



## Taxonomic status of *Xyrosaris melanopsamma* Meyrick, 1931 (Lepidoptera: Yponomeutidae) with notes on congeneric species in East Asia

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### Abstract

The species *Xyrosaris melanopsamma* Meyrick, 1931, **stat. rev.** is reinstated from synonymy with *X. lichneuta* Meyrick, 1918 based on morphological analysis of the female genitalia. The association of conspecific males and females of *X. melanopsamma* is confirmed by molecular analysis using a fragment of the mtCOI gene and by studying material reared from larvae collected in the local population on Rikord Island. The genitalia of both sexes are illustrated. The recently described species *X. vaginata* Bae et Na, 2024 is treated as a junior subjective synonym of *X. melanopsamma* Meyrick, 1931. An annotated checklist of *Xyrosaris* spp. from East Asia is provided.

**Key words:** Ermine moths, new status, new synonymy, host plant, molecular analysis, COI

### Introduction

To date, the genus *Xyrosaris* Meyrick includes 15 valid species (Lewis & Sohn 2015; Agassiz 2019; Bippus 2020; Ponomarenko & Beljaev 2023; Na & Bae 2024), of which five species inhabit East Asia (*X. lichneuta* Meyrick, 1918, *X. lirinopa* Meyrick, 1922, *X. insularis* Ponomarenko et Beljaev, 2023, *X. vaginata* Bae et Na, 2024, *X. triacantha* Bae et Na, 2024).

The original descriptions of *Xyrosaris* species known in East Asia were based on a single or a few specimens. Thus, the species *X. lirinopa* Meyrick was diagnosed and described based on one specimen from China (Shanghai) (Meyrick 1922). This species has not been treated subsequently nor has its type been examined, so what is known comes solely from the original description. The species *X. lichneuta* Meyrick was described from Khasis, Assam (NE India) based on two specimens collected in May and October (Meyrick 1918). Later the species *X. melanopsamma* Meyrick was described from Japan, also based on two specimens collected on Honshu in October and November (Meyrick 1931). For each of these species, *X. lichneuta* and *X. melanopsamma*, a lectotype was designated and their genitalia were illustrated by Clarke (1965). Later, *X. melanopsamma* was synonymized with *X. lichneuta* by Moriuti (1977). Since then, all specimens collected from the territory of East Asia and resembling *X. lichneuta* have been identified as this species, which is probably not always correct.

Recently, three more species (*X. insularis*, *X. vaginata* and *X. triacantha*) were described from Far East of Russia and South Korea (Ponomarenko & Beljaev 2023; Na & Bae 2024). To date, contradictory and erroneous data have been accumulated in the published literature dealing with the genus *Xyrosaris*, which need a critical analysis. In addition, the studied material collected in the Far East of Russia has been found to belong to a larger number of species than previously recorded in this region. Therefore, the main goal of the present study is to revise the species known to occur in East Asia and examine the bionomics of the listed species.

## Material and methods

**Material.** Specimens of *Xyrosaris* spp. were attracted to the light of a 250 W and 400 W mercury lamps in different districts of Khabarovskii Krai, Primorskii Krai, Sakhalin and Kunashir Islands (Far East, Russia). The special emphasis was put on the specimens reared from larvae and collected from host plants on Rikord and Russkii Islands. The moths were preserved as dry material for further morphological study. The abdomens of some adults were fixed in 96 % ethanol for genetic research. In total, 251 specimens were dissected and the morphology of genitalia was studied in detail, of which 98 specimens were reared from larvae, collected on *Euonymus maximoviczianus* Prokh. and 78 specimens were reared from larvae, collected on *Celastrus orbiculatus* Thunb. (Celastraceae).

In the description of morphological characters, the terminology of genital structures follows Klots (1970). The studied specimens are deposited in the Federal Scientific Center of the East Asia Terrestrial Biodiversity (FSCB), Far Eastern Branch of Russian Academy of Sciences (Vladivostok), the vouchers of samples processed for molecular study are also deposited here and part of the material is deposited in the Zoological Institute (ZIN) of Russian Academy of Sciences (St.-Petersburg). For genitalia slides the following abbreviation are used: gen. slide—genital slide; MP—prepared by M.G. Ponomarenko; YuZ—prepared by Yu.N. Zinchenko.

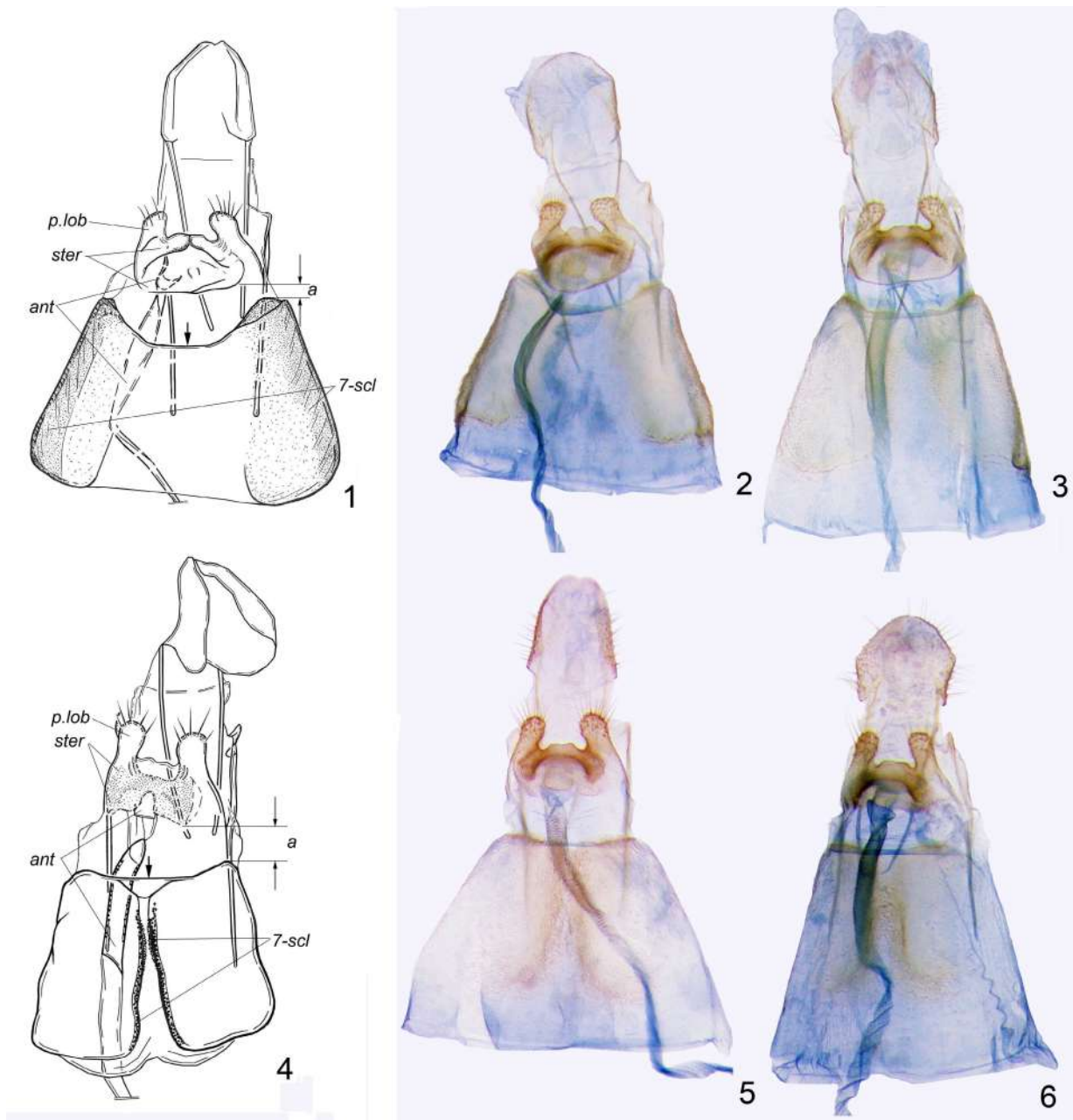
**Morphological study.** The genitalia preparations were made using a standard technique suggested by Falkovitsh & Stekolnikov (1978), which includes the maceration of the soft tissue in 10–15 % KOH. The membranous parts of the genitalia were stained with chlorazol black. Genital structures were studied using Nikon SMZ-10 and Leica M80 stereomicroscopes. After examination, the genitalia of both sexes were slide-mounted in Euparal following the technique described by Robinson (1976). The genital slides were photographed using an Olympus SZX16 stereomicroscope equipped with a DP74 Nikon digital camera. Some photographs of genital structures at higher magnification were taken using a Zeiss Axioskop 40 microscope equipped with a digital camera AxioCam HRc.

