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FUNCTIONAL MORPHOLOGY OF THE MALE GENITALIA OF THE FAMILY AUTOSTICHIDAE (LEPIDOPTERA) WITH DESCRIPTION OF A NEW GENUS AND A NEW SPECIES FROM THE RUSSIAN FAR EAST

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Summary. The new genus *Laszlogozmanya* **gen. n.** and new species *L. eclecticus* **sp. n.** of the family Autostichidae are described from Primorskii krai. The taxonomic position of the new genus within the nominative subfamily Autostichinae is clarified on the base of the functional morphological analysis of the male genitalia in representatives of the family. The morphology of the musculoskeletal apparatus of the male genitalia in the genus *Autosticha* Meyrick, 1886 is described for the first time.

Key words: moths, Autostichidae, taxonomy, new genus, new species, male genitalia, functional morphology, Primorskii krai, Russia.

М. Г. Пономаренко. Функциональная морфология гениталий самцов семейства Autostichidae (Lepidoptera) с описанием нового рода и нового вида с Дальнего Востока России // Дальневосточный энтомолог. 2022. N 464. С. 7-20.

Резюме. Из Приморского края описаны новый род *Laszlogozmanya* **gen. n.** и новый вид *L. eclecticus* **sp. n.** семейства Autostichidae. Таксономическое положение нового рода в номинативном подсемействе Autostichinae устанавливается на основе функционально-морфологического анализа гениталий самцов у представителей семейства. Для рода *Autosticha* Meyrick, 1886 впервые описано строение скелетно-мышечного аппарата гениталий самца.

INTRODUCTION

The family Autostichidae is one of the taxonomically problematic groups with a rich history of changing of position in the Lepidoptera system, change in taxonomic status and composition.

Le Marchand (1947) established the subfamily Autostichinae for the "*Autosticha* type" group, identified by Meyrick within the family Gelechiidae (Meyrick, 1925). The position of this group within family Gelechiidae was later supported in a number of publications (Clarke, 1971, 1986; Sattler, 1973, Zimmermann, 1978).

Another solution was to transfer the autostichid moths from Gelechiidae to the family Oecophoridae (Hodges, 1978). At the same time, the position of Autostichinae in the family

Oecophoridae was grounded on the base of the functional morphological study of the male genitalia in *Oegoconia* Stainton, 1854 (Kuznetzov & Stekolnikov, 1978). Furthermore, in support and continuation of this decision Autostichinae has been synonymized with the Xyloryctinae (Minet, 1986) within the oecophoroid moths. However, the status of separate subfamily for moths was soon restored. The position of autostichid moths within oecophoroid moths in different status (from group of related genera to separate subfamily) is traced in the series of publications (Common, 1990, 1994; Nielsen & Common, 1991; Scoble, 1992; Nielsen *et al*., 1996; Ueda, 1997; Heppner, 1998; Park & Wu, 2003). The autostichid moths are currently considered in the status of a separate family within Gelechioidea, which was proposed by Sinev (1992) and later supported in following publications (Lvovsky, 2011; Ueda, 2013; Lvovsky, 2016; Lvovsky & Sinev, 2019; Pohl, 2018). Based on publications the taxonomic structure and composition of the family Autostichidae vary from three (Leraut, 1997: Oegoconiinae, Symmocinae and Holcopogoninae; Hodges, 1999, Kristensen *et al*., 2007: Holcopogoninae, Autostichinae and Symmocinae) to five (Kaila, 2004: Holcopogoninae, Symmocinae, Glyphidocerinae, Autostichinae, Lecithocerinae and the genus *Odites* Walsingham, 1891), or to six subfamilies (Heikkila *et al*., 2014: Autostichinae, Deoclonidae, Glyphidoceridae, Holcopogoninae, Oegoconiinae and Symmocinae). As a rule, the taxonomic structure and composition of the Autostichidae were determined by the clustering of taxa into the resulting dendrogram, reconstructed primarily on the base of the analysis of molecular data. The morphological basement was attached later and was of secondary importance. The autostichid clade established with an accompanying morphological reasoning only in the work by Kaila (2004).

Despite a series of successive phylogenetic analyzes, purely morphological or molecular, and with a combination of morphological and molecular markers, the complex apomorphies for identification of this family, same as for included subfamilies, had not been outlined. The representatives of the family Autostichidae possess the morphological characters which are recorded in genera of other groups, both Gelechioid and Oecophoroid complexes. It is especially actual for taxa from the nominative subfamily and Symmocinae.

Present paper is devoted to the description of the new genus, which is distinguished by a set of characters inherent to taxa from different autostichid subfamilies. To determine the position of the new genus in the family, the characters of external morphology, the structure of the musculoskeletal apparatus of the male genitalia and features of the female genitalia were analyzed. Since the morphology of the musculoskeletal apparatus of the male genitalia among autostichids has been studied hitherto only in the genus *Oegoconia*, belonging to the subfamily Symmocinae, the functional morphology of the male genitalia was examined in the type genus *Autosticha* Meyrick, 1886 of nominative subfamily. As result of comparative morphological analysis, the new genus is tentatively placed in the subfamily Autostichinae.

