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RESEARCH ARTICLE

New records of Macroheterocera (Insecta, Lepidoptera) from the southernmost part of the Khabarovsk Krai (Russian Far East)

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Abstract

Fourteen species of Lepidoptera from the families Limacodidae, Uraniidae, Notodontidae, Erebidae, Nolidae, and Noctuidae are reported from the Bikin District (Khabarovsk Krai, Russia). Among these, *Rhamnosa angulata* Fixsen, 1887 (Limacodidae), *Dysaethria illotata* (Christoph, 1880) (Uraniidae), *Hypena narratalis* Walker, 1858, and *Hypersypnoides astrigera* (Butler, 1885) (Erebidae) represent first records for Khabarovsk Krai. New occurrences of *Miltochrista pallida* (Bremer, 1864) and *Stigmatophora flava* (Bremer & Gray, 1852) (Erebidae) confirm their presence in the region. Additionally, rare East Asian species – *Mimopydna pallida* (Butler, 1877) (Notodontidae), *Stigmatophora leacrita* (Swinhoe, 1894) (Erebidae), *Gelastocera eminentissima* Bryk, 1948 (Nolidae), *Imosca coreana* (Matsumura, 1926), *Orthosia satoi* Sugi, 1960, *O. ryrholmi* G. Ronkay, L. Ronkay, Gyulai & Hacker, 2010, and *Perigrapha extincta* Kononenko, 1989 (Noctuidae) – were documented, significantly expanding knowledge of their Far Eastern distributions. The boreal species *Brachionycha sajana* Draudt, 1934 (Noctuidae) was recorded at its southernmost known range limit.

Keywords

Lepidoptera, fauna, new records, biodiversity, climate change, Bikin District, Khabarovsk Krai, Amur Basin, Russian Far East

Introduction

The Bikin District, situated in southern Khabarovsk Krai, borders Primorsky Krai to the south/east and China (along the Ussuri River) to the west (Fig. 1). Recent lepidopterological surveys in this area have revealed numerous East Asian Macroheterocera species previously known in Russia only from Primorsky Krai, as well as taxa with sporadic records in the Amur Region (Koshkin 2021, 2022, 2024; Koshkin et al. 2021). Several species – including *Rhodinia fugax* (Butler, 1877) (Saturniidae), *Phalerodonta bombycina* (Oberthür, 1881) (Notodontidae), and *Numenes disparilis* Staudinger, 1887 (Erebidae) – now form stable populations in Bikin District but remain exceptionally rare near Khabarovsk (Dubatolov 2023).

Notably, some Lepidoptera, such as *Pryeria sinica* Moore, 1877 (Zygaenidae), *Rhodinia jankowskii* (Oberthür, 1880) (Saturniidae), *Ambulyx tobii* (Inoue, 1976) (Sphingidae), *Stauropus basalis* Moore, 1877, *Phalera flavescens* (Bremer et Gray, 1853), *Ph. assimilis* (Bremer et Gray, 1853), *Odontosia patricia* Stichel, 1918 (Notodontidae), *Zanclognatha lilacina* (Butler, 1879), *Enispa albosignata* (Staudinger, 1892), *Catocala eminens* Staudinger, 1892 (Erebidae), *Acrodontis kotshubeji* Sheljuzhko, 1944 (Geometridae), *Sephisa princeps* (Fixsen, 1887) (Nymphalidae), exhibit no confirmed occurrences north of the vicinities of the Bikin (Koshkin 2021, 2022). Approximately half of these taxa are abundant in the upper Shivki River watershed, with annual records.

A striking example of range expansion linked to climate change is the tropical nolid moth *Siglophora sanguinolenta* (Moore, 1888), first recorded in Russia (Bikin District) in 2020 (Koshkin 2021). By 2024, it had naturalized across the southern Russian Far East, including Khabarovsk and Primorsky Krai (Dubatolov 2021; Koshkin and Golovizin 2022).

