

Checklist of the butterflies (Papilionoidea) of the Saur Mountains and adjacent territories (Kazakhstan), including systematic notes about the *Erebia callias* group

NIKOLAI I. RUBIN¹ & ROMAN V. YAKOVLEV²

¹ Popovich lane 5–33, Grodno, 230029, Belarus; entobel@tut.by

² Altai State University, South-Siberian Botanical Garden, Lenina pr. 61, Barnaul, 656049, Russia; cossus_cossus@mail.ru

Received 23 May 2013; reviews returned 12 August 2013; accepted 9 September 2013.

Subject Editor: Zdeněk F. Fric.

Abstract. A checklist of Papilionoidea of the Saur Mountains is presented with 159 butterfly species (Hesperiidae: 15; Papilionidae: 7; Pieridae: 17; Nymphalidae: 71; Lycaenidae: 49). The specific status of *Erebia sibirica* Staudinger, 1881 is confirmed. *Araschnia levana* (Linnaeus, 1758), *Clossiana selenis* (Eversmann, 1837), *Phengaris alcon* (Denis & Schiffermüller, 1775) and *Aricia nicias* (Meigen, 1829) are reported for the Saur for the first time.

Introduction

The Saur is a small mountain range which is a part of the Tarbagatai mountain system; it is situated on the border between Eastern Kazakhstan and China south-eastwards from Zaisan lake and the Black Irtysh River (Figs 1–6). To the north it is bordered by the Zaisan depression, and the Chilikty depression separates it from the Tarbagatai in the south. In its western part the Saur is in contact with the small Manrak range and in the north-eastern part with the Saikan range. The Saur stretches 140 km from the west to the east and reaches an altitude of 3816 m (Muзtau Mt.). Average temperature in January is -20°C , in July $+22^{\circ}\text{C}$. Annual average precipitation is 350–500 mm. The humidity rises with altitude, and the temperature falls. The snow line is situated at an altitude of 3300 m in the Saur, and hence its peaks are always covered by snow. Glaciers are situated in the Muзtau Mt.; the largest one reaches an area of 4–5 km².

The north foot of the Saur up to 700 m belongs to the semi-desert zone where semi-desert plants grow on