The type material is kept in the Federal Scientific Center for Biodiversity, Far Eastern Branch of the Russian Academy of Sciences (Vladivostok).

MATERIAL AND METHODS

The specimens of the new taxa were collected in Furugelm Island and the other material on autostichid moths was collected in the continental part of Khasanskii district and in Vladivostok. All localities are situated in the south of Primorskii krai of the Russian Far East. The specimens were attracted at light of 400 W mercury lamp. The specimens for functional morphological research were fixed in 70% ethanol; the rest material was collected as a dry collection. The male and female genitalia were prepared by traditional lepidopterological techniques described in detail by Falkovitsh & Stekolnikov (1978). The male and female genitalia

were stained by Chlorazol black. The genitalia of both sexes were examined with a Nikon SMZ-10 stereomicroscope and then the genitalia were mounted in the Euparal following the technique described by Robinson (1976).

Photographs of adult and genitalia slides were captured using an Olympus SZX16 microscope with a DP74 digital camera.

In the description the terminology follows Klots (1970) for genital structures and Kuznetzov & Stekolnikov (1978, 2001) for musculature of the male genitalia.

The following abbreviations and acronyms are used in the text and figures for skeletal scructures and muscles:

aed – aedeagus, *an* – anellus, *an.c* – anal conus, *b.pr* – basal process of valva, *cl* – cucullus, *crn* – cornuti, *d–b.pr* – medial dorso-basal process of valva, *ej.d* – ejaculatory ductus, *fr.an* – fragment of anellus, *fr.jux* – fragment of juxta, *gn* – gnathos, *jux* – juxta, *sc* – saccus, *scl* – sacculus, *teg* – tegumen, *unc* – uncus, *v.l* – ventral lobe of anellus, *vl* – valva, *vnc* – vinculum.

m_1 – *musculus tergalis intersegmentalis 9–10*, depressor of uncus;
m_2 – *musculus gonopodalis externus dorsolateralis*, abductor of valva;
m_3 – *musculus laminae mediale anterior*, ventral abductor of valva;
m_4 – *musculus gonopodalis externus dorsomedialis*, adductor of valva;
m_5 – *musculus phallicus externus posterior*, protractor of aedeagus;
m_6 – *musculus phallicus externus anterior*, retractor of aedeagus;
m_7 – *musculus gonopodalis internus medialis*, intravalvar muscles;
m_{10} – *musculus tergalis intersegmentalis*, retractor of anal conus;
m_{21} – *musculus phallicus internus longitudinalis*, retractor of vesica;
m_{28} – *musculus phallicus internus transversus*, protractor of vesica.

Genitalia slides are identified by the acronym MP (M.G. Ponomarenko), who prepared the slides.

DESCRIPTION OF NEW TAXA

Genus *Laszlogozmanya* Ponomarenko, gen. n.

https://zoobank.org/NomenclaturalActs/682BED41-5906-4015-99D4-A3BAFB5F3F19

Type species: *Laszlogozmanya eclecticus* **sp. n.**

DIAGNOSIS. The new genus possesses by female retinaculum consisting of anteriorly directed setaceous scales between base of *Cu* and *R*; wing venation with R_4 and R_5 coincident in forewing; with *Rs* and M_1 stalked, M_3 and Cu_1 stalked in hindwing; second abdominal sternite with venulae+apodemes. The male genitalia have elongated uncus with small protrusions at the apex, band-like gnathos with weak developed median hook; valva differentiated into regions, joined with vinculum basally, with large dorso-basal lobe (*hemitranstilla*) and strongly sclerotized sacculus; strongly sclerotized anellus surrounded aedeagus; juxta complicated in shape joined with anellus and valva dorso-basally; aedeagus tube-like, without caecum and cornuti. The female genitalia with extremely narrow antrum and ductus bursae, and corpus bursae without signum. The new genus is similar to the Autostichinae genera by pattern of forewing and female retinaculum, to the type species of the *Cornusymmoca* Gozmány, 1965 and *Kertomesis* Gozmány, 1962 (Symmocinae) by large dorso-basal lobe (*hemitranstilla*) of valva. The new genus differs from mentioned genera by band-like gnathos lacking long developed median hook, large sclerotized sacculus trapezoidal distally and sclerotized anellus surrounded aedeagus in the male genitalia; and by the female genitalia with narrow genital tract and corpus bursae without signum.

COMPOSITION. The genus consists of type species only.

ETYMOLOGY. The genus named after Dr. Laszlo Gozmány, who made an outstanding contribution to lepidopterology. The generic name is masculine and formed according to Article 30.2 of the International Code of Zoological Nomenclature (ICZN, 1999).