This study reports 14 species newly recorded in Khabarovsk Krai or previously known from single specimens. For taxa like *Rhamnosa angulata*, *Dysaethria illotata* and *Hypersypnoides astrigera*, their recent appearance (2023–2024) after decades of surveys suggests northward shifts driven by rising temperatures (Koshkin et al. 2021).

Materials and methods

Study area: Specimens were collected near the Shivki Research Station (Institute of Water and Ecology Problems FEB RAS), 8 km SE of Boitsovo Village, Bikin District (46°55′N, 134°23′E; 165–205 m asl), in mixed coniferous-broadleaf forests (Figs 2–3).

Collection methods:

- Night sampling: UV LepiLED® and 250W mercury-vapor lamps (DRL).
- Diurnal collection: *Dysaethria illotata* was netted aerially.

Specimen processing:

- Genitalia dissections: Abdomens cleared in 10% KOH (5–7 min).
- Imaging: Habitus photos taken with a Sony SLT-A65 (50 mm macro lens); genitalia photographed using a Zeiss Stemi 2000-C stereomicroscope with AxioCam ERc5s.

Collector: All specimens were collected by Evgeny Koshkin.

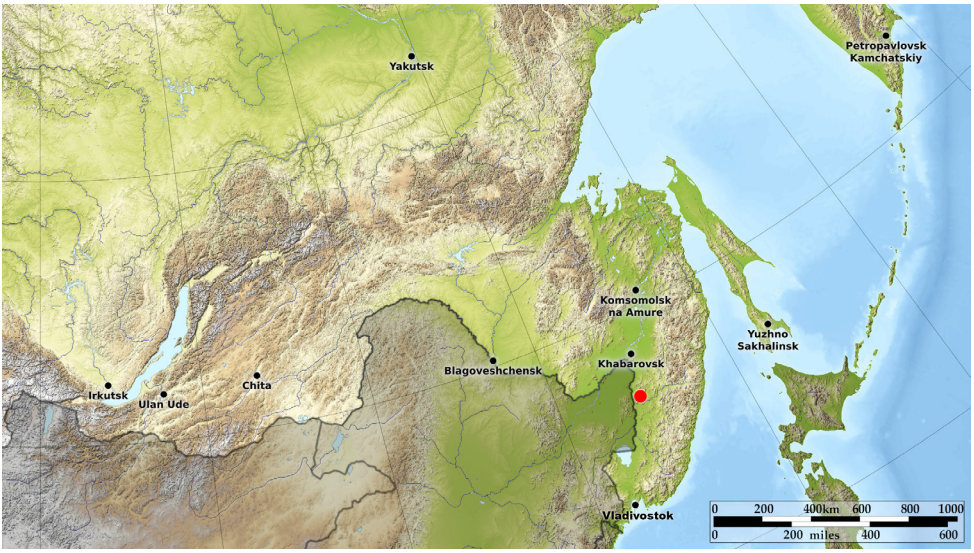

Figure 1. Location of the study area (upper reaches of the Shivki River, Bikin District, Khabarovsk Krai) (red circle).

Figure 2. Coniferous broad-leaved mixed forest near the Shivki Research Station, where Lepidoptera was collected (August 5, 2020).

Results

Species list

Family Limacodidae Duponchel, 1845

***Rhamnosa angulata* Fixsen, 1887**
Figs 4A, 6A

Material examined. Shivki: 4 ♂, 21–25.VII.2023; 4 ♂, 2–4.VIII.2024.

Remarks. This species is widespread in Eastern and Central China and Korea. In Russia, it was known from a single find of a male in 2014 in Kamen-Rybolov on Lake Khanka in Primorsky Krai (Solovyev and Dubatolov 2015). The discovery of a series of specimens over two years in the Bikin District of Khabarovsk Krai may indicate an expansion of the species' range to the north, as it had not previously been recorded there. The external appearance and genitalia structure of the collected moths do not differ from specimens from other parts of the range.

