

First records of *Apatura ilia* ([Denis & Schiffermüller], 1775) and *Limenitis camilla* (Linnaeus, 1764) in West Siberia

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Two Nymphalidae species - *Apatura ilia* ([Denis & Schiffermüller], 1775) and *Limenitis camilla* (Linnaeus, 1764) are reported from the territory of West Siberia for the first time. At this moment we can observe the second wave of expansion of nemoral species of butterflies into Western Siberia from the European part of Russia. The driving factor of the range expansions discussed is no doubt the notorious global warming.

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Keywords

Lepidoptera, Nymphalidae, *Apatura ilia*, *Limenitis camilla*, West Siberia, Kurgan Region, Tyumen' Region, Omsk Region, Fauna, new records

Introduction

Among butterflies of the temperate zone of Eurasia, five species of Nymphalidae are remarkable for their amphipalaearctic distribution, that is their range is split to two parts in Europe and East Asia with a huge gap in Siberia. These are *Limenitis camilla* (Linnaeus, 1764), *Apatura iris* (Linnaeus, 1764), *A. ilia* ([Denis & Schiffermüller], 1775), *A. metis* Freyer, 1829 (but this species has an isolate along the Irtysh River in North Kazakhstan and West Siberia) and *Argyronome laodice* (Pallas, 1771) (Dubatolov and Kosterin 2000; Korshunov 2002; Gorbunov and Kosterin 2007). However, in XXI century expansion of *A. iris* (Knyazev and Kosterin 2003; Kosterin et al. 2007; Ivonin et al. 2013; 2016; Dragan 2018; Solovyev et al. 2022) and *A. laodice* (Kosterin et al. 2007) to West Siberia from Europe and the former species to East Siberia from the Far East has been registered. In this communication we for the first time report analogous range expansions from the Ural Mts to the West Siberian Plain of two more such species, *L. camilla* and *A. ilia*.

Materials and methods

All material processed within the framework of this article was collected on the territory of West Siberia by the authors using standard method of collecting by butterfly net. All collected specimens are deposited in the collections of Svyatoslav Knyazev (SKO, Omsk, Russia), Pavel Sitnikov (PST, Tyumen', Russia), Vitaly Stolbov (VST, Tyumen', Russia), Dmitry Galich (DGT, Tyumen', Russia), Alexander Litvinov (ALT, Bogandinskiy, Tyumen' Region). Both of the species considered in the article are reliably identifiable by their appearance and are easily recognizable in photos.

Therefore, we also use the data freely available on the popular iNaturalist (2024) platform for citizen science. The link to an iNaturalist observation has the following format:

<http://www.inaturalist.org/observations/x>, where 'x' is its unique numeral (of variable number of digits). These unique numerals are provided in parentheses in the text below. All photographic records are geo-tagged; the coordinates are provided below in the decimal degree format. The map was prepared using the Google-Earth program (Fig. 1). Localities were imported into it from a csv-file.

The list of collecting cites with their geographical coordinates is presented below.

Kurgan Region:

Shatrovo - Shatrovskiy district, 2,5 km NE of Shatrovo village, 56°33'29" N, 64°40'51" E;

Tyumen' Region:

Bogandinsky - Tyumenskiy district, Bogandinskoe village vicinity, 56°56'48"N, 65°50'48"E;

Bochanka - Tyumenskiy district, bank of the river Bochanka, 57°17'37"N 64°54'41"E;

Kuchak - Nizhnetavdinskiy district, biostation near lake Kuchak, 57°21'00"N, 66° 3'18.40"E;

Levashi - Tyumenskiy district, Levashi village vicinity, 56°49'58"N, 65°22'12"E;

Lobanova - Isetskiy district, 3 km W of Lobanova village, 56°32'44"N, 65°00'44"E;

Perevalovo - Tyumenskiy district, Perevalovo village vicinities, 57°04'25"N 65°12'33"E;

Reshetnikova - Tyumenskiy district, Reshetnikova village vicinity, 57°15'08"N, 65°25'06"E;

Yamangelka - Tyumenskiy district, 2 km S of Bolshiye Akiyary village, river Yamangelka, 56°56'05"N, 65°21'22"E;

Yurty-Iska - Nizhnetavdinskiy district, 1 km N of Yurty-Iska village, 57°39'21"N, 65°37'12"E;

Omsk Region:

Bol`shaya Bitcha – Ust`-Ishimskiy district, 3 km NW of Bol`shaya Bitcha vil- lage, 57°53'29"N, 70°34'21"E;

Skorodum – Ust`-Ishimskiy district, 0,3 km N of Skorodum village, 57°48'28"N, 70°54'54"E;

Ust`-Ishim – Ust`-Ishimskiy district, Ust`-Ishim village, 57°41'47"N, 71° 8'25"E.

