and slightly longer than hind one. Ostium rounded, located in segment center. Area around ostium lobate. Caudal setae of segment VIII strongly modified into clavate spines. Ductus bursae membranous, broad, gradually passing into large, ovoid bursa without additional area of sclerotization.

Diagnosis: Accordingly to the structure of the genitalia (presence of a hook-shaped appendage on uncus and finger-like processes of the vinculum), *Vadimas* resembles *Megalopyge* Hübner, [1820], but differs by some important characters. In *Vadimas* the cucullar part of the valves is very elongate and slender. The uncus is triangular, hooked on the dorsal side, which is not fused with the tegumen, while in *Megalopyge* the uncus is rudimentary and bears a strong ventral hook fused with tegumen, completely or partially (VOLKOVA, ZOLOTUHIN & KURSHAKOV, 2017). In addition, there are some significant differences in the structure of the aedeagus, which is small in *Vadimas*, with tapered apical bag-shaped vesica, not lobed apically. The aedeagus of *Megalopyge* often bears single or multiple cornuti or numerous spines forming scobinate fields. The vesica of *Megalopyge* is quite complex, usually with 2-4 distinct lobes (Fig. 15). Finally, none of known *Megalopyge* species possess golden scales on wings. The habitus of *Megalopyge lanata* (Stoll, [1780]), a typical species of the genus *Megalopyge*, is largely different from *Vadimas*. *M. lanata* more powerful, large (wingspan from 50 to 90 mm), has a typical wing pattern with admixture of pink and gray scales, as well as a large belly with a ring pattern (Figs 7-8).

The following diagnostic characters (probably apomorphies) can be listed for *Vadimas*: galea and labial palpi strongly reduced; sacculus partially reduced and fused annularly at base; cucullar part of valves elongate and slender; wing pattern strongly modified from the typical medial scheme; glossy metallic (golden) scales present. The function of the oblong tongue-shaped process of the forewing is unclear, but it has not been recorded in any other genera of this phylogenetic lineage. Clavate scales on the caudal margin of the female abdominal segment VIII are not typical of any other known genus and maybe also an autapomorpha or synapomorpha of several closely related groups.

According to the overall structure of the genitalia of both sexes, the genus *Vadimas* is placed in the subfamily Megalopyginae.

Distribution: The genus is here reported from Colombia and Ecuador. It may be restricted to highlands, as all the specimens were collected above 2750 m and most of them - at the altitude of about 3000 m. Two species included in this genus are described below. In addition, among the examined specimens there was a single female from Peru that certainly belongs to *Vadimas* but cannot be attributed to any of the two species because of a distinctly different wing pattern. The Peruvian specimen remains undescribed and unidentified until a male specimen becomes available.

Etymology: This genus is named in honor of Prof. Dr. Vadim V. Zolotuhin, in gratitude for his invaluable assistance and support. Gender masculine.

***Vadimas zolotuhini* Volkova, sp. n. (Figs 1-3, 11-12)**

Type material Holotype: 1 ♂, ECUADOR, Carchi prov., El Angel Ecol. Reserv., road Tulcan-El Chical, 3300 m, 0°48'46" N 78°00'40" W, 14-XI-2012, V. Sinyaev leg. (MWM, GU 29947).