**Molecular study.** Molecular analysis based on the mtCOI gene fragment was performed on 13 samples. Of these, six sequences were obtained from specimens reared from larvae collected on *Euonymus maximoviczianus* Prokh. Five sequences of the target fragment of the recently described species *X. insularis* were included in the analysis. The numbers of vouchers for DNA samples are listed in the paragraph ‘Material examined’. Genomic DNA from abdominal muscles was extracted following the protocol recommended in the Purification of Genomic DNA from insects appended to the Qiagen DNeasy Blood & Tissue Kit (Qiagen GmbH, Hilden, Germany), with the following modifications. Since genitalia in micromoths have diagnostic significance, the abdomen of each sample was not ground for lysis to save the copulative apparatus as a voucher for further slide-mounting with Euparal. One individual of each species was sampled for genomic DNA. The stages of PCR sequencing and the reaction mixture are described in detail by Ponomarenko *et al.* (2021). PCR sequencing of the target fragment of COI gene was done using the Sanger sequencing method. In PCR, the primer combination LepF (forward) (5'-ATTCAACCAATCATAAAGATATTGG-3') and EnhLepR1 (reverse) (5'-CTCCWCCAGCAGGATCAAAA-3') was used after Herbert *et al.* (2004). The PCR fragments were sequenced in the Genetic Analyzer 3130xl (Applied Biosystems, USA). As a result, sequences of the mtCOI gene fragment, 609–715 bp in length were obtained from 11 samples reared from larvae collected in Far East of Russia. After editing and alignment, the resulting fragment included in the molecular analysis was 607 bp. Sequence visualization and export for editing and alignment were done with the Program Sequence Scanner v 1.0 (Applied Biosystems 2005). The editing and alignment of the obtained nucleotide sequences were performed using the software packages FinchTV 1.4.0. (Patterson *et al.* 2004) and MEGA-7 (Kumar *et al.* 2016).

**Genetic comparative analysis.** Genetic analysis based on the mtCOI gene fragment was performed using the MEGA-7 software package. The original nucleotide sequences of the COI gene fragment for 11 Far Eastern samples were included in comparative genetic analysis, as well as data on species identified as *X. lichneuta* from China (Shaanxi) and South Korea (Cheongju) obtained from the Genbank (NCBI) and Bold databases. The numbers of these samples are given in Table 1. The tree with inferred relationships between *Xyrosaris* species based on the mtCOI gene fragment was constructed using the Neighbor-Joining statistical method and the Kimura 2-parameter model (Kimura 1980).

**TABLE 1.** List of COI gene sequences of the *Xyrosaris lichneuta* Meyrick taken from GenBank (NCBI) and BOLD bases for molecular study.

Name of species (as identified in GenBank and BOLD)	Country of sample origin	Voucher number	GenBank Accession Nos.	BOLD Sequence ID
<i>Xyrosaris lichneuta</i> Meyrick, 1918	South Korea: Cheongju	JCS-08-1006	KF523851.1	LTOLB064-08.COI-5P
<i>Xyrosaris lichneuta</i> Meyrick, 1918	China: Shaanxi	BIOUG14502-B02	-	GMCHM714-14.COI-5P



**FIGURES 1–6.** *Xyrosaris* spp., female genitalia. 1, *X. lichneuta*, re-drawn photo of lectotype from Clarke, 1965, 5: pl. 201, photo 2 a–b; 2, ditto, gen. slide 231; 3, ditto, gen. slide 232; 4, *X. melanopsamma*, re-drawn photo of lectotype from Clarke, 1965, 5: pl. 201, photo 4 a–c; 5, ditto, gen. slide 233; 6, ditto, gen. slide 234. *a*—distance between posterior edge of segment 7 and anterior edge of sterigma, *ant*—antrum, *p.lob*—lobes of postvaginal plate, *ster*—sterigma, *7-scl*—sclerotisation of 7th sternite; black arrow shows posterior edge of 7<sup>th</sup> sternite.

## Results of morphological and molecular analysis

Species of the genus *Xyrosaris* inhabiting East Asia with known male and female genitalia are divided into two morphological groups that are relatively well diverged from each other. The first group includes *X. lichneuta* and the recently described *X. vaginata* with narrow, more or less long harpa on the medial side of the valva in the male genitalia and relatively narrow gutter-like hollows on the sterigma covered with short setae. The second group includes the recently described *X. insularis* and *X. triacantha* with short and wide valval harpa bearing strong thorns along the convex edge in the male genitalia and relatively wide gutter-like hollows on the sterigma covered with long setae. Both mentioned species of the last group are well separable by the size and shape of the harpa in the male genitalia, that was discussed and showed in recently published papers (Ponomarenko & Beljaev 2023: 140, Fig. 13; Na & Bae 2024: 422, 3D, H).

From the first group, only *X. lichneuta* is recorded in the Russian Far East. However, it was established that the specimens collected in Far East of Russia belong to several species, some of them were attracted to light, and most of them were reared from larvae.

Since its description, the species *X. lichneuta* has been mentioned in a series of publications containing contradictory data, especially regarding its morphology. Therefore, data on *X. lichneuta* and related species, including the previously synonymized *X. melanopsamma*, were analyzed to identify the collected specimens.