Family Uraniidae Leach, 1815

Subfamily Epipleminae Hampson, 1892

***Dysaethria illotata* (Christoph, 1880)**
Figs 4B, C, D, 6B

Material examined. Shivki: 20 ♂, 11 ♀, 26–30.V.2024; 2 ♂, 3 ♀, 3–6.VIII.2024.

Remarks. A very rare species, previously known in Russia from single specimens from the Jewish Autonomous Oblast (Pompeevka – the type locality of the species, and the Bastak Nature Reserve), the southern part of the Primorsky Krai, South Sakhalin and Kunashir (Beljaev and Barma 2012; Zolotuhin and Nedoshivina 2021; Beljaev and Titova 2023). Outside the Russian Far East, it is found in Japan (Hokkaido, Honshu and Shikoku) (Zolotuhin and Nedoshivina 2021; Beljaev and Titova 2023). The species has never been recorded in the Khabarovsk Krai. Its discovery in 2024 in large numbers in the upper reaches of the Shivki River in the Bikin District is quite unexpected. In previous years it was not recorded there despite special searches. The moths were found in thickets of *Viburnum burejaeticum* (Adoxaceae), to which the species is probably trophically related in the larval stage. Adults sit on *Viburnum* leaves during the day. Their active flight occurs in the early evening (about 5 – 7 pm) in intense sunlight. At night, the moths are almost not attracted to light sources. It is interesting to note that *Viburnum burejaeticum* is widespread in the floodplains of the Shivki River and its tributaries, in some places forming large thickets. In the Primorsky Krai moths have also been collected near the bushes of this species of *Viburnum* (Beljaev and Titova 2023). It is reasonable to assume that

Dysaethria illotata in the Bikin District of the Khabarovsk Krai develops in two generations annually, taking into account the time of collection of moths (late May and early August), as well as their condition.

Figure 3. Automatic light trap using LepiLED® UV lamp in coniferous broad-leaved mixed forest near the Shivki Research Station (May 7, 2021).

Family Notodontidae Stephens, 1829

***Mimopydna pallida* (Butler, 1877)**
Figs 4O, P

Material examined. Shivki: 4 ♂, 27.VI–1.VII.2022.

Remarks. A very rare species in the mainland of the Russian Far East, from where it was reliably known only from three specimens from the south of the Khabarovsk Krai (near Khabarovsk and Lake Gassi) (Dubatolov et al. 2013; Dubatolov 2020). The map in Schintlmeister's book (2008) shows a locality in the southwest of the Jewish Autonomous Oblast (probably Radde), but nothing is said about it in the text. It also states that in Russia the species is occurs only on Sakhalin Island and the southern Kuril Islands. Outside of Russia it is widespread in Japan and Korea. The occurence in the Bikin District of the Khabarovsk Krai indicates a wider distribution of the species in the Amur basin. It is very likely that the species will be discovered in the Primorsky Krai, as the locality in the upper reaches of the Shivki River is close to the border of this region. Larval host plants are various species of Poaceae (Schintlmeister 2008). The dark pattern on the upper side of the wings is variable (Figs 4O, P).

Family Erebidae Leach, 1815

Subfamily Arctiinae Leach, 1815

Tribe Lithosiini Billberg, 1820

***Miltochrista pallida* (Bremer, 1864)**
Fig. 4E

Material examined. Shivki: 1 ♀, 24–25.VII.2023; 1 ♀, 5.VIII.2024.

Remarks. In Russia, the species is distributed in Primorsky Krai. There is also a reference to its occurrence in the Bikin District of Khabarovsk Krai, but without any details (Dubatolov 2014; Dubatolov 2019). Finds from the Shivki River basin confirm the distribution of this species in Khabarovsk Krai. Outside Russia it is found in China and Korea (Dubatolov 2014).

***Stigmatophora leacrit*a (Swinhoe, 1894)**
Figs 4F, G, H, 6D

Material examined. Shivki: 5 ♂, 1 ♀, 24–26.VII.2021; 2 ♂, 1 ♀, 25–26.VII.2023.