The coordinates of iNaturalist observations are given in the materials section below.

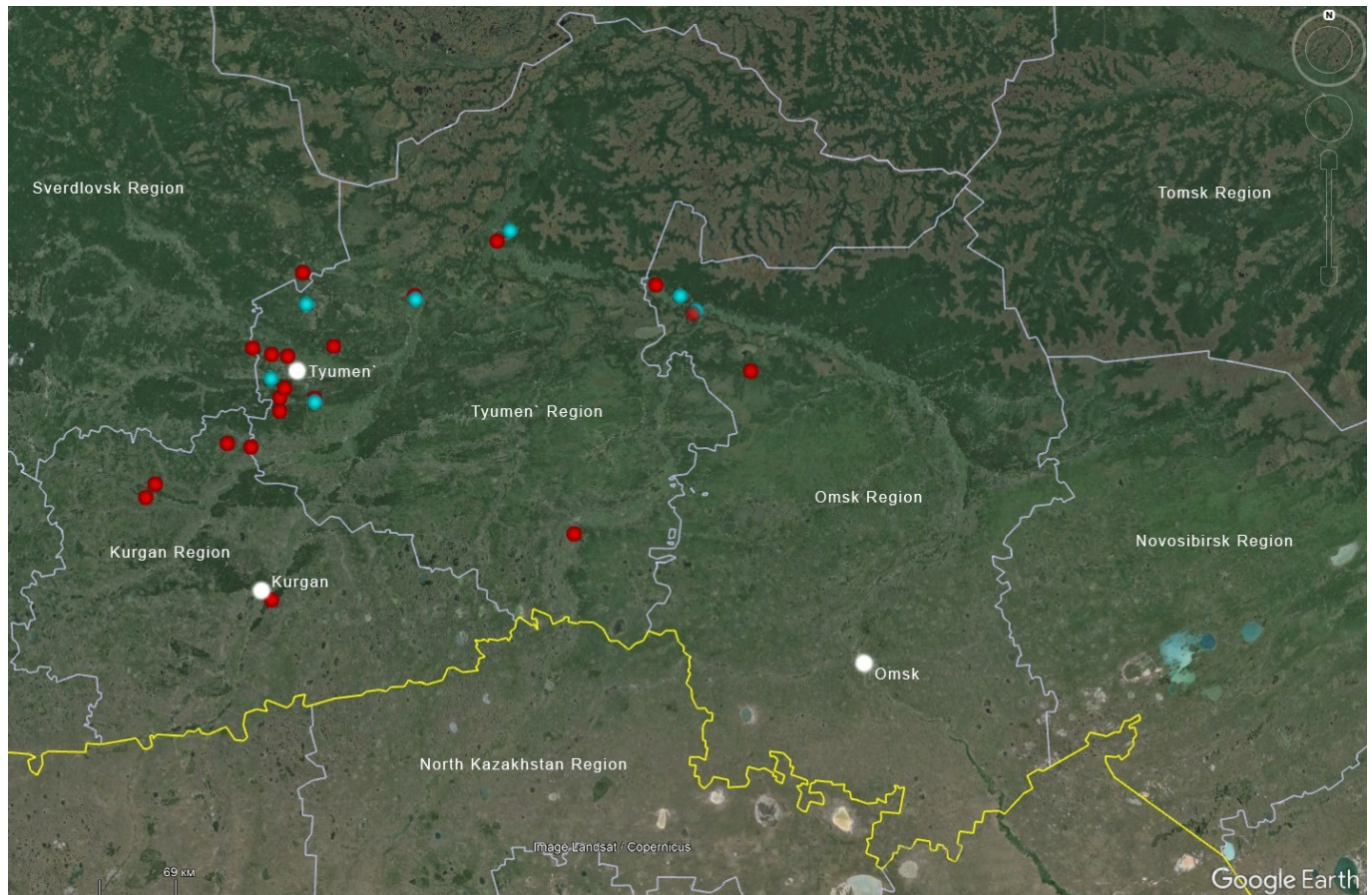


Figure 1. Distribution map of *Apatura ilia* (red circles) and *Limenitis camilla* (blue circles) in West Siberia.