**Comparison of female genitalia.** The lectotypes of *X. lichneuta* and *X. melanopsamma*, both females, were photographed by Clarke (1965). The genitalia were photographed with segment 7, which turned out to be successful for the delimitation of these species. The photographs of type specimens in Clarke (1965) were redrawn to show differences between the female genitalia of *X. lichneuta* and *X. melanopsamma* (Figs 1, 4). These two species differ well in the following characters: the distance between the anterior edge of the sterigma and the posterior edge of segment 7, the shape of the sterigma, the zone of microtrichia on sternite 7, and sclerotisation of the latter. Two morphotypes with genitalia that matched the lectotypes illustrated by Clarke (1965: Figs 2a–b, 4a–c) were found among the Far East material and photographed for comparison (Figs 2, 3, 5, 6).

The diagnostic characters that allow the species *X. lichneuta* and *X. melanopsamma* to be distinguished from each other by females are defined and listed in Table 2. These two species differ well in morphology of females from the recently described *X. insularis* and *X. triacantha*. The species *X. insularis* and *X. triacantha* possess a strongly convex sterigma covered with strong, relatively long setae externally, and by having sclerotised lobes on the anterior margin of the sterigma. In addition, *X. insularis* has the 7<sup>th</sup> sternite sclerotised in the distal half and, unlike its congeners, lacks a setaceous zone (Ponomarenko & Beljaev 2023: 140, Figs 19, 21; Na & Bae 2024: 424, Figs 4D, 5B, D).

**TABLE 2.** Diagnostic characters for *X. lichneuta* and *X. melanopsamma* on the base of female and male genitalia.

No	Diagnostic character\ species	<i>X. lichneuta</i>	<i>X. melanopsamma</i>
<b>Female genitalia</b>			
1	distance between anterior edge of sterigma and posterior edge of 7 <sup>th</sup> segment	relatively short, 7.6 times shorter than papillae anales	relatively long, 2.5 times shorter than papillae anales
2	shape of posterior edge of 7 <sup>th</sup> sternite	rounded concave, with distinct lateral triangular projections	almost straight, with faintly distinguishable lateral projections
3	shape of sterigma	transversely oval with distinct anterior margin	more or less angular, with a weakly defined anterior edge
4	7 <sup>th</sup> sternite	with relatively wide longitudinal zone almost lacking microsetae in the middle and sclerotised lateral sides	with close longitudinal lines of dense microsetae in the middle and weak sclerotised lateral sides
5	plate between base of papillae anales	as equilateral triangle	as longitudinally elongated triangle

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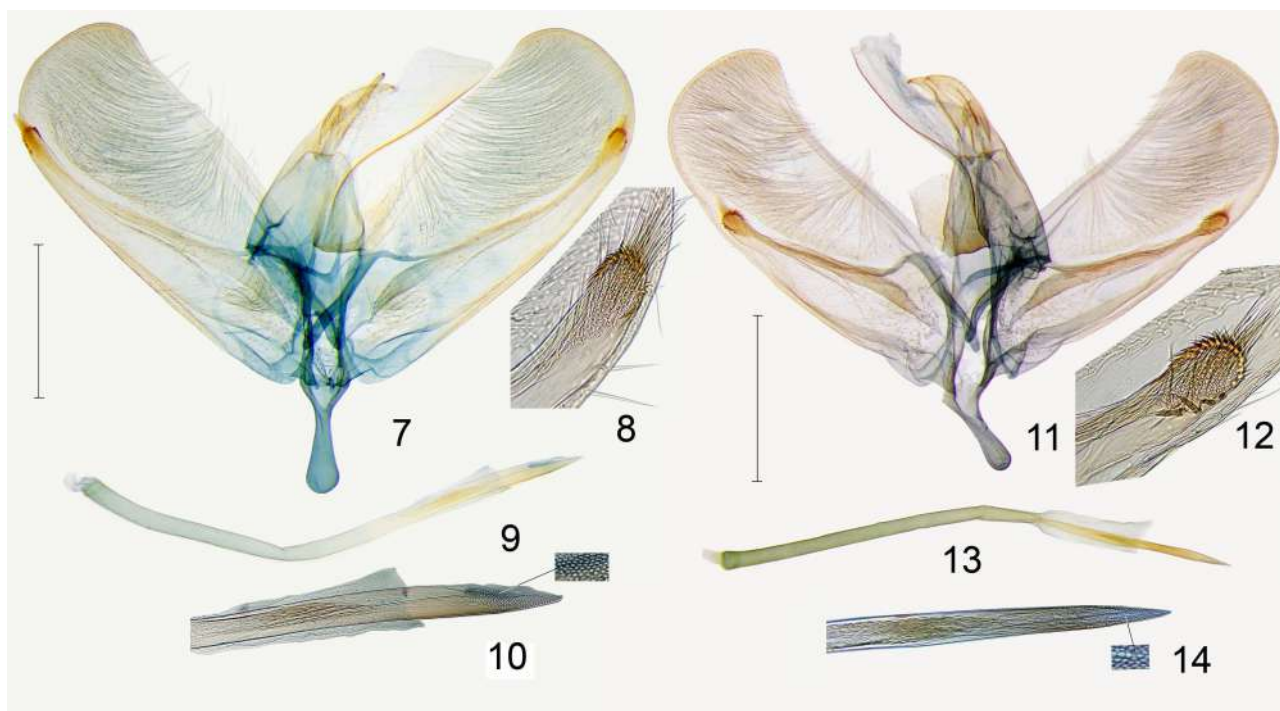
TABLE 2 (Continued)

No	Diagnostic character\ species	<i>X. lichneuta</i>	<i>X. melanopsamma</i>
<b>Male genitalia</b>			
6	length of harpa	reaches 9/10 of valva length	slightly exceeds 3/5 of valva length
7	row of strong thorns on apical part of harpa	semioval with equal dorsal and ventral parts (Fig. 8)	arched, with longer part along ventral margin of harpa (Fig. 12)
3	thorns on the apical part of harpa	smaller	larger, especially along ventral margin of harpa
4	shape of valva	smoothly widened from base towards 3/5 (Fig. 7)	smoothly widened from base towards 1/3, further parallel-sided towards 2/3 (Fig. 11)

As a result of the comparison of female genitalia of lectotypes and collected specimens in Far East of Russia it was established that *X. lichneuta* and *X. melanopsamma* are two independent species. Thus, the specific name *Xyrosaris melanopsamma* Meyrick, 1931, **stat. rev.** is reinstated from synonymy with *X. lichneuta* Meyrick, 1918.

**Comparison of male genitalia and association with conspecific females.** Examination of the male genitalia of collected specimens in the Far East of Russia indicates the presence of three species, differing in shape and length of the harpa on the medial side of the valva. Of these, the recently described *X. insularis* is easily distinguished by a relatively wide and short valval harpa bearing strong thorns on the triangular distal part in the male genitalia (Ponomarenko & Beljaev 2023: 140, Fig. 13). The species *X. triacantha*, described from South Korea is also well-distinguished by a slightly arched distal part of the harpa, bearing only three thorns at the apex (Na & Bae 2024: 422, Figs 4D, H).