Paratypes: 22 ♂♂, 1 ♀, ECUADOR, Carchi prov., El Angel Ecol. Reserv., road Tulcan-El Chical, 3300 m., 0°48'46" N 78°00'40" W, 14-XI-2012, V. Sinyaev leg.; 18 ♂♂, Carchi prov., El Ángel Ecol. Reserv., road Tulcan-El Chical, 3320 m., 0°46'14" N 78°03'27" W, 9-11-XI-2012, V. Sinyaev leg.; 9 ♂♂, Carchi prov., El Ángel Ecol. Reserv., road Tulcan-El Chical, 2785 m., 0°45'31" N 78°01'40" W, 7-8-XI-2012, V. Sinyaev leg.; 7 ♂♂, Carchi prov., El Moran, 2940 m., 0°45'50" N 78°02'38" W, 1-3-V-2012, V. Sinyaev & R. Brechlin leg.; 2 ♂♂, Lova prov., 5 km S Saraguro, 3065 m., 3°40'01" S 79°15'17" W, 8-9-II-2012, V. Sinyaev and R. Brechlin leg.; 1 ♂, Lova prov., 6 km S Saraguro, 3065 m., 3°40'01" S 79°15'17" W, 20-II-2012, V. Sinyaev and R. Brechlin leg.; 1 ♂, Lova prov., 10 km SW

Saraguro, 3164 m., 3°41'32" S 79°17'42" W, 19-II-2012, V. Sinyaev and R. Brechlin leg.; 1 ♂, Napo prov., Papallacta, Río San Pedro, 3010 m., 0°22'56" S 78°07'27" W, 4-XI-2011, V. Sinyaev and O. Romanov leg.; 1 ♂, Esmeraldas prov., 2,8 km W Lita, 2750 m., 0°52'48" N 78°29'36" W, 30-IV-2012, V. Sinyaev and R. Brechlin leg.; 1 ♂, Pichincha prov., Guagua Pichincha, 3676 m., 0°06'20" S 78°34'19" W, 21-X-2011, V. Sinyaev and O. Romanov leg.; 1 ♂, Road Loja-Zamora., 2700 m., 3°58'45" S 79°08'28" W, 22-II-2012, V. Sinyaev and R. Brechlin leg.; 2 ♂♂, Pichincha prov., old road Quito to Santo Domingo, 32 km., 2750 m., 0°17'15" S 78°40'20" W, 13-14-III-2013, A. Käch and R. Brechlin leg. 1 ♀, Ecuador, Pichincha prov., old road Quito to Santo Domingo, 32 km., 2750 m., 0°17'15" S 78°40'20" W, 13-14-III-2013, A. Käch and R. Brechlin leg. (MWM, GU 29948) (all in MWM).

Description (Figs 1-3): Wingspan 30-36 mm in males; 48-52 mm in females. Female forewings with touch of golden scales on basal expansion of anal stem. Male hindwings semitransparent, fringed with black scales. Female hindwings black with cilia of gold and gray scales. Head, abdomen and antennae the genus description above.

Male genitalia (Fig. 11): Uncus and saccular part of valva as in the genus description. Cucullus clavate, long and slender, slightly darkened in comparison to sacculus and densely covered with setae. Vinculum with two small saber-shaped processes fused basally.

Female genitalia (Fig. 12): As in the genus description. Clavate scales larger and more numerous than in *V. radogast*.

Biology: Adults were collected in October-November and in February-May. The species is confined to Andean montane forests where moths were collected at the altitudes from 2750 to 3300 m.

Distribution: Ecuador: from the North-Central regions (Esmeraldas and Carchi provinces) to the Central (Napo and Pichincha provinces) and South (Loja province). Probably, the species distribution is interrelated to the position of the Andes, represented in this region by two parallel ridges - the Eastern and Western Cordilleras.

Diagnosis: *Vadimas zolotuhini* can be differentiated from its only congener, *V. radogast*, by male hind wing having black ground color and narrower wing scales making the wing almost transparent in central field, by more pronounced golden pattern by the slenderer uncus, by cucullus of valves shorter and thicker, and by vincular processes saber-shaped. The height, size and shape of the papillae anales, clavate spines and apophyses are different from *V. radogast* as illustrated in Figs. 13, 14.

Vadimas radogast Volkova, sp. n. (Figs 4-6, 13-14)

Type material: Holotype 1 ♂, COLOMBIA, Tolima, Nevado del Tolima, 2850 m, 04°36'20" N 75°19'36" W, 8-11-XII-2013, V. Sinyaev leg. (MWM, GU 29950).