Result

Apatura ilia ([Denis Schiffermüller], 1775)

Figures 2–11

Material examined. Sverdlovsk Region: 1♂, 1 km NW of Vas`kovo vill., 57°53'38"N, 65°31'59"E, 8.VII.2023, P.S. Sitnikov (photo) (Fig. 8); **Kurgan Region:** 2♂, Shatrovo, 14.VI.2021, D.E. Galich (DGT); **Tyumen` Region:** 1♂, Levashi, 16.VI.2020, P.S. Sitnikov (photo); 6♂, 1♀ Yamangelka, 16.VI.2021 and 19–20.VIII.2021, P.S. Sitnikov (PST) (Fig. 9); 1♀, Reshetnikova, 29.VI.2021, P.S. Sitnikov (PST); 1♂, Bogandinskiy, 7–15.VII.2021, P.S. Sitnikov (PST); 1♀, Levashi, 30.VII.2022, P.S. Sitnikov (photo); 2 specimens, Botchanka, 4.VII.2020, V. Stolbov (VST); 6 specimens, Kuchak, VII.2022, students materials (VST); 1♂, Lobanova, 15.VI.2021, D.E. Galich (DGT); 1♂, Bogandinskiy, 20.VI.2015, A. Litvinov (ALT); 1♂, Bogandinskiy, 15.VIII.2021, A. Litvinov (ALT);

Omsk Region: 1♂, Bol'shaya Bitcha, 23.VII.2023, S.A. Knyazev, S.M. Saikina (SKO); 2♀, Ust'-Ishim, 21.VII.2023, S.A. Knyazev, S.M. Saikina (SKO) (Fig. 10,11); 1♂, Ust'-Ishim, 23.VII.2023, S.A. Knyazev, S.M. Saikina (SKO) (Fig. 2).

Photographic records on iNaturalist (2024) (identification numbers for specific observations are given in parenthesis). **Kurgan Region:** 1♂, Shadrinskiy district, Glubokoe village vicinity, 56.20255 N, 63.73742 E, 9.VII.2017, Yu. Red'kin (165472439) (Fig. 4); 1♂, Shadrinskiy district, Shadrinsk town, 56.09323 N, 63.62696 E, 3.VII.2016, Yu. Red'kin (165427255) (Fig. 5); 1♂, Kurgan district, Keramzitnyi village vicinity, 55.40991 N, 65.45846 E, 22.VIII.2020, T. Denzanova (57215467) (Fig. 3); **Tyumen' Region:** 1♂, Ishimskiy district, Sinitsyna village, 56.00906 N, 69.46660 E, 29.VI.2023, S. Kvashnin (183438601) (Fig. 6); 1♂, Tyumenskiy district, Taraskul', 57.00876 N, 65.41127 E, 26.VII.2023, polina567 (177292987); 1♂, Tyumenskiy district, Kamenka village vicinity, 57.25635 N, 65.18878 E, 2.VII.2023, I. Ganochenko (170598239); 1♂, Yarkovskiy district, Malyi Esaul village vicinity, 57.76457 N, 67.15334 E, 1.VII.2023, V. Salavatulin (170431505); 1♂, Tobol'skiy district, Tobol'sk town, 58.20543 N, 68.29242 E, Yu. Yahnke (170624972); **Omsk Region:** 3 specimens, Bol'sheukovskiy district, Listvyagi village, 57.23253 N, 71.89326 E, 5.VII.2023, V. Teploukhov (171505684) (Fig. 7).

Remark. These are the first records in West Siberia. An amphipalaearctic species, distributed in Russia in European Part, South Ural and the Far East (Korshunov 2002). The first photo of a single male of this species was made in Tyumen' Region in 2020 by P.S. Sitnikov. After this record, the species was discovered in large numbers in 2021-2022. According to Pavel Sitnikov's and Alexander Litvinov's observations, in the vicinity of the village of Bogandinskiy since July 2021, *Apatura ilia* was found in the amount of 10-20 specimens per day. Several specimens were found in the Tavdinsky district of the Sverdlovsk region, near the border of Tyumen' Region, in 2023. In Omsk Region these butterflies were found in 2023 in the taiga zone in its north-western part. Males were sitting on moist soil; females were flying about treetops and were easily attracted on wine baits sprayed on the leaves of the lower branches. The imago flight period in Western Siberia is from mid-June to the end of August.