Two other morphological types of the male genitalia belong to the species group *X. lichneuta* and related ones (Figs 7–14). Both of these morphotypes were previously illustrated based on specimens collected in Japan. Valva with a short harpa was figured for *X. melanopsamma* by Friese (1962: 322, Fig. 15) and valva with a long harpa was illustrated for *X. lichneuta* by Moriuti (1977: pl. 33, Fig. 336), who considered the latter as the senior subjective synonym of the first taxon.



**FIGURES 7–14.** *Xyrosaris* spp., male genitalia. 7–10: *X. lichneuta*, gen. slide 236: 7, ventral view; 8, apical part of harpa; 9, aedeagus; 10, apical part of aedeagus; 11–14: *X. melanopsamma*, gen. slide 184: 11, ventral view; 12, apical part of harpa; 13, aedeagus; 14, apical part of aedeagus. Scale bar 0.5 mm with the exception of enlarged figures 8, 10, 12, 14.

The adults of both sexes attracted to the light in different districts of Khabarovskii Krai, Primorskii Krai and Sakhalin Island have different morphology and high variability in colouration and wing pattern overlapping in the species (Figs 21 A–F, 22 A–I). To correctly associate conspecific males and females, the series of adults reared from larvae collected on the *Euonymus maximoviczianus* Prokh. in the local insular population was given greater attention. All specimens reared from larvae feeding on this host plant possessed female genitalia typical for *X. melanopsamma* with the characters listed above and male genitalia with a short harpa (Figs 5, 6, 9, 10). Besides, the conspecificity of reared specimens was also confirmed by molecular analysis based on the fragment of the COI gene.

On the built neighbor-joining tree six samples reared from larvae collected on *E. maximoviczianus* Prokh. on Rikord Isl. (Far East of Russia) are united in clade 1 with bootstrap support of 89 %, that confirming their conspecificity (Fig. 15). Of them, one sample (voucher 771) was female with genitalia typical for *X. melanopsamma* as illustrated by Clarke and five specimens were males (vouchers 770, 772, 775, 776, 787) with a short harpa on the medial surface of the valva. As for the number of thorns on the apical part of the harpa, especially along its ventral edge, their number is different in each specimen and even on the left and right harpa of the same specimens. So, this character is not diagnostic. Vouchers (genitalia) 771 (female) and 776 (male) including the apical parts of the harpa are illustrated (Figs 16–20).

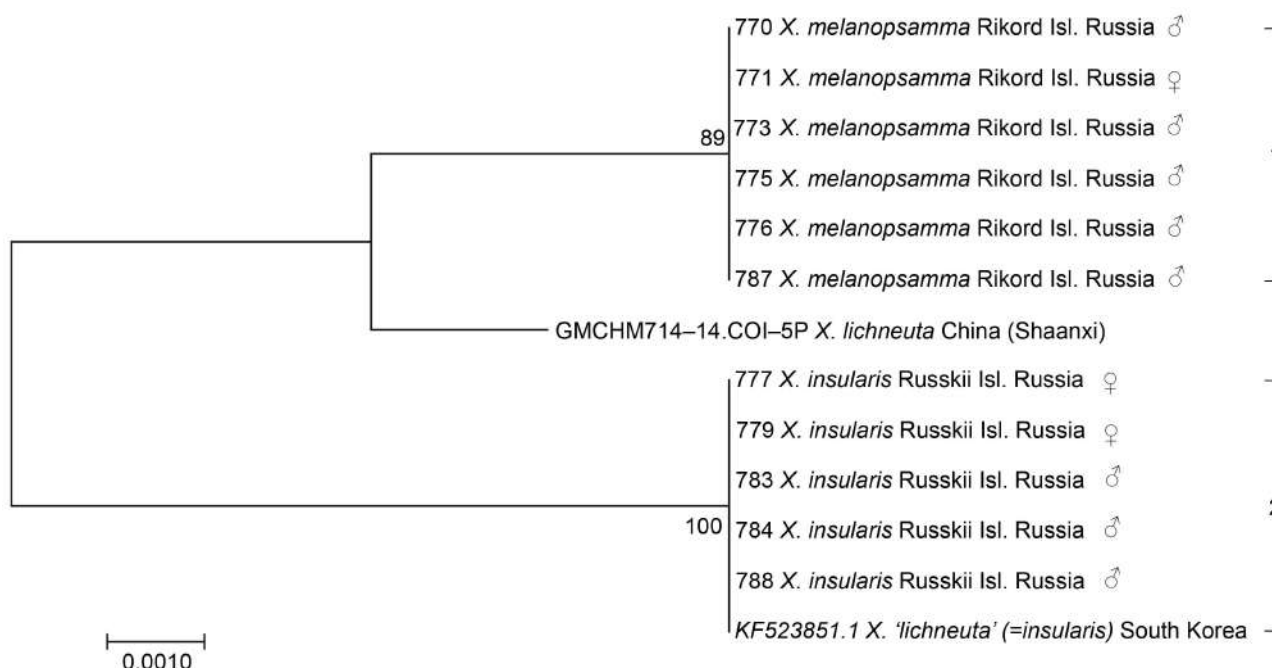
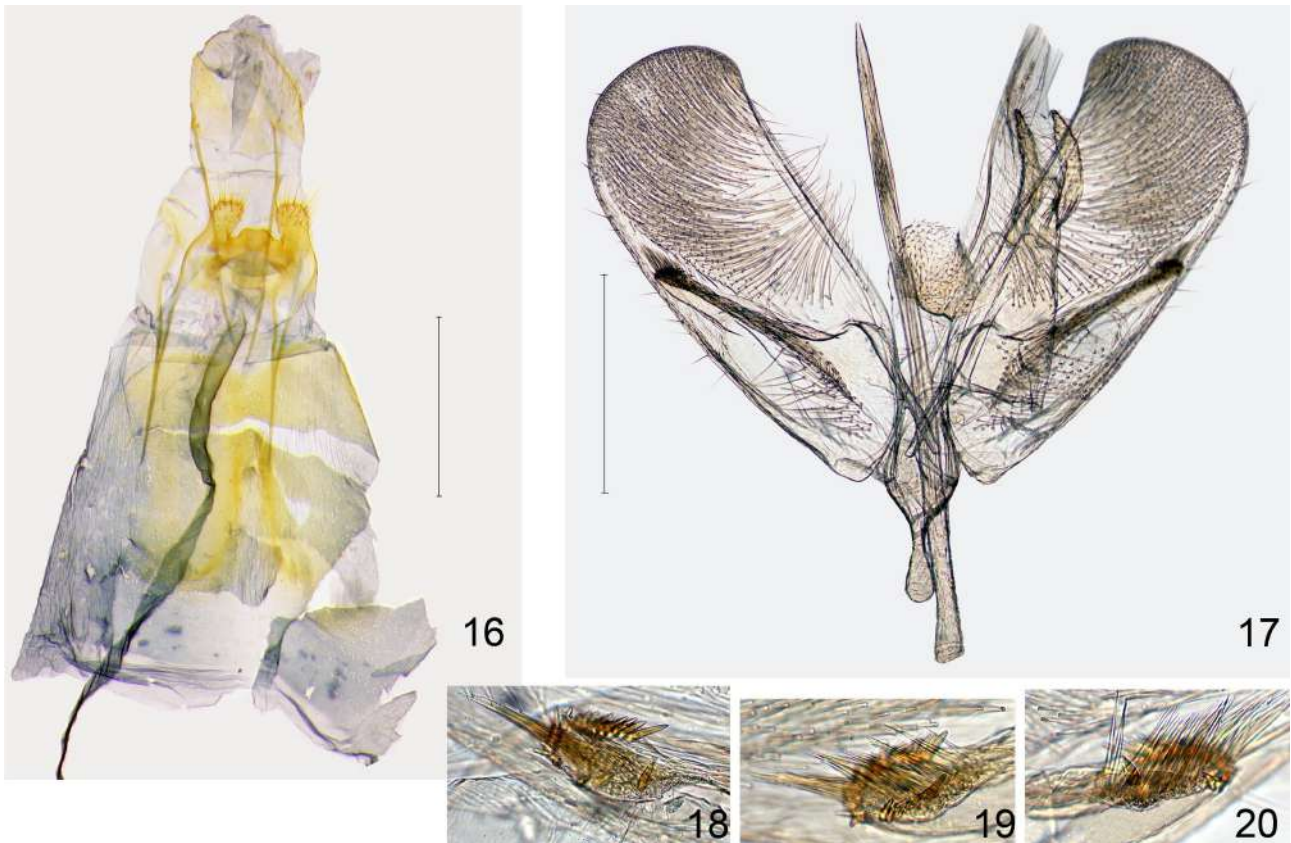