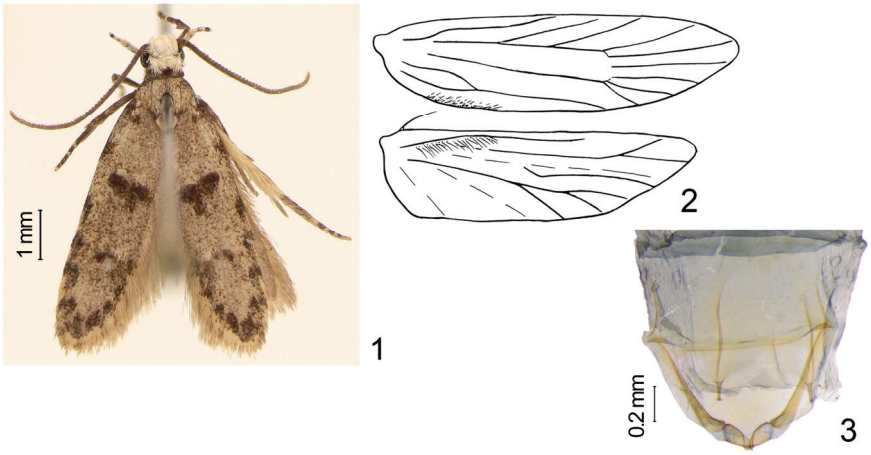
***Laszlogozmanya eclecticus* Ponomarenko, sp. n.**

https://zoobank.org/NomenclaturalActs/32C275DC-817D-47D3-8515-A90EE75BE1D9

Figs 1–11

TYPE MATERIAL. Holotype: ♂, **Russia**: Primorskii krai, Khasanskii distr., 59 km SW Slavyanka, Furugelm Island, 42°27′55″N 130°55′10″E, 16.VII 2015, gen. slide 120 MP (Ponomarenko leg.). Paratypes: 7 ♂, 1 ♀, same locality and collector, gen. slides 121 (f) MP, 122–128 (m) MP (Ponomarenko leg.).

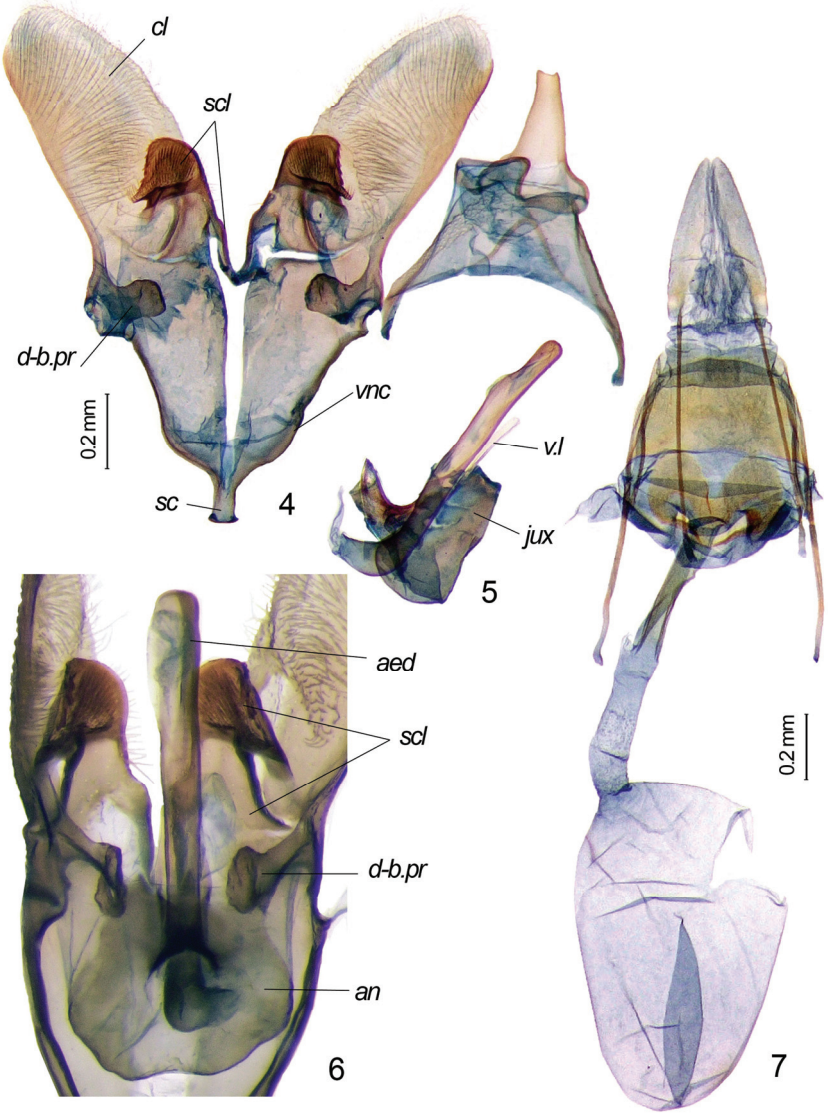
DIAGNOSIS. New species can be distinguished by well-developed sacculus with trapezoidal distal part and serrated dorsal margin and by tube-like aedeagus by the same width throughout, with basal part curved dorsally in the male genitalia; and heart-shaped postvaginal plate, long and narrow sclerotized antrum and corpus bursae without signum in the female genitalia.