Limenitis camilla (Linnaeus, 1764)

Figures 12-15

Material examined. Tyumen' Region: 1 specimen, Perevalovo, 29.VI.2017, V. Stolbov (VST); 1♀, Yurty-Iska, 11.VII.2018, P.S. Sitnikov (PST) (Fig. 14); 1 specimen, Kuchak, 26.VII.2022, Yu. Ismagilova (VST); 1 specimen, Bogandinskiy, VII.2017, A. Litvinov (visual registration); **Omsk Region:** 1♀, Ust'-Ishim, 23.VII.2023, S.A. Knyazev, S.M. Saikina (SKO); 1♀, Skorodum, 23.VII.2023, S.A. Knyazev, S.M. Saikina (SKO) (Fig. 12, 13).

Photographic records on iNaturalist (2024) (identification numbers for specific observations are given in parenthesis). Tyumen' Region: 1♂, Tobol'skiy district, Potapova village vicinity, 58.28836 N, 68.47206 E, 22.VII.2023, Yu. Yahnke (174253434) (Fig. 15).

Remark. The species is for the first time recorded in West Siberia. Its previously known distribution in Russia was in European Part, South Ural and, after the huge gap in Siberia, in the Far East (Korshunov 2002). In Tyumen' Region the specimen was sitting on the wet dirty road among specimens of another species of the same genus, *Limenitis populi* (Linnaeus, 1758). In Omsk Region two females were collected in forest clearings in taiga zone (dominated by the following tree species: *Pinus sibirica*, *Pinus sylvestris*, *Picea abies*, *Betula pendula*, *Populus tremula*, *Tilia cordata*), in the North-West of the Region. The imago flight period in Western Siberia is from mid-June to the end of July.

Discussion

According to the observations of Pavel Sitnikov, Vitaly Stolbov, Aleksander Litvinov, both species considered were not observed in the Tyumen Region until 2015. These butterflies were also previously absent from the materials of student practices. Since 2020, *A. ilia* become more common and is increasing its numbers, in some places becoming even more widespread than *Apatura iris* (Linnaeus, 1758).

Currently, we can observe the second wave of expansion of nemoral species of butterflies into Western Siberia from the European part of Russia. Similarly to the first wave with the participation of *A. iris*, *Argynnis laodice* (Pallas, 1771) and *Maniola jurtina* (Linnaeus, 1758) (Knyazev and Kosterin 2003; Kosterin et al. 2007), the penetration of *Apatura ilia* and *Limenitis camilla* into Siberia takes place along the taiga and northern forest-steppe zones, where optimal climatic conditions, with respect to temperature and humidity, are probably present for the overwintering of the preimaginal stages of these species. The mentioned first rate of expansion appeared impressively fast. In XX century, *Apatura iris* was unknown in West Siberia while in the East Siberia was found only in Transbaikalia (Dubatolov and Kosterin 2000; Korshunov 2002). In 1991 it was found in Tyumen' Region (Sitnikov 1992), in 1997 in Omsk Region (Knyazev and Kosterin, 2003), in 2006 in Tomsk Region (Kosterin et al., 2007), in 2010 in Novosibirsk (Ivonin et al. 2013) and Altaiskiy Kray, (Yakovlev and Kostyunin, 2015), in 2012 in Kemerovo Region (Yakovlev and Kostyunin, 2015), in 2017 in Khakasia (Dragan, 2018), the latter already being Central Siberia. These data suggest expansion for ca 2,000 km for about 30 years, that is a speed of 70 km per year. The opposite expansion of *A. iris* from its Far Eastern range part to the west is also observed. It was not at all reported for Siberia by Korshunov (1970) but in 2002 he included Transbaikalia in its eastern range part (Korshunov 2002). In 2009 the species was recorded at Lake Baikal (Berlov and Berlov 2021). Based on the above estimate of the speed of expansion of *A. iris*, Solovyev et al. (2022) predicted the opposite waves of *A. iris* migration to meet somewhere in southern Central Siberia in ca 2030, after which the species will no longer remain amphipalaearctic.

Analogously, Ivonin et al. (2016) estimated the rate of eastward expansion of *M. jurtina* to West Siberia as 50 km per year and predicted its arrival to Novosibirsk in 2018, and it was registered for the first time in Novosibirsk in this exact year indeed (Ivonin et al. 2018). The currently easternmost findings of *M. jurtina* are in Kemerovo Region (Kostyunin and Klyueva 2020).