Remarks. The species is found in the south of the Khabarovsk Krai (near Khabarovsk), in the Primorsky Krai, and outside Russia in China, Korea, and Japan (Tshistjakov and Dubatolov 1990; Dubatolov 2014, 2019). A new locality from the Bikin District indicates its wider distribution in the southern part of the Khabarovsk Krai. In the male genitalia, the distal process of the sacculus does not reach the apex of the valva. The vesica has a well-defined sack-shaped basal diverticulum densely covered with small spinules. The cornuti are compactly arranged in a semicircular row at the apex of the vesica. There is also a large area densely covered with small spinules (Fig. 6D).

***Stigmatophora flava* (Bremer et Grey, 1852)**
Figs 4I, J, 6C

Material examined. Shivki: 1 ♂, 21–22.VII.2023.

Remarks. The species is widely distributed in southern Siberia and the Far East, including the Amur Oblast, the Jewish Autonomous Oblast, and the Primorsky Krai (Tshistjakov and Dubatolov 1990; Dubatolov 2014, 2019). It is claimed that it has not been found in the Khabarovsk Krai (Dubatolov 2014). However, there is an earlier reference to its occurrence in Abrek Bay on Maly Shantar Island (Tshistjakov and Dubatolov 1990). A finding from the Bikin District confirms the distribution of this species in the Khabarovsk Krai. In the upper reaches of the Shivki River, the species occurs together with the closely related *Stigmatophora leacrita* (Swinhoe, 1894), from which it differs by the presence of two dots in the outer margin on the underside of the forewing and blackening in the central area of the underside of the

forewing (Tshistjakov and Dubatolov 1990; Dubatolov 2014). In contrast to *S. leacrita*, the valva in the male genitalia does not reach the distal process of the sacculus. Conical cornuti of various sizes cover irregularly a considerable part of the surface of the vesica. The basal diverticulum is almost not expressed (Fig. 6C).

Subfamily Hypeninae Herrich-Schäffer, [1851]

***Hypena narratalis* Walker, 1858**
Figs 4K, L

Material examined. Shivki: 1 ♂, 26.VIII.2017; 2 ♀, 16–17.IX.2017; 2 ♂, 23–27.IV.2021; 1 ♀, 7.V.2021; 1 ♂, 25–26.IX.2021; 1 ♂, 17–18.V.2022.

Remarks. The species is recorded for the first time in Khabarovsk Krai. Previously it was known in Russia from Primorsky Krai and Jewish Autonomous Oblast (Bastak Nature Reserve) (Kononenko 2010; Matov et al. 2019a; Koshkin 2023). It is also found in China, Japan, and Northern India (Kononenko 2010). It occurs together with the similar species *Hypena tristalis* Lederer, 1853, from which it differs in the pointed outer edge of the costal spot on the forewings, as well as the long subapical stroke. The imago hibernates.

Subfamily Erebinae Leach, 1815

Tribe Sypnini Holloway, 2005

***Hypersypnoides astrigera* (Butler, 1885)**
Fig. 4M

Material examined. Shivki: 1 ♂, 30–31.V.2024.

Remarks. A spring-early summer species, distributed mainly in China (including Taiwan), Korea and Japan. In Russia, it was previously recorded from the southern part of Primorsky Krai (where it reaches the latitude of Lake Khanka in the north) and from Kunashir Island (Kuril Islands) (Kononenko 2010; Matov et al. 2019a). The discovery in the south of Khabarovsk Krai significantly extends the range of the species to the north.

Family Nolidae Bruand, 1846

Subfamily Chloephorinae Stainton, 1859

***Gelastocera eminentissima* Bryk, 1948**
Fig. 4N

Material examined. Shivki: 1 ♀, 26.VII.2021; 1 ♀, 4.VIII.2024.

Remarks. A rare species, recorded in Khabarovsk Krai from several specimens in the Bolshekhekhtsirsky Nature Reserve south of Khabarovsk (Dubatolov et al. 2013; Dubatolov 2021). Also known from the southeast of the Amur Oblast (Barbarich 2014). Main distribution in Primorsky Krai and Korea (Kononenko 2010).