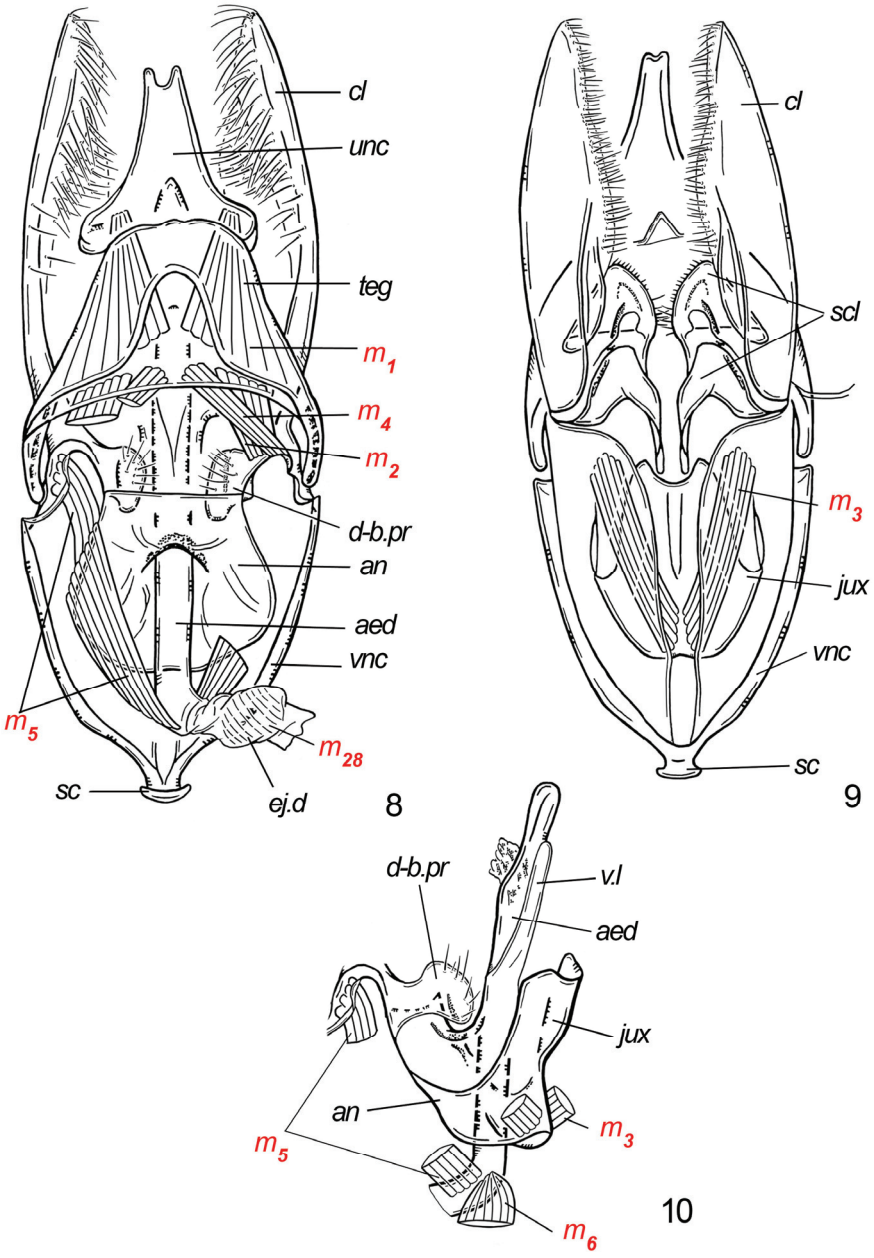
Figs 1–3. *Laszlogozmanya eclecticus* sp. n., male 1 – adult, holotype; 2 – wing venation; 3 – 2nd abdominal sternite.

DESCRIPTION**. Adult** (Fig. 1). Forewing length 5.5-6.5 mm. Head whitish grey. Antenna slightly shorter than 3/4 of forewing length, scape dark grey on upper side and light grey on lower side, flagellum dark grey. Labial palpi with fuscous first segment, second segment dark grey in basal 2/3 and light grey distally, third segment slightly shorter than second one, with dark ring on the whitish basal half, with fuscous distal half and whitish apex. Thorax mainly grey, with tegula fuscous anteriorly. Forewings light grey, costal margin with six dark dots – two ones on the basal part (at the base and 1/5 of wing length), another four ones along distal part of costal margin; series dark dots placed along external margin from apex to tornus; two dark sports, like merged two-three dots, on the longitudinal axis of wing – larger spot at 1/3 and smaller one at 3/5 of wing length; cilia light grey. Hindwing grey, cilia slightly lighter. Venation

with R_4 and R_5 coincident, M_3 and Cu_1 connate, Cu_2 absent in the forewing; and with *Rs* and M_1 stalked, M_3 and Cu_1 stalked in the hindwing (Fig. 2). Fore- and midlegs dark grey and hindlegs slightly lighter, with grey femur, each segment of tarsus with very narrow light ring distally; spurs of mid- and hindlegs grey with light apices. Abdominal 2nd segment with slightly sinuous venulae and drumstick-shaped apodemes.