There is no doubt that the here reported second wave of expansion of the amphipalaearctic species *L. camilla* and *A. ilia* will proceed further east in West Siberia as well, and the opposite westwards waves of expansion of the these species over East Siberia will also be soon reported. The fact that the expansion of the second wave species, *L. camilla* and *A. ilia*, lags behind that of the first wave species, *A. iris*, *M. jurtina* and *A. laodice*, suggest that the second wave is probably slower.

The driving factor of the range expansions discussed is no doubt the notorious global warming. The example of *A. iris*, which is going to occupy the whole South Siberia for some 30 years, suggest that under favorable climatic conditions such expansions may occur very fast, almost instant in the geological time scale. This leaves no room for the old concept that the range disjunctions of the amphipalaearctic species appeared due to the Pleistocene climate coolings, that is are some 1-1.5 million years old. The climate of the Atlantic time of the Holocene, the so-called Holocene climatic optimum which took place some five thousand years ago, was comparable to the current climate. At that time the amphipalaearctic species most probably enjoyed the contiguous Palaearctic ranges (having restored them after previous splits or expanded for the first time in their history), so that their disjunctions can hardly be older than five thousand years (Dubatolov and Kosterin 2000; Solovyev et al. 2022). This hypothesis was supported by the analysis of the mitochondrial COI gene and the nuclear gene of histone H1 in *L. camilla*, which did not reveal any divergence between the western and eastern populations for the genes analyzed (Solovyev et al. 2022), suggesting their very recent split in evolutionary time scale.



The above suggest that the current alarming climatic situation at the same time offers an unique opportunity to observe faunogenesis in action, and butterflies are among the best model objects for this.



Figure 2. Figures 2-9. **2.** *Apatura ilia*, ♂, an imago in nature, feeding on the wine baits sprayed on the leaves of *Tilia cordata*, Omsk Region, Ust`-Ishimskiy district, Ust`-Ishim village vicinity, 23.VII.2023, photo by S.A. Knyazev; **3.** *Apatura ilia*, ♂, an imago in nature, Kurgan Region, Kurgan district, Keramzitniy village vicinity, 55.409905 N, 65.458464E, 22.VIII.2020, photo by T. Denzanova (57215467); **4.** *Apatura ilia*, ♂, an imago in nature, Kurgan Region, Shadrinskiy district, Glubokoe village vicinity, 56.202546 N, 63.737416 E, 9.VII.2017, photo by Yu. Redkin (165472439). **5.** *Apatura ilia*, ♂, an imago in nature, Kurgan Region, Shadrinskiy district, Shadrinsk town, 56.093232 N, 63.626956 E, 3.VII.2016, photo by Yu. Redkin (165427255); **6.** *Apatura ilia*, ♂, an imago in nature, Tyumen' Region, Ishimskiy district, Sinitsyna village, 56.009055 N, 69.466595 E, 29.VI.2023, photo by S. Kvashnin (183438601); **7.** *Apatura ilia*, ♂♂, imagines in nature, Omsk Region, Bol`sheukovskiy district, Listvyagi village, 57.232528 N, 71.89326 E, 5.VII.2023, photo by V. Teploukhov (171505684); **8.** *Apatura ilia*, ♂, an imago in nature, Sverdlovsk Region, 1 km NW of Vas`kovo vill., 57°53'37.66"N, 65°31'58.83"E, 8.VII.2023, photo by P.S. Sitnikov; **9.** *Apatura ilia*, ♀, an imago in nature, Tyumen' Region, Yamangelka, 19.VIII.2021, photo by P.S. Sitnikov.