Family Noctuidae Latreille, 1809

Subfamily Bagisarinae Crumb, 1956

***Imosca coreana* (Matsumura, 1926)**
Fig. 5A

Material examined. Shivki: 1 ♀, 24–25.VII.2023; 1 ♀, 5.VIII.2024.

Remarks. A rare subboreal species, known in Russia from the Primorsky Krai and from single specimens from the southern part of the Khabarovsk Krai (near Khabarovsk) (Kononenko 2010; Dubatolov et al. 2013). The host plant of larvae is *Tilia* (Kononenko 2010).

Subfamily Amphipyrinae Guenée, 1838

***Brachionycha sajana* Draudt, 1934**
Fig. 5B

Material examined. Shivki: 1 ♂, 22.IV.2021.

Remarks. A rare boreal species known from a few localities in the Urals, southern Siberia, the Amur region, Northern China, and Japan (Honshu) (Kononenko 2016a, 2016b; Matov et al. 2019b). The new locality in the Shivki River basin is the southernmost in the continental part of the range. The moths fly in April – early May.

Subfamily Noctuinae Latreille, 1809

***Orthosia satoi* Sugi, 1960**
Figs 5C, D

Material examined. Shivki: 2 ♂, 3 ♀, 7.V.2021.

Remarks. A very rare early spring species, so far known in Russia from the south of Primorsky Krai and from two single occurrences from the vicinity of Khabarovsk and south-east of the Amur Oblast (Dubatolov and Dolgikh 2009; Kononenko 2016b; Matov et al. 2019b; Koshkin and Kuzmin 2023). It is also distributed in Japan (Honshu), Korea and China (Kononenko 2016b).