Figs 4–7. *Laszlogozmanya eclecticus* sp. n., genitalia. 4 – male genitalia without aedeagus, juxta and anellus, medial view, holotype; 5 – aedagus, juxta and anellus, holotype; 6 – fragment of ventral part of the male genitalia (sacculi, dorso-basal processes of valvae, aedeagus, anellus), medial view; 7 – female genitalia, ventral view.



Figs 8–10. *Laszlogozmanya eclecticus* sp. n., functional morphology of the male genitalia. 8 – dorsal view; 9 – ventral view, without aedeagus; 10 – aedeagus, juxta and anellus, hemitranstilla (dorso-basal process of valva), lateral view.

Male genitalia (Figs 4–6). Uncus elongated, lamellar with two small protrusions and a rounded notch between them at the apex, slightly dilated basally. Tegumen widened anteriorly, with semioval sclerotized curve at the middle of anterior part. Gnathos with narrow lateral arms and weak median hook. Valva indistinctly concaved at the middle of costa, dorso-basal process large and angular, curved inwards and joined with sclerotized anellus; sacculus almost separated from cucullus, consisting of strongly sclerotized more or less trapezoidal apical part with serrated dorsal margin and dense brush of strong spines on medial surface, and /\–shaped basal part, joined with juxta ventrally (Fig. 6). Aedeagus tube-like, with elongated one-sided right wall in the distal part and base curved dorsally, vesica spinuliferous and lacking needle-like cornuti. Anellus strongly sclerotized, enveloped aedeagus by tube with long ventral lobe rounded apically (Figs 5, 10). Juxta gutter-like, fused with sclerotized anellus and joined with narrow ventral processes of sacculi. Vinculum fused with valva, as narrow arched sclerite with short saccus enlarged apically.

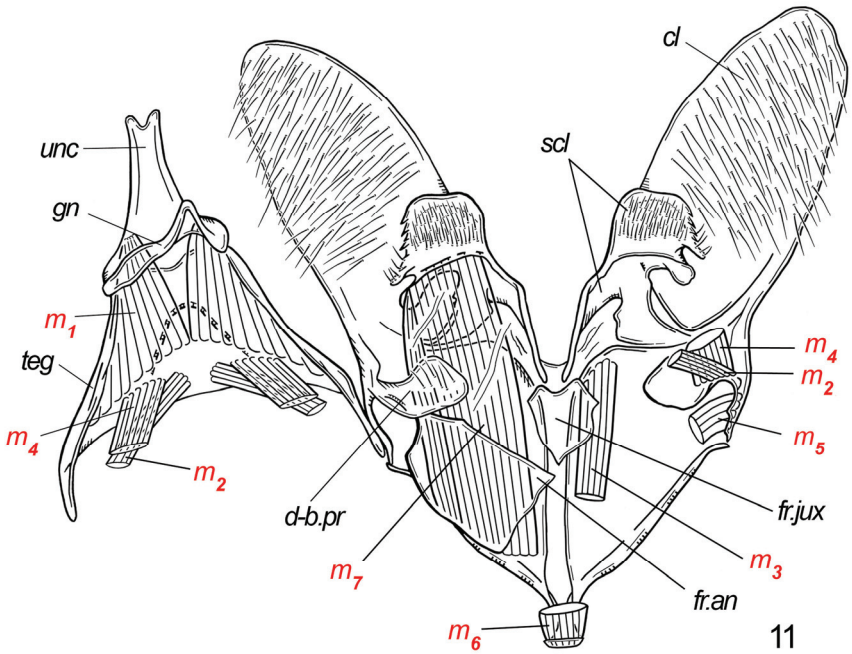


Fig. 11. *Laszlogozmanya eclecticus* sp. n., functional morphology of the male genitalia, unrolled view, aedeagus removed.

Female genitalia (Fig. 7). Ovipositor very short, papillae anales sclerotized basally. Apophyses anteriores slightly shorter than apophyses posteriores. Posterior margin of the eighth tergite concave at the middle. Eighth sternite with heart-shaped postvaginal plate. Ostium relatively small, equal to antrum in diameter, placed anterad the heart-shaped post-vaginal plate; antrum very narrow and tube-like, sclerotized on the left side, its length is almost equal to rest membranous part of ductus bursae; the latter slightly wider than antrum; ductus seminalis is arising from boarder between sclerotized and membranous parts of ductus bursae. Corpus bursae membranous and oval, without signum.

DISTRIBUTION. Russian Far East (Primorskii krai: Furugelm Island.).

ETYMOLOGY. The specific name, *eclecticus*, is derived from Greek ἐκλεκτός, meaning a mix or combining heterogeneous characters (in this case) and refers to the morphology of the described species, external features and genital characters of which are typical for genera belonging to different subfamilies of the family.

Functional morphology of the male genitalia in representatives of the family Autostichidae

Laszlogozmanya eclecticus sp. n.