Paratype: 1 ♂, COLOMBIA, Tolima, Nevado del Tolima, 2850 m, 04°36'20" N 75°19'36" W, 8-11-XII-2013, V. Sinyaev leg. (all in MWM); 1 ♀, Tolima, Nevado del Tolima, 2850 m, 04°36'20" N 75°19'36" W, 8-11-XII-2013, V. Sinyaev leg. (MWM, GU 29949).

Description (Figs 4-6): Wingspan 34-37 mm in males, 49 mm in the only female examined. Forewings coloration dark grey, wing pattern is complex, net-teardrop shaped and composed by golden scales. Hindwing dark gray, with narrow fringe of gold scales, without transparent fields. Male head and abdomen black. Antennae pale grey.

Male genitalia (Fig. 13): Uncus more powerful and broader than in *V. zolotuhini*, not expanded basally, with a more powerful spike-shaped process on dorsal side. Saccular part of valva and vinculum as in the genus description. Cucullar part clavate, slightly slendered apically, densely covered with setae. Vinculum with two small tongue-shaped processes fused basally.

Female genitalia (Fig. 14): Papillae anales large and triangular. Fore apophysis stronger and longer than the hind one. Clavate scales less numerous than in *V. zolotuhini*.

Biology: Presumably winter fliers. The species was collected in montane Andean forest at the altitude of 2850 m in the first half of December.

Distribution: So far known only from the type locality.

Diagnosis: *Vadimas radogast* differs from *V. zolotuhini* in forewings having a dark grey (not black) ground color with complex net-teardrop shaped golden pattern; in cucullar part of valve longer and slenderer, in vinculum processes tongue-shaped and uncus more powerful, not expanded basally. Hind wings of the males are semitransparent but without any distinct hyaline fields. In female genitalia the papillae anales are of triangular form.

Discussion: According to molecular genetic analysis undertaken, the genus *Vadimas* forms own cluster on the phylogenetic tree. The species *Vadimas zolotuhini* differs from the *V. radogast* by ca. 6%, which confirms the independence of these two taxa. Data from our molecular genetic studies can be found on the BOLD website. The species of *Megalopyge* have no frenulum hence it is present in *Vadimas* spp. This may indicate that *Vadimas* is a more primitive group. This fact forces us to review the whole system of the family Megalopygidae and clarify the status of subfamilies and generic groups. This problem is planned to be solved in the course of further research.

Eymology: The species is named after Radogast, the ancient pagan Slavic God of fertility, sunlight and the healing power. The species name is a noun in apposition.