FIGURE 15. Neighbor-Joining tree of *Xyrosaris* species on the base of sequences of the fragment of COI gene.

Clade 2 with a bootstrap support of 100 % is comprised of five samples (2 females and 3 males) reared from *Celastrus orbiculatus* Thunb., which belong to the recently described species *X. insularis* from the Far East of Russia and one sample from South Korea. Their conspecificity was previously discussed based on the uniting into a single clade and a genetic distance of 0 % between their mtCOI gene sequences (Ponomarenko & Beljaev 2023). The erroneous identification of the South Korean specimen posted to the Genbank (NCBI) and BOLD databases as *X. lichneuta* was recently confirmed by Korean specialists (Na & Bae 2024). The genetic distance between *X. melanopsamma* and *X. insularis* based on the target fragment of COI gene is only 1.5 %, despite the significant differences in the male and female genitalia.

Thus, the species *X. lichneuta* is noticeably different from *X. melanopsamma* in the male genitalia, namely the length of harpa, the size of thorns on its apical part and the shape of the valva. Their diagnostic characters are indicated in Table 2. Both species have an aedeagus with numerous, small, needle-like cornuti arranged in two bunches and a granular texture in the apical part (Figs 10, 14).

Since the recently described species *X. vaginata* Bae et Na, 2024 from South Korea has male genitalia that match exactly that of *X. melanopsamma* Meyrick, 1931, the former species name should be considered a junior subjective synonym of the latter: *X. melanopsamma* Meyrick, 1931 = *X. vaginata* Bae et Na, 2024, **syn. n.**



**FIGURES 16–20.** *Xyrosaris melanopsamma*, genitalia and apical part of harpa. 16, female genitalia, voucher 771, gen. slide 238; 17, male genitalia, voucher 776, gen. slide 245; 18–20: apical part of harpa: 18, left harpa, gen. slide 241; 19, 20, left and right harpa, respectively, gen. slide 244. Scale bar 0.5 mm except for the enlarged figures 18–20.

### Annotated checklist of the *Xyrosaris* species from East Asia

(the order of taxa corresponds to the historical sequence of their description)

#### *Xyrosaris lichneuta* Meyrick, 1918

*Xyrosaris lichneuta* Meyrick, 1918, *Exotic Microlepidoptera*, 2: 188. Type locality: Khasis, Assam, NE India.

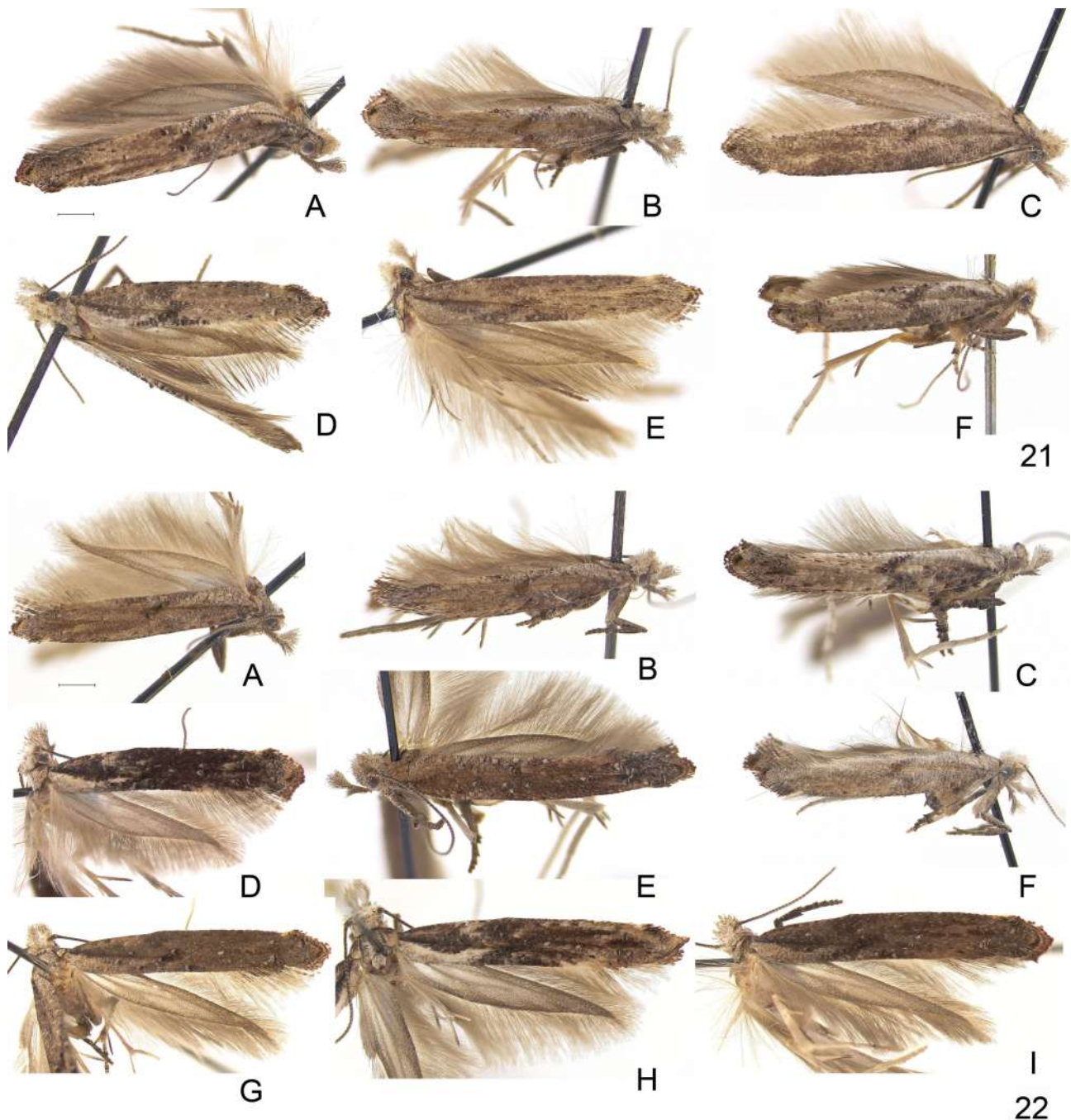
*Xyrosaris lichneuta*: Clarke 1965: 404, pl. 201, figs 2, 2a–c; Moriuti 1977: 224, Fig. 336; Sinev 2008: 46; Yamauchi & Hirowatari 2013: 162, pl. 3–17, figs 2, 3; Lewis & Sohn 2015: 119; Ponomarenko 2016: 61; Ponomarenko & Sinev 2019: 44; Komatsu 2020: 64, figs 7–9; Yagi 2022: 47, figs 1, 2; Na & Bae 2024: 420, figs 3A.