MUSCULOSKELETAL APPARATUS OF MALE GENITALIA (Figs 8–11). In musculoskeletal apparatus eight paired muscles (m_1, m_2, m_3, m_4, m_5, m_6, m_7, m_{10}) and two unpaired muscles (m_{21}, m_{28}):

m_1 – well-developed, attached along anterior and median parts of tegumen by anterior end and to latero-basal part of uncus by posterior end, functioning as depressor of uncus (Figs 8, 11);

m_2 – arised from near anterior margin of dorsal part of tegumen and attached to the base of dorso-basal process of valva (*hemitranstilla*), functioning as abductor of valva (Figs 8, 11);

m_3 – attached to medial side of valva and to ventral surface of juxta anterior part, functioning as abductor of valva (Figs 9–11);

m_4 – attached to antero-lateral part of tegumen and to base of dorso-basal process (*hemitranstilla*) of valva, functioning as adductor of valva (Figs 8, 11);

m_5 – well–developed, stretched from medial surface of dorso-basal process (*hemitranstilla*) of valva to base of aedeagus, going around the dorso-lateral edge of the anellus, functioning as protractor of aedeagus (Figs 8, 10);

m_6 – muscles merged into one, stretched from medial surface of saccus to ventral side of curved base of aedeagus, functioning as retractor of aedeagus (Figs 10, 11);

m_7 – well–developed, intravalvar muscles, stretched from base of valva to anterior margin of saccular distal part, flexing valva transversally (Fig. 11);

m_{10} – attached to dorsal part of tegumen and to anal conus, functioning as retractor of the latter;

m_{21} – placed within basal part of aedeagus, functioning as retractor of vesica;

m_{28} – placed within bulbus ejaculatorius, functioning as protractor of vesica (Fig. 8).

Autosticha modicella (Christoph, 1882)

MATERIAL EXAMINED. Russia: Primorskii krai, Khasanskii district, 59 km SW Slavyanka, Furugelm Isl., 42°27′55″N 130°55′10″E, 6, 10.VIII 2013, 2 ♂ (Ponomarenko leg.); Vladivostok, 5 km SEE Okeanskaya, 0.5 km E Shamorovskii pass, Bogataya Griva range, 240 m a.s.l. 43°13'01 N, 132°03'48 E, 15.VII 2016 2 ♂ (Ponomarenko leg.).

MUSCULOSKELETAL APPARATUS OF MALE GENITALIA (Figs 12–14). In musculoskeletal apparatus eight paired muscles (m_1, m_2, m_3, m_4, m_5, m_6, m_7, m_{10}) and two unpaired muscles (m_{21}, m_{28}). Muscles m_1, m_2, m_4, m_{10}, m_{21} and m_{28} have same attachment and functioning as described for *L. eclecticus*, moreover muscles m_2 and m_4 placed with similar spatial cross. There are some differences in attachment of following muscles:

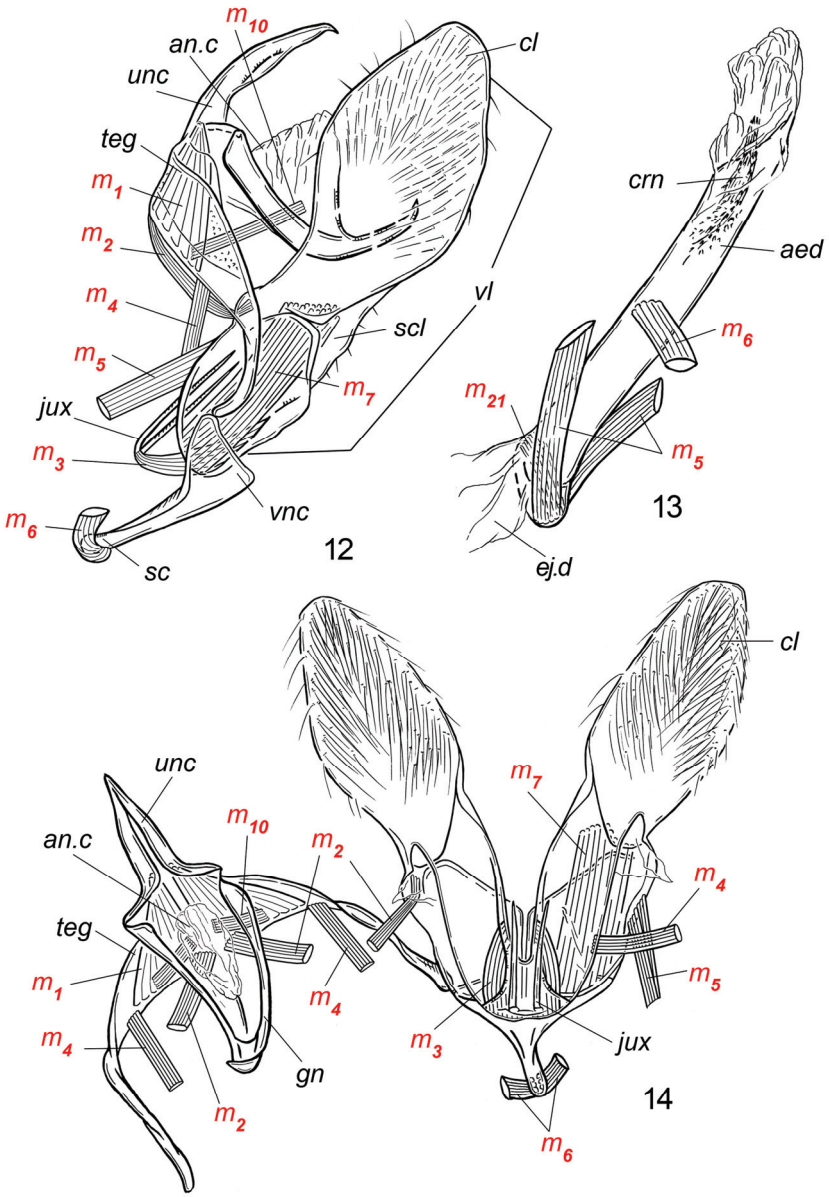
m_2 – ventral end of muscle penetrated the valva and attached on the its lateral wall from the inside (Figs 12, 14);