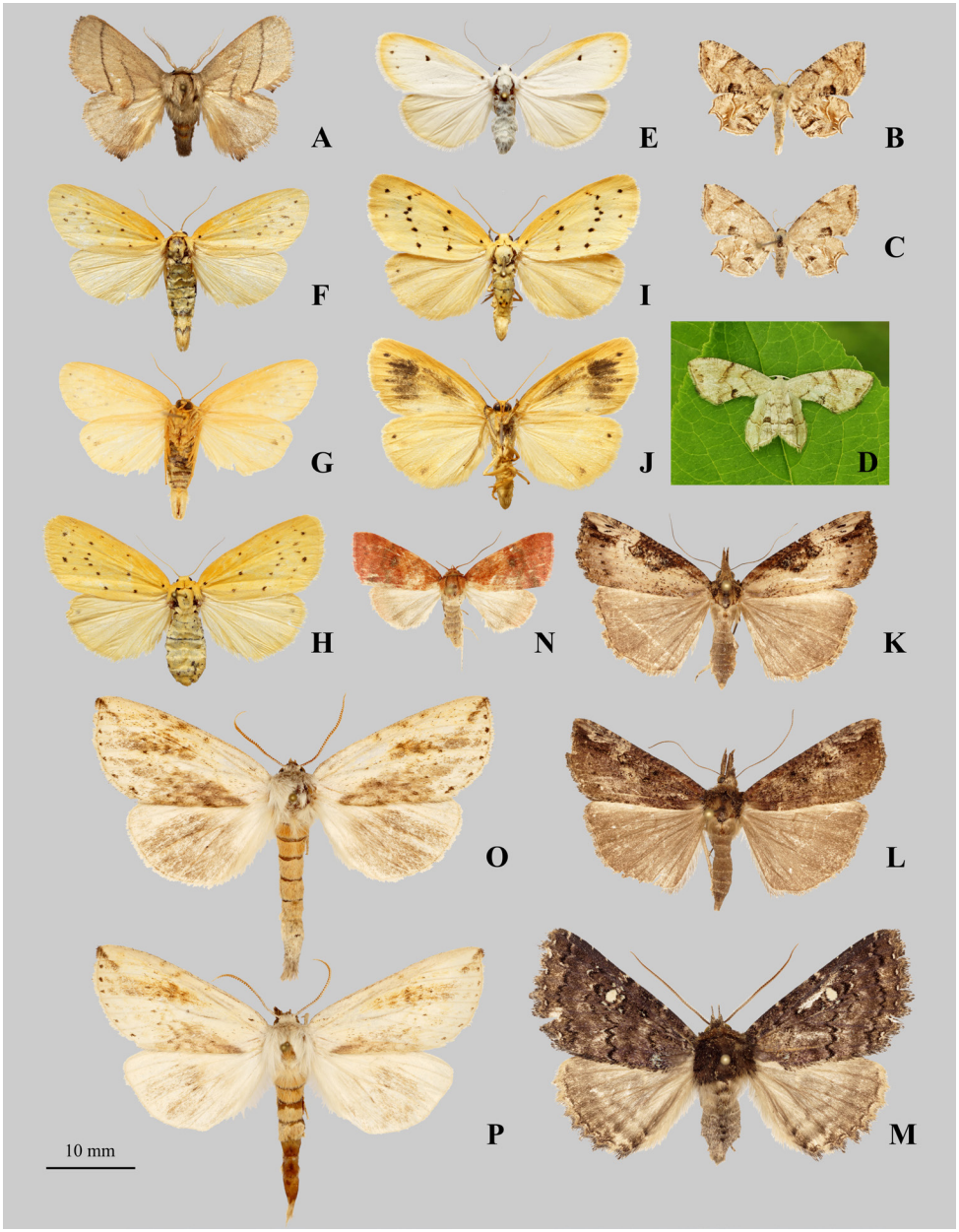

Figure 4. Some species of Lepidoptera from the Bikin District of the Khabarovsk Krai (upper reaches of the Shivki River), adults, habitus: **A** – *Rhamnosa angulata*, ♂, 21–22.VII.2023; **B** – *Dysaethria illotata*, ♂, 26–27.V.2024; **C** – *D. illotata*, ♀, 26–27.V.2024; **D** – *D. illotata*, photo in nature, 30.V.2024; **E** – *Miltochrista pallida*, ♀, 24–25.VII.2023; **F**, **G** – *Stigmatophora leacrita*, ♂, 25–26.VII.2023; **H** – *S. leacrita*, ♀, 25–26.VII.2023; **I**, **J** – *S. flava*, ♂, 21–22.VII.2023; **K** – *Hypena narratalis*, ♀, 27.IV.2021; **L** – *H. narratalis*, ♂, 27.IV.2021; **M** – *Hypersypnoides astrigera*, ♂, 30–31.V.2024; **N** – *Gelastocera eminentissima*, ♀, 4.VIII.2024; **O** – *Mimopydna pallida*, ♂, 27–28.VI.2022; **P** – *M. pallida*, ♂, 30.VI–1.VII.2022. **A–F**, **H**, **I**, **K–P** – upperside, **G**, **J** – underside.