*Xyrosaris vaginata*: Na & Bae 2024: 424, fig 4C (female genitalia), misidentification.

**Material examined. Russia, Primorskii Krai:** 3♂, Olginskii distr., upper course of Milogradovka riv., 31.5 km NEE Lazo settl., 24.05.2012, gen. slide 236 MP (leg. M. Ponomarenko); 1♀, Ussurijsk district, 3 km SE Krasnyi Jar vill., 14.07.2000, gen. slide 232 MP (leg. M. Ponomarenko); 1♀, Ussurijskii distr., 2.5 km S of Kamenushka, Kaimanovka vill., 43°36'14" N 132°13'09" E, 25.08.2001, gen. slide 231 MP (leg. M. Ponomarenko); 1♂, Ussurijskii distr., Gornotajezhnoe vill., 22.09.1995 (leg. M. Ponomarenko); 2♂, Chernigovskii distr., 10 km SE Chernigovka, Gribnoe vill. vicinity, 44°15'30" N 132°40'41" E, 25, 27.08.1998 (leg. M. Ponomarenko); **Sakhalin:** 1♂, Nevelskii distr., Yasnomorskoe vill. 18.08.2019, gen. slide 179 MP (leg. M. Ponomarenko), all in FSCB.

**Primorskii Krai:** 4♂, Pogranichyi distr., Barabash-Levada vill., 16.07–8.08.1989 (leg. S. Sinev); 2♂, Oktyabr'skii distr., 15 km SW of Pokrovka, Orlikha, 1–3.08.2005 (leg. S. Sinev); 1♂, Nadezhdinskii distr., De-Friz Peninsula, 8.08.1961 (leg. M. Omelko); 1♀, Khasanskii distr., 15 km SW of Slavyanka, Ryazanovka vill., 7.08.1983 (leg. S. Seksyayeva); **Khabarovskii Krai:** Khabarovsk env., Bol'shekhekhtsyrskii Nature Reserve: 1♂, Bychikha vill., 48°18' N 134°49' E, 13.05.2006; 1♂, Sosnenskii kordon, 48°14' N 134°47' E, 7–8.06.2011 (leg. V. Dubatolov); 1♀, Chirki kordon, 48°12' N 134°41' E, 25–26.08.2011 (leg. A. Dolgikh); 1♀, Chirki kordon, 48°11' N 134°41' E,

17–18.09.2012 (leg. V. Dubatolov); **Sakhalin**: 8♂, 4♀, Kholmskii distr., Kholmsk settl. vic., 47°028' N 142°037' E, 7–10.10.2018, 31.08.2019 (leg. O. Titova); **Kuril Islands**: 1♂, Kunashir Isl., 30 km SW Yuzhno-Kuril'sk settl., Alekhino kordon, 14–16.08.1992 (leg. V. Zolotuhin), all in ZIN.



**FIGURES 21, 22.** *Xyrosaris* spp., adults, variability of colouration and wing pattern. 21 A–F, *Xyrosaris lichneuta*; 22 A–I, *X. melanopsamma*. Scale bar 1 mm.

**Distribution.** Russian Far East (Khabarovskii Krai, Primorskii Krai, Sakhalin and Kunashir Islands); South Korea; Northern, Eastern and Central China (Hebei, Jiangsu, Henan and Hubei); Japan (Hokkaido, Honshu, Shikoku, Kyushu); North–East India (Assam).

**Host plants.** Confirmed data are absent.

**Remarks.** Until recently, only two species, *X. lirinopa* and *X. lichneuta*, had been recorded in East Asia, but all specimens collected in the area were associated with the last species only. Despite the fact that all collected specimens possess high variability in colouration and wing pattern, the identification of them was made mainly by



appearance. Thus, the sample from South Korea identified as *X. lichneuta* and posted to the Genbank (NCBI) was found to be conspecific with *X. insularis* based on genetic data (Ponomarenko & Beljaev 2023). Moreover, both mentioned species are well differing by male and female genitalia. Therefore, data on the distribution of northeast Indian species *X. lichneuta* in Eastern Asia as well as its host plants require verification and clarification.

### *Xyrosaris lirinopa* Meyrick, 1922

*Xyrosaris lirinopa* Meyrick, 1922, *Exotic Microlepidoptera*, 2: 551. Type locality: Shanghai, China.

**Distribution.** Eastern China (Shanghai).

**Host plants.** Unknown.

### *Xyrosaris melanopsamma* Meyrick, 1931, stat. rev.

*Xyrosaris melanopsamma* Meyrick, 1931, *Exotic Microlepidoptera*, 4: 171. Type locality: Ikeno [Gifu Prefecture], Honshu, Japan.

*Xyrosaris melanopsamma*: Clarke 1965: 404, pl. 201, figs 4, 4a–c; Moriuti 1969: 132, 212, fig. 67, pl. 61, fig. 244; 1977: 224, fig. 440; Issiki 1970: 23, pl. 3, fig. 79; Ponomarenko 2016: 61.

*Zelleria melanopsamma*: Friese 1962: 320, figs 15, 16.

*Xyrosaris* sp. 1: Komatsu 2020: 64, figs 1–3; Yagi 2022: 47, figs 3, 4.

*Xyrosaris vaginata* Bae et Na, *In*: Na & Bae 2024: 423, **syn. n.**

*Xyrosaris vaginata*: Na & Bae 2024: 422, Figs 3C, G (male genitalia), misidentification.