m_4 – ventral end of muscle attached to dorsal margin of medial wall of valva (Fig. 14);

m_5 – stretched from dorsal margin of lateral wall of valva to small caecum of aedeagus (Figs 12–14);

m_6 – stretched from ventral surface of apical part of saccus to middle part of aedeagus ventrally (Figs 12–14);

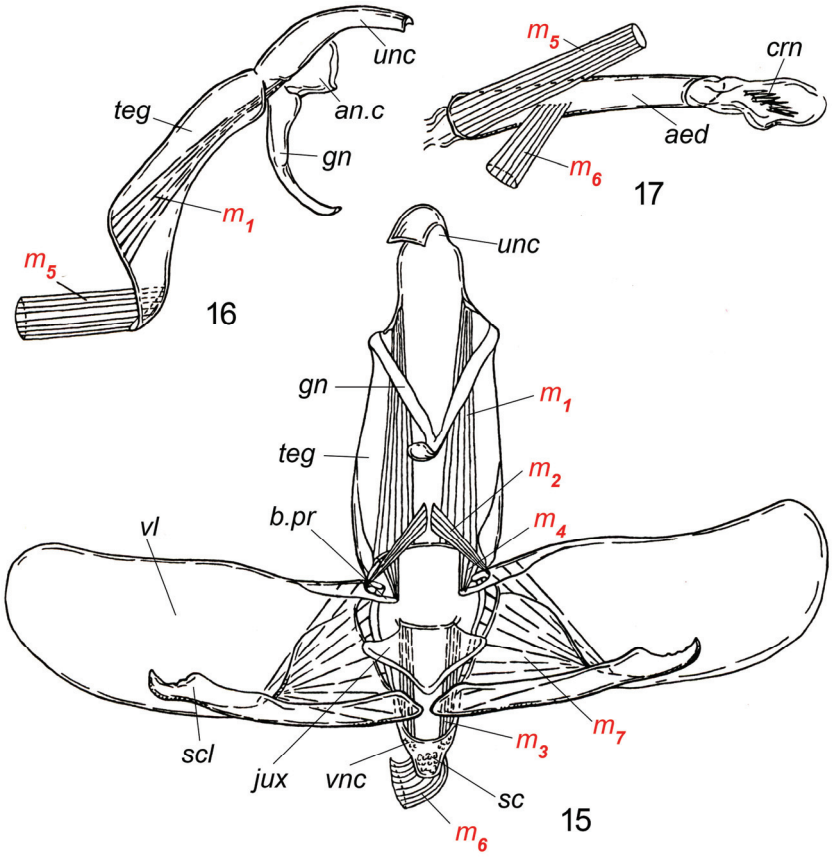
m_7 – well-developed intravalvar muscles, stretched from valvar base to anterior edge of separated distal part (Figs 12, 14).



Figs 12–14. *Autosticha modicella*, functional morphology of the male genitalia. 12 – lateral view; 13 – aedeagus, lateral view; 14 – unrolled view, aedeagus removed.

***Oegoconia quadripuncta* (Haworth, 1828)**

MUSCULOSKELETAL APPARATUS OF MALE GENITALIA (Figs 15–17). The musculoskeletal apparatus of the male genitalia is described and illustrated by Kuznetzov & Stekolnikov (1978: 132, Fig. 1; 2001: 166, Figs 47 А, Б, В).



Figs 15–17. *Oegoconia quadripuncta*, functional morphology of the male genitalia (after Kuznetzov & Stekolnikov, 1978). 15 – ventral view; 16 – uncus, tegumen and gnathos, lateral view; 17 – aedeagus, lateral view.

DISCUSSION

The position of a new genus within Autostichidae is established on the base of the similarity in morphology and functioning of musculoskeletal apparatus of the male genitalia. Hitherto among autostichid moths the muscular system of the male genitalia was studied in the type species of the genus *Oegoconia* – *O. quadripuncta* (Haworth, 1828) only (Kuznetzov & Stekolnikov, 1978). The genus was considered within Autostichinae (Kuznetzov & Stekolnikov, 2001), Symmocinae (Hodges, 1999), or treated as type genus for subfamily Oegoconiinae (Heikkilä *et al*., 2013).