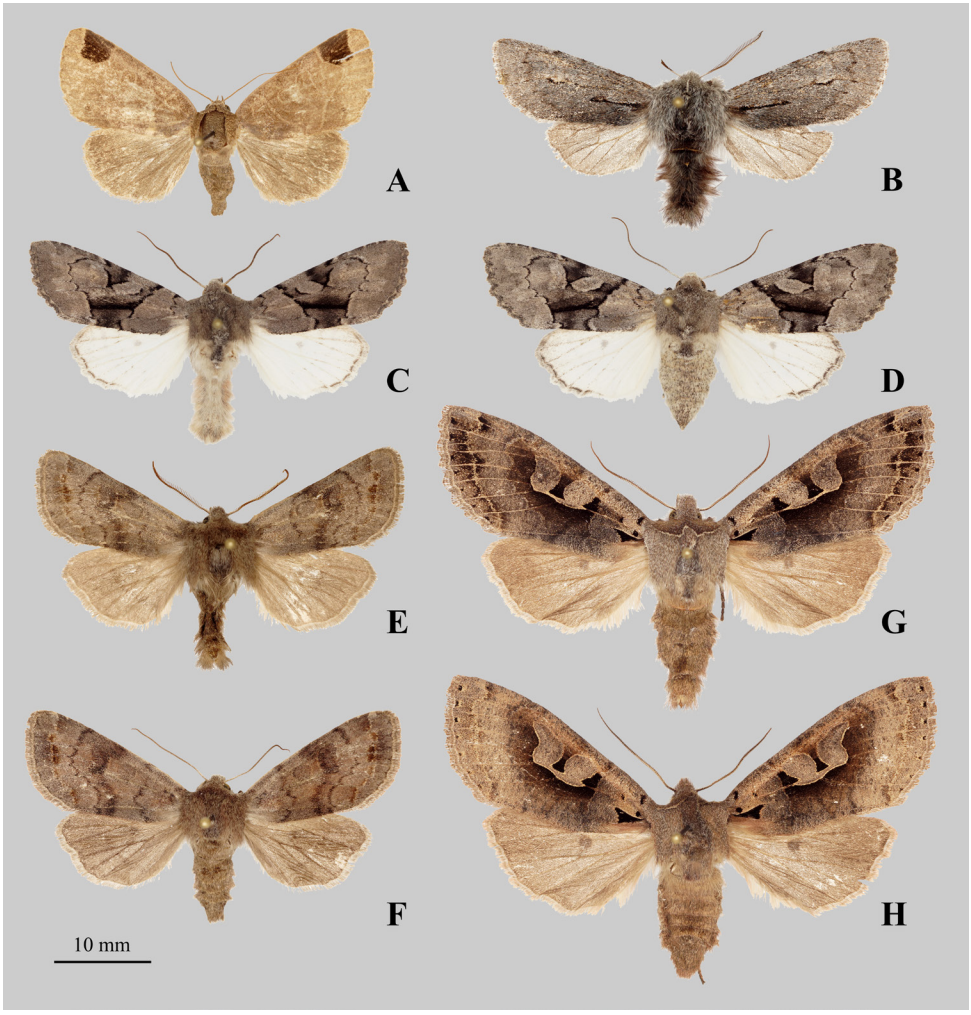

Figure 5. Some species of Noctuidae from the Bikin District of the Khabarovsk Krai (upper reaches of the Shivki River), adults, habitus (upperside): **A** – *Imosca coreana*, ♀, 5.VIII.2024; **B** – *Brachionycha sajana*, ♂, 22.IV.2021; **C** – *Orthosia satoi*, ♂, 7.V.2021; **D** – *O. satoi*, female, 7.V.2021; **E** – *O. ryrholmi*, ♂, 22.IV.2021; **F** – *O. ryrholmi*, ♀, 22.IV.2021; **G** – *Perigrapha extincta*, ♂, 27.IV.2021; **H** – *P. extincta*, ♀, 27.IV.2021.

***Orthosia ryrholmi* G. Ronkay, L. Ronkay, Gyulai & Hacker, 2010**
Figs 5E, F, 6E

Material examined. Shivki: 10 ♂, 4 ♀, 22–27.IV.2021.

Remarks. A local species, previously known in Russia only from Khabarovsk and its surroundings (Dubatolov and Dolgikh 2009; Volynkin and Dubatolov 2015; Koshkin 2020). Initially, the species was identified as *Orthosia populeti* Fabricius,

1775 (Dubatolov and Dolgikh 2009). The discovery of a population in the Bikin District of Khabarovsk Krai may indicate a wider distribution of this species in the southern Russian Far East. The main part of the range in Central China (Shaanxi and Sichuan provinces), from where the species was described. There is a disjunction of more than 2600 km between the Russian and Chinese populations. The moths fly mainly in April, before most of the other *Orthosia* species appear. *Orthosia ryrholmi* is very close to the allopatric Euro-Siberian species *O. populeti*, but differs in somewhat broader forewings and details of the structure of the genitalia (Fig. 6E).