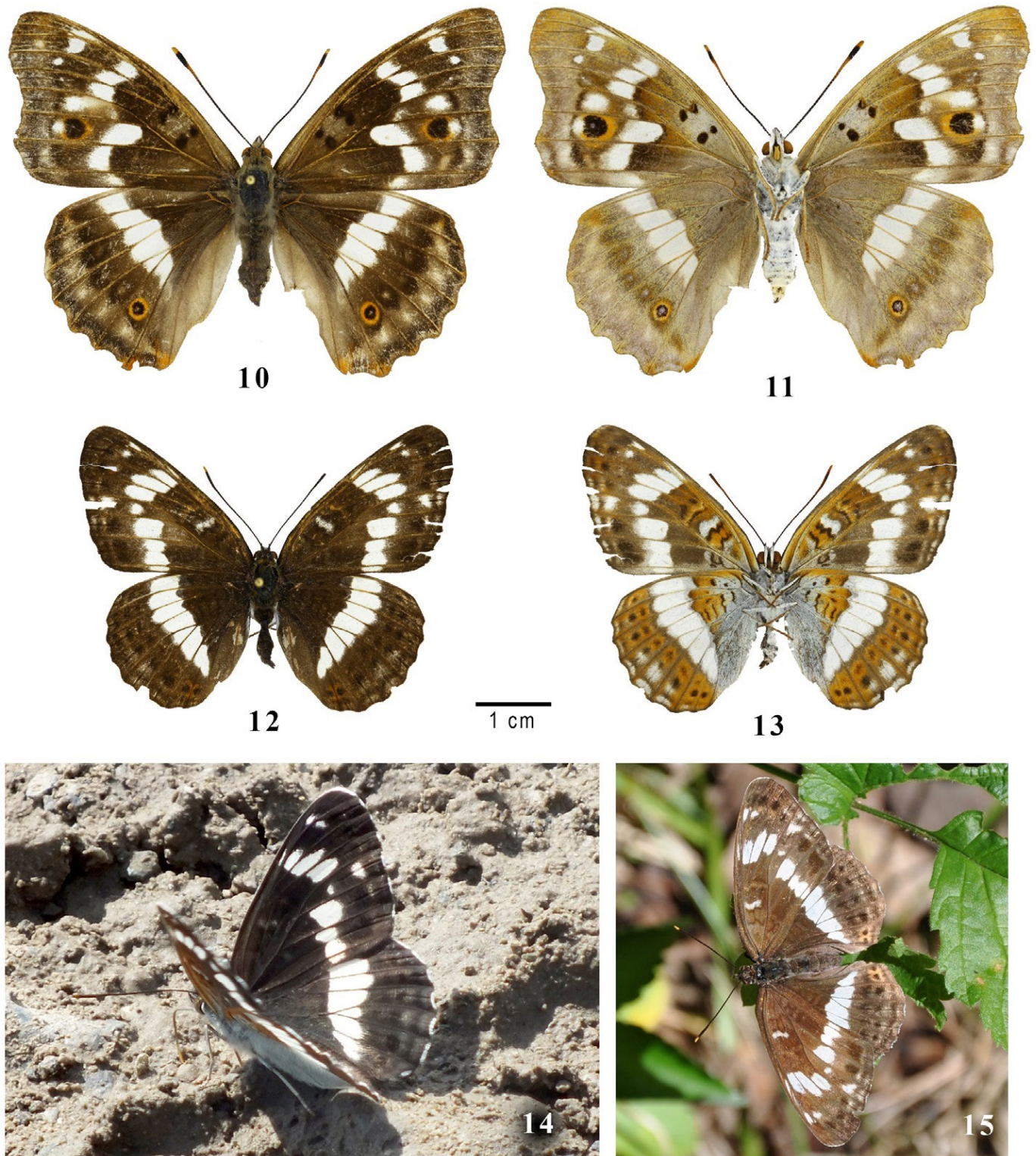


Figure 3. Figures 10-15. **10.** *Apatura ilia*, ♀, an imago, upperside, Omsk Region, Ust`-Ishimskiy district, Ust`-Ishim village vicinity, 21.VII.2023; **11.** *Apatura ilia*, ♀, an imago, underside, Omsk Region, Ust`-Ishimskiy district, Ust`-Ishim village vicinity, 21.VII.2023; **12.** *Limenitis camilla*, ♀, an imago, upperside, Omsk Region, Ust`-Ishimskiy district, 0,3 km N of Skorodum village, 23.VII.2023; **13.** *Limenitis camilla*, ♀, an imago, underside, Omsk Region, Ust`-Ishimskiy district, 0,3 km N of Skorodum village, 23.VII.2023; **14.** *Limenitis camilla*, an imago in nature, Tyumen` Region, Nizhnetavdinskiy district, 1 km N of Yurty-Iska village, 11.VII.2018, photo by P.S. Sitnikov; **15.** *Limenitis camilla*, an imago in nature, Tyumen` Region, Tobolskiy district, Potapova village vicinity, 58.288359 N, 68.472063 E, 22.VII.2023, photo by Yu. Yahnke (174253434).

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