Generally, morphology and functioning of musculoskeletal system of the male genitalia are similar in all studied genera of the family Autostichidae – *Oegoconia*, *Autosticha* and *Laszlogozmanya* for excepting of some generic peculiarities in attachment of some muscles. The muscles m_1, m_{10}, m_{21} and m_{28} have identical position and functioning in all genera. There is typical spatial cross of valvar muscles m_2 and m_4 found in each studied genus. The differences are in attachment of ventral end of muscles m_2 and m_4. Both genera, *Laszlogozmanya* and *Oegoconia*, have valva with dorso-basal process, and muscles m_2 and m_4 attached to this process directly or to its base (Figs 8, 11, 15). Whereas *Autosticha* differs by valva lacking the dorso-basal process, and muscles m_2 and m_4 attached to the valvar lateral wall from the inside or to its dorsal margin (Fig. 14). As to position and attachment of muscle of medial plate (*juxta*) and phallic musculature, they are similar in genera *Laszlogozmanya* and *Autosticha*. The muscle m_3 stretched in *Laszlogozmanya* and *Autosticha* from ventral surface of invaginated juxta to ventral margin of basal part of valva (Figs 9, 14), whereas in *Oegoconia* they are attached to inner surface of juxta and medial surface of vinculum (Fig. 15). The muscles protractor of aedeagus m_5 arise from base of dorso-basal process of valva or from its dorsal margin in *Laszlogozmanya* and *Autosticha*, respectively (Figs 8, 10, 12–14), whereas these muscles stretched from lateral parts of tegumen in *Oegoconia* (Fig. 16). The valva in *Laszlogozmanya* and *Autosticha* folds transversely due to the contraction of the intravalvar muscle m_7, since the distal end of this muscle widely attached to anterior margin of sacculus or along anterior margin of separated distal part of valva, respectively (Figs 11, 12, 14); whereas in *Oegoconia* the muscle m_7 is attached narrowly at the base of the saccular process and the ventral edge of the valva is lifted only due its contraction (Fig. 15). Thus, new genus *Laszlogozmanya* is similar with autostichid genera in functional morphology of the male genitalia, and closer to the genus *Autosticha* than *Oegoconia*.

As to external characters and the morphology of the genitalia, a new genus possesses characters belonging to representatives of Autostichinae and Symmocinae. A new genus has female retinaculum consisting of anteriorly directed setaceous scales between base of *Cu* and *R* that is typical for representatives of both mentioned subfamilies (Hodges, 1999). It is similar with *Autosticha* by pattern of forewing. The new genus has similarity with some species of *Autosticha* (*A. leukosa* Park et Wu and *A. sichunica* Park et Wu) in wing venation. The male genitalia of a new genus have elongated and dorso-ventrally flattened uncus with notch at apex and valva with large strongly sclerotized sacculus that is similar to those in *Oegoconia*. The large lobe-like dorso-basal process of valva is similar to that in type species of *Cornusymmoca* and *Kertomesis* (Symmocinae). The genus *Laszlogozmanya* differs from *Autosticha* by lamellar uncus with apical notch and strongly developed sacculi; from *Oegoconia* by aedeagus lacking needle-like cornuti, by gnathos with thin lateral arms and weak median hook, and by valva with large lobe-like dorso-basal process; from *Cornusymmoca* and *Kertomesis* by uncus, gnathos and aedeagus as mentioned in foregoing text. The genus *Laszlogozmanya* can be separable from all mentioned genera by female genitalia, which have extremely narrow antrum and ductus bursae and corpus bursae without signum. The new genus differs from *Eremicamura* Gozmány, 1962, described supposedly from Amur region, by R_4 and R_5 coincident in forewing, by angulate dorso-basal process of valva, large trapezoidal distal part of sacculus and aedeagus lacking thorn-shaped cornuti; whereas *Eremicamura* possesses by R_4 and R_5 stalked in forewing, and long dorso-basal valvar process evenly tapering to a sharp apex, sacculus tapering to curved inwards apex and aedeagu with row of thorn-shaped cornuti in the male genitalia typical for Symmocins. The species diversity of the subfamily Symmocinae has been recorded in the Mediterranean. As noted L.A. Gozmány (1963), the most Symmocins ranges around circummediterranean area, habiting there in the warmly insolated slopes of the dolomite or limestone mountains and hills, or the low, hot seacoast areas, or, again, the sandy or rocky semi-deserts and deserts.

Only one monotypic genus *Eremicamura* from Symmocinae has been described from Amur region of the Russian Far East according to label in single specimen of the type species, and hitherto its habitation there has not yet been confirmed; whereas the subfamily Autostichinae is represented in the Far Eastern fauna. Taking into account similarity in external characters and musculoskeletal apparatus of the male genitalia and also the preferred habitats, the new genus *Laszlogozmanya* is tentatively placed within subfamily Autostichinae.

ACKNOWLEDGEMENTS

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