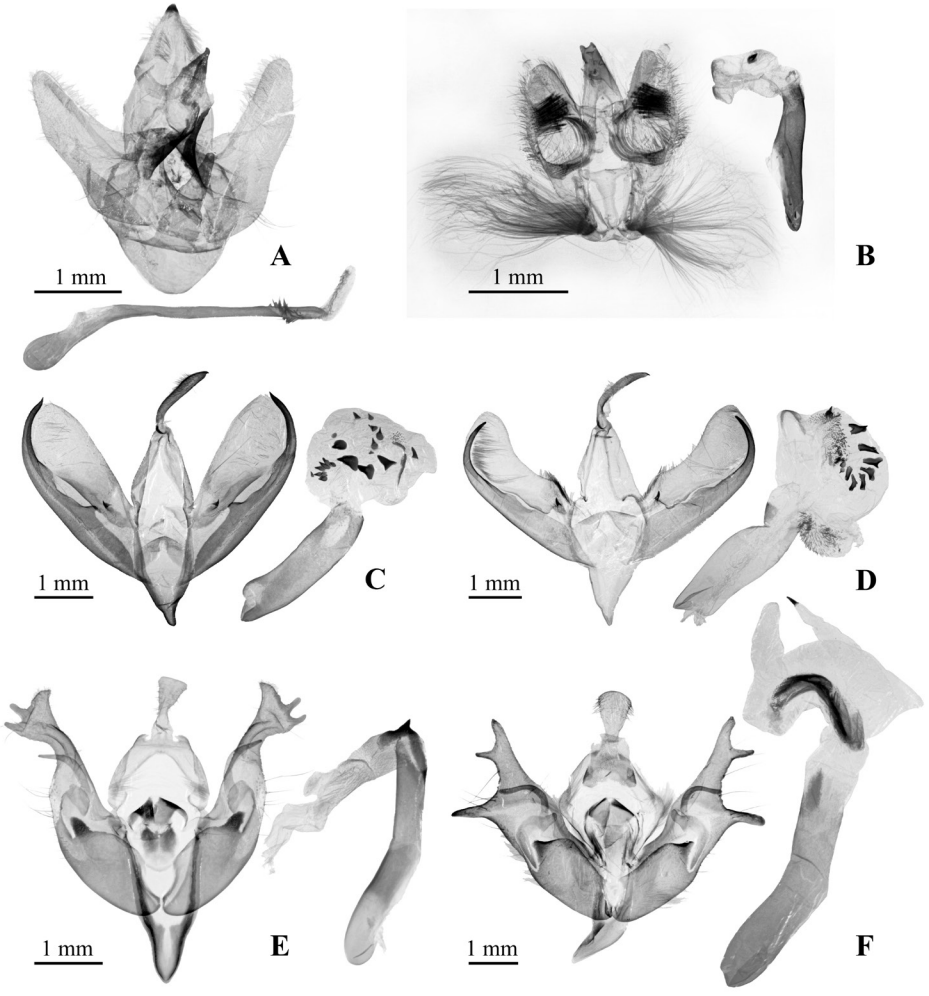

Figure 6. Some species of Lepidoptera from the Bikin District of the Khabarovsk Krai (upper reaches of the Shivki River), male genitalia: **A** – *Rhamnosa angulata*; **B** – *Dysaethria illotata*; **C** – *Stigmatophora flava*; **D** – *S. leacrita*; **E** – *Orthosia ryrholmi*; **F** – *Perigrapha extincta*.

***Perigrapha extincta* Kononenko, 1989**
Figs 5G, H, 6F

Material examined. Shivki: 18 ♂, 7 ♀, 22–27.IV.2021.

Remarks. In Russia, the species was known from the southern Primorsky Krai and two localities in the southern part of the Amur region (near Khabarovsk and the Bastak Nature Reserve) (Dubatolov and Dolgikh 2009; Koshkin 2023). In the upper reaches of the Shivki River this species occurs together with *Perigrapha hoenei* Püngeler, 1914.

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