*Xyrosaris lichneuta*: Na & Bae 2024: 424, Fig. 4A (female genitalia), misidentification.

**Material examined. Russia, Primorskii Krai:** 4♂, 1♀, Ussurijskii distr., 20 km SE Ussurijsk, Gornotajezhnoe vill., 23.08.1994; 20, 23.09.1995, gen. slide 243 (f) MP (leg. M. Ponomarenko); 1♀, 20 km SW Krounovka, Medveditsa riv., 02.09.1998 (leg. M. Ponomarenko); 3♂, 3♀, Chernigovskii distr., 10 km SE Chernigovka, Gribnoe vill. vicinity, 44°15'30" N 132°40'41" E, 25.08.1998, gen. slides 175 (m), 176, 234 (♀♀) MP (leg. M. Ponomarenko); 1♀, 30.5 km NW Arsen'ev, Siniy ridge, 600 m a.s.l., 44°21'45"N 133°00'34"E, 02.09.1999 (leg. M. Ponomarenko); 1♂, Shkotovskii distr., 6 km W Novaya Moskva, 43°21'19"N 132°39'57"E, 20.04.2002 (leg. M. Ponomarenko); 2♀, Olginskii distr., upper course of Milogradovka riv., 31.5 km NEE Lazo settl., 24.05.2012 (leg. M. Ponomarenko); 9♀, Rikord Island, 15.06.2012 (leg. M. Ponomarenko, Yu. Zinchenko); 3♂, 3♀, Khasanskii district, Gamov Peninsula, Vityaz' Bay, 8–10.10.2021, gen. slides 233 (♀), 241 (♂) MP (leg. V. Dubatolov); 43♂, 55♀, Rikord Island, reared from *Euonymus maximoviczianus*, 25–26.07.2022 (E. Beljaev leg.); 11.08.–06.09.2022, vouchers Nos./ DNA Nos 770 (♂) / gen. slide 247 MP, 771 (♀) / gen. slide 238 MP, 773 (♂), 775 (♂) / gen. slide 240 MP, 776 (♂) / gen. slide 245 MP, 787 (♂) / gen. slide 246 MP, gen. slides 183, 184 (♂♂), 185, 244 (♀♀) MP (leg. M. Ponomarenko and E. Beljaev); **Sakhalin:** 5♂, 9♀, Nevelskii distr., Yasnorskoe vill. 18–20.08.2020, gen. slides 177, 235, 242 (♂♂), 178, 237 (♀♀) MP (leg. M. Ponomarenko), all in FSCB.

**Primorskii Krai:** 3♂, Ussurijskii distr., 20 km SE Ussurijsk, Gornotajezhnoe vill., 22–30.08.1978 (leg. V. Kuznetsov); 5♂, 6♀, Ussurijskii distr., 20 km SE Ussurijsk, Gornotajezhnoe vill., 43°42' N 132°09'E, 135 m, 8.07.1982, 28.04.1983, 3.09.1983, 11.07.1988, 11–15.07.1996, 11.07.2018 (leg. S. Sinev); 1♀, Spasskii distr., 18 km SE Spassk-Dal'nii settl., Kalinovka recreation center, 44°28' N 132°58'E, 170 m, 6.07.2018 (leg. S. Sinev); 1♀, Anuchinskii distr., Vinogradovka vill., 19.05.1929 (leg. A. Djakonov and N. Filipjev); **Khabarovskii Krai:** Khabarovsk env., Bol'shekhkhtyrskii Nature Reserve: 1♂, Bychikha vill., 48°18' N 134°49' E, 29.04.2006 (leg. V. Dubatolov); 1♂, 1♀, Sosnenskii kordon, 48°14' N 134°47' E, 100 m, 6–7.06.2006, 30.09–1.10.2011 (leg. V. Dubatolov); 1♂, Chirki kordon, 48°11' N 134°41' E, 29.05.2006 (leg. V. Dubatolov), all in ZIN.

**Distribution.** Russian Far East (Khabarovskii Krai, Primorskii Krai and Sakhalin), South Korea, Japan (Hokkaido, Honshu, Kyushu).

**Host plant.** *Euonymus oxyphyllus* Miq., *E. sieboldianus* Blume, *E. alata* (Thunb.) Sieb., ?*Celastrus orbiculatus* Thunb. (after Issiki 1957, 1970; Friese, 1962; Moriuti 1969, 1977); *Euonymus maximoviczianus* Prokh. (**first record**) (Celastraceae).

**Bionomics.** Larvae of different instars were collected on *E. maximoviczianus* Prokh. two times in July, 6 and August, 1 on Rikord Island (south of the Russian Far East). They were feeding on the upper and lower surfaces of

leaves, skeletonizing them in younger instars and gnawing holes in older instars. The head of larvae is wider than the thorax, with a distinct epicranial suture dividing it into two slightly inflated halves. Almost throughout the entire period of development, the larvae had a light brownish grey head and a dark grey prothoracic shield, whereas the colour of their body was variable (Figs 23 A–F). In younger instars they were pale green and greyish green with two longitudinal bands on the dorsum—dark grey on thoracic segments and greyish green on abdominal ones. In older instars they became predominantly greyish brown with two bands on the dorsum—dark grey on thoracic segments and dark brown on abdominal ones. In the laboratory, larvae collected in July soon began to pupate starting on 10.07.2022. Pupation took place in a loose silken cocoon (Fig. 24). The duration of pupal development in the laboratory was 7–10 days. Imagoes emerged starting on 18.07.2022. The larvae collected in August began to pupate from 4.08.2022 onwards. Imagoes emerged between 16.08 to 6.09.2022.



**FIGURES 23, 24.** Preimaginal stages of *Xyrosaris melanopsamma*. 23 A–F, larvae of different instars on leaf of *Euonymus maximoviczianus* Prokh.; 24, cocoon with pupa.

**Remarks.** The species was described based on two specimens collected in two different localities. According to ICZN, Art. 73.2.3. after the designation of lectotype by Clarke (1965) the type locality of this species is the place of its origin, what is fixed by Art 76.2 (ICZN, 1999), as it is indicated above. The other specimen, paralectotype, was collected on Mt. Iwawakisan, Kii [Wakayama Prefecture], and currently lacks its abdomen.

The recently described species *X. vaginata* Bae et Na, 2024 from South Korea turned out conspecific with *X. melanopsamma* Meyrick, 1931 in the male genitalia, and should be considered as a junior subjective synonym of the latter. As to the female of *X. vaginata*, non-conspecific males and females were associated in the original species description and the genitalia of *X. lichneuta* were illustrated (Na & Bae 2024: 424, Fig. 4A).