Acknowledgements

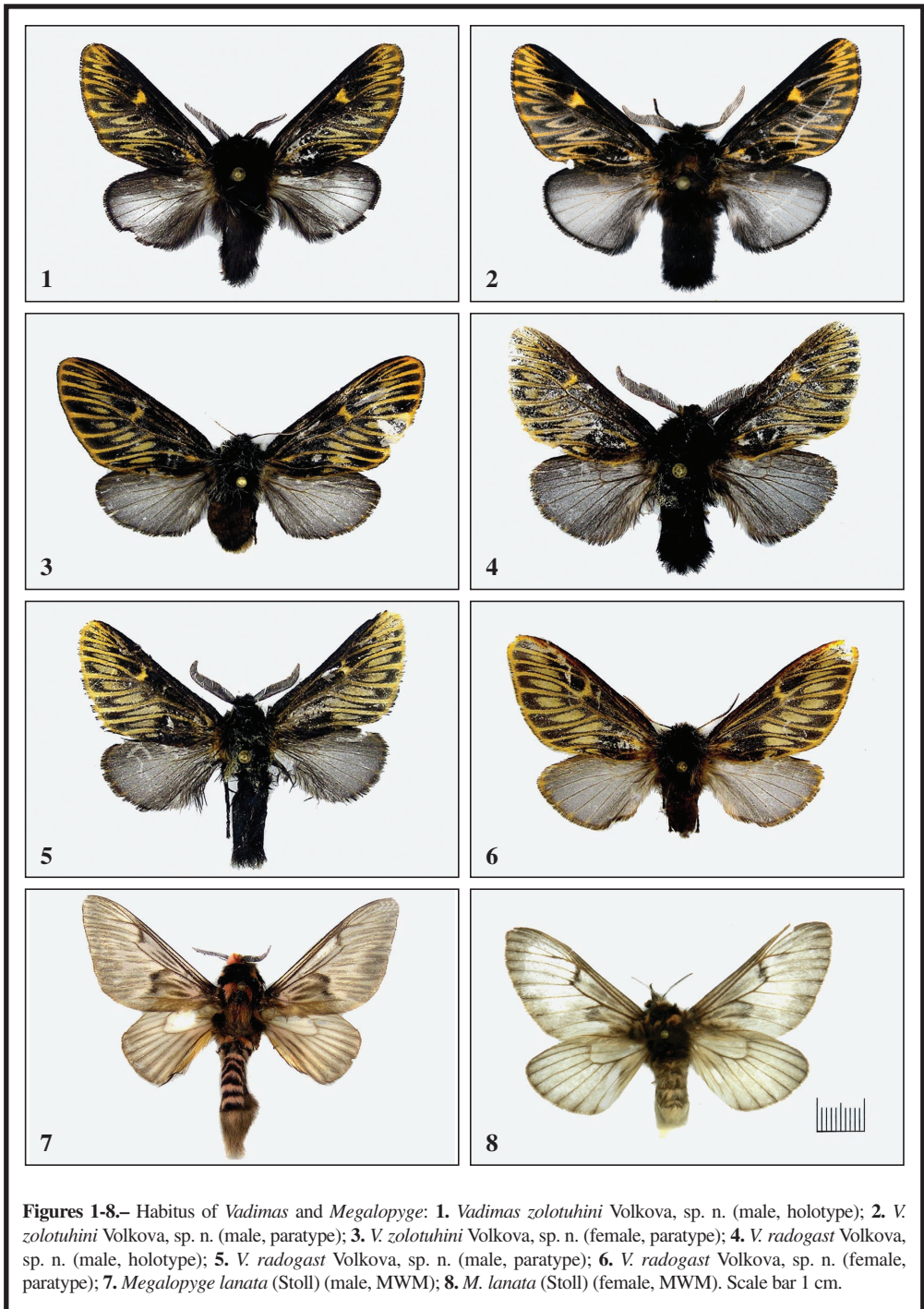
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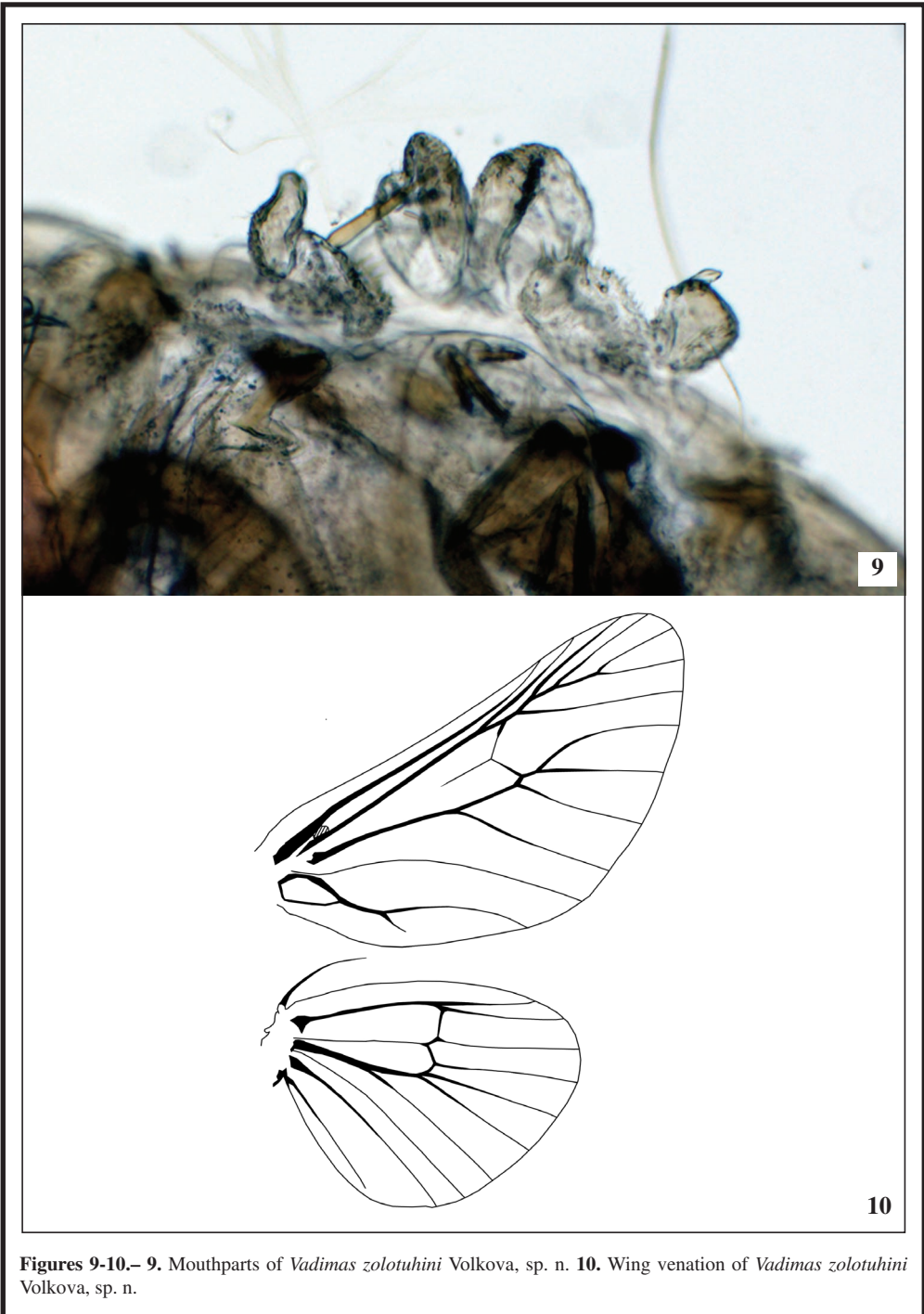
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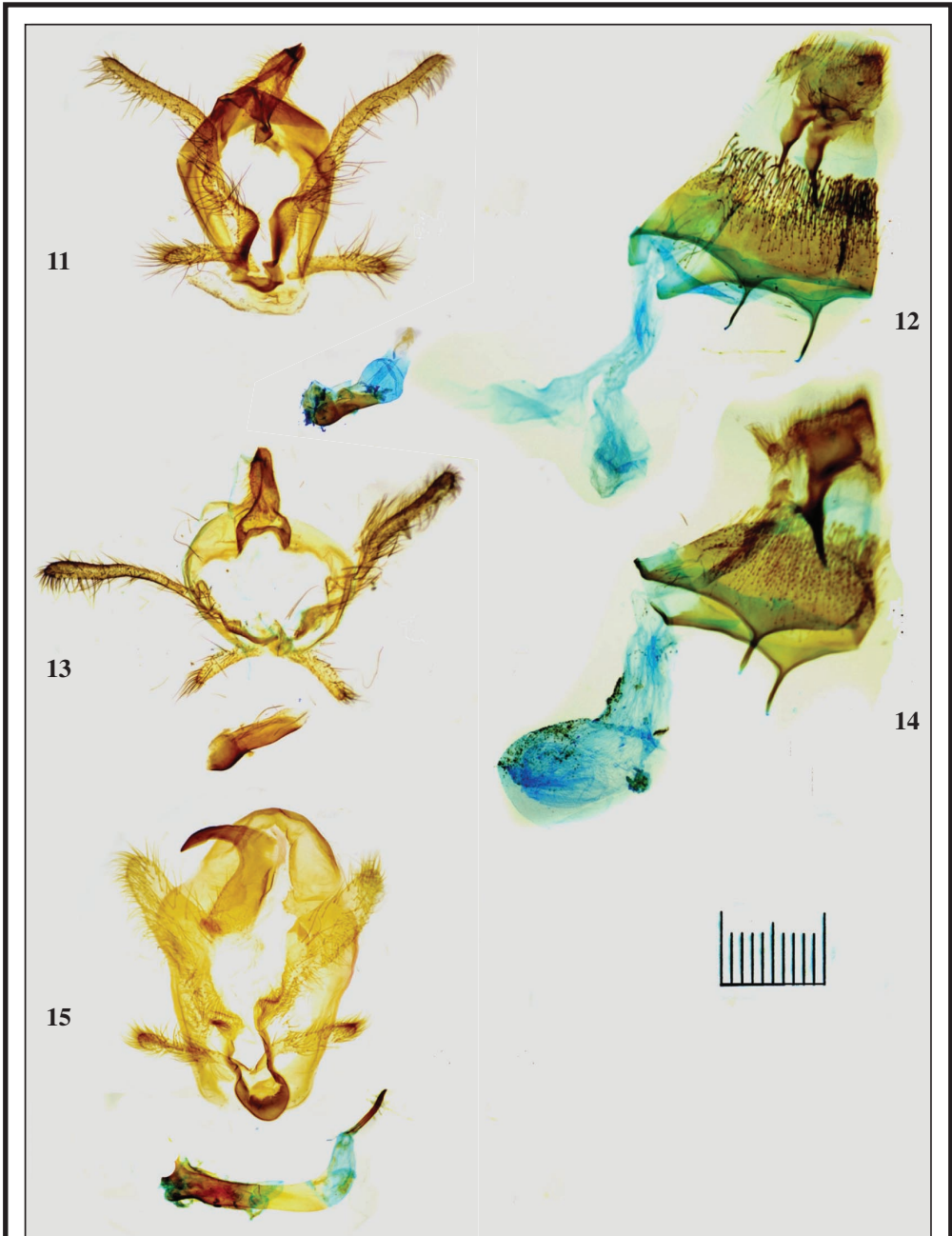
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Figures 1-8.— Habitus of *Vadimas* and *Megalopyge*: **1.** *Vadimas zolotuhini* Volkova, sp. n. (male, holotype); **2.** *V. zolotuhini* Volkova, sp. n. (male, paratype); **3.** *V. zolotuhini* Volkova, sp. n. (female, paratype); **4.** *V. radogast* Volkova, sp. n. (male, holotype); **5.** *V. radogast* Volkova, sp. n. (male, paratype); **6.** *V. radogast* Volkova, sp. n. (female, paratype); **7.** *Megalopyge lanata* (Stoll) (male, MWM); **8.** *M. lanata* (Stoll) (female, MWM). Scale bar 1 cm.



Figures 9-10.– 9. Mouthparts of *Vadimas zolotuhini* Volkova, sp. n. 10. Wing venation of *Vadimas zolotuhini* Volkova, sp. n.



Figures 11-15.— Genitalia of Megalopygidae. **11.** *Vadimas zolotuhini* Volkova, sp. n. (male, holotype); **12.** *V. zolotuhini* Volkova, sp. n. (female, paratype); **13.** *V. radogast* Volkova, sp. n. (male, holotype); **14.** *V. radogast* Volkova, sp. n. (female, paratype); **15.** *Megalopyge lanata* (Stoll, [1780]).