Issiki (1957), Friese (1962, after Issiki 1957) and Moriuti (1969) indicated *Celastrus orbiculatus* Thunb. among host plants for *X. melanopsamma*. Later, when *X. melanopsamma* was treated as a junior synonym of *X. lichneuta*, all recorded host plants of the first species were ascribed to the second one in subsequent publications. Moreover, *Celastrus orbiculatus* was often listed first, as the main host plant for *X. lichneuta* (Moriuti 1977; Gershenson & Ulenberg 1998; Lewis & Sohn 2015; Ponomarenko 2016; Na & Bae 2024). According to Moriuti (1977), of the 132 specimens reared from larvae, only 5 specimens were fed on *Celastrus orbiculatus* and the rest 127 specimens fed on different species of *Euonymus* spp. Since there are two independent species (*X. lichneuta* and *X. melanopsamma*), that do not reliably differ in general appearance, there is a high probability that the specimens reared on *Celastrus orbiculatus* were not conspecific with those reared from *Euonymus* spp. The morphology of their genitalia are unknown and there is currently no data confirming the feeding of *X. melanopsamma* on *Celastrus orbiculatus*.

### ***Xyrosaris insularis* Ponomarenko et Beljaev, 2023**

*Xyrosaris insularis* Ponomarenko et Beljaev, 2023, *Zootaxa*, 5306 (1): 135–143. Type locality: Russkii Island, Primorskii Krai, Russia.

*Xyrosaris insularis*: Na & Bae 2024: 421, Figs 2D, E; 3B, F, 4B.

*Xyrosaris* sp. 2: Komatsu 2020: 64, figs 4–6; Yagi 2022: 47, figs 5, 6.

**Material examined.** Type material. **Russia, Primorskii Krai:** ♂, holotype, 1 km SW of Vladivostok, Russkii Isl., Rogozin cape, 42°59'13" N 131°44'47" E, reared from *Celastrus orbiculatus*, 18.07.2022, gen. slide 181 MP (leg. E. Beljaev); paratypes: 1 ♀, same locality, date, host plant and collector as in holotype; 32 ♂, 40 ♀, same locality and host plant, 22.08–09.09.2022, gen. slides 182 (f), 190 (♂) MP (leg. M. Ponomarenko and E. Beljaev), voucher Nos 777 (♀), 779 (♀), 783 (♂), 784 (♂), 788 (♂); 29 ♂, 17 ♀, Khasanskii distr., 59 km SW Slavyanka, Furugelm Isl., 42°27'55" N 130°55'10" E, 20–22.09.2012, gen. slides 186 (♂) YuZ, 187, 189, 191 (♂♂), 188, 192, 193 (♀♀) MP (leg. M. Ponomarenko), all in FSCB.

**Primorskii Krai:** 2 ♂, 2 ♀, paratypes, 1 km SW of Vladivostok, Russkii Isl., Rogozin cape, 42°59'13" N 131°44'47" E, 26.08, 29.08.2022 (leg. M. Ponomarenko and E. Beljaev), all in ZIN.

**Distribution.** Russian Far East (Primorskii Krai), South Korea, Japan (Hokkaido, Honshu, Kyushu).

**Host plants.** *Celastrus orbiculatus* Thunb., ?*Euonymus alatus* f. *ciliatodentatus* Hiyama (Celastraceae).

**Remarks.** The narrow trophic specialization was noted for larvae of this species. When the larvae were reared in laboratory conditions, they fed on *Celastrus orbiculatus* Thunb. only, refusing to eat even a closely related species *C. flagellaris* Rupr., belonging to the same botanic genus.

Unfortunately, in a recently published work (Na & Bae 2024), the specimen reared from *Euonymus alatus* f. *ciliatodentatus* Hiyama is not indicated in the examined material. Also, it is unclear whether its genitalia are illustrated. Moreover, the authors gave an erroneous combination of plant species with the generic name “*E[uonymus] orbiculatus*”, which causes confusion in the host plants of this species and wrongly associate the main host plant *Celastrus orbiculatus*, on which 68 specimens were collected and reared, with the genus *Euonymus*.

### ***Xyrosaris triacantha* Bae et Na, 2024**

*Xyrosaris triacantha* Bae et Na, In: Na & Bae, 2024, *Zootaxa*, 5397 (3): 418–426. Type locality: Mt. Baeka-san, Hwasun-gun, Jeollanamdo Province, South Korea.

**Distribution.** South Korea.

**Host plants.** Unknown.

### **Discussion**

The genus *Xyrosaris* in East Asia includes five species, of which only *X. lichneuta* is distributed outside of this region. None of the known species have clear diagnostic external characters, so identification is only possible by dissecting the genitalia. Published East Asian records of *X. lichneuta*, which was described from North–Eastern

India, require verification and confirmation, especially if the determination of specimens was made based on external characters.

Larval rearing and documenting associated host plants in this study revealed novel information about the species in this group. The studied species have polycyclic development. On the host plant, along with larvae of middle and old instars, the larvae of younger instars are found. First instar larvae continue to emerge in laboratory conditions on the leaves collected in nature. The development of larvae proceeds rapidly and ends within two weeks. After pupation, the imaginal stage appears in 7–10 days. Adults are not very active. They mate and lay eggs without flying away from the host plant. The narrow trophic specialization of the larvae was noted. Thus, larvae collected on *Celastrus orbiculatus* refused to feed on plant of the same botanical genus, *C. flagellaris*. Therefore, the previous records, indicating a wide range of food plants from different botanical genera for *Xyrosaris* spp. requires verification and confirmation.

Molecular genetic analysis showed that species of this genus have a lower threshold for species delimitation based on the barcoding fragment of the COI gene than that is accepted for other lepidopteran groups. Thus, the genetic distance between *X. melanopsamma* and *X. insularis* based on the COI gene fragment is 1.5 %, while the species differ well in genital morphology. This is not unique, since in the related genus *Yponomeuta* Latreille the genetic distances in the species group *Y. padella* Linnaeus based on the DNA barcoding fragment of the COI gene can be as low as 0 % (Huemer & Herbert 2016).

Results of our study suggest an integrative taxonomic approach is necessary for delimiting *Xyrosaris* spp.: the molecular analysis based on several target fragments of mitochondrial genes combined with the study of genital morphology. However, genetic data on other fragments of mitochondrial genes are poorly represented in International GenBanks, as well as collected specimens from East Asia. Obviously, the study of the taxonomic diversity of the genus *Xyrosaris* is still far from complete, and further research will probably increase the number of known species inhabiting in this area.

## Acknowledgements

The authors are grateful to Drs Evgeny A. Beljaev (Federal Scientific Center of the East Asia Terrestrial Biodiversity, Vladivostok, Russia) for organizing an expedition and helping to collect larvae of the *Xyrosaris* spp., Vladimir V. Dubatolov (Institute of Systematics and Ecology of Animals of Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia) for material collected on Gamov Peninsula (Far East of Russia), Y. Sakamaki (Kagoshima University, Kagoshima, Japan) for his help with copies of publications on Japanese species of the genus *Xyrosaris*, anonymous reviewers for their recommendations and Mark A. Metz (Smithsonian Institution National Museum of Natural History, Washington, USA) for correcting the linguistics of the text.

The research was carried out within the state assignment of Ministry of Science and Higher Education of the Russian Federation (themes No. 124012400285-7 and No. 122031100272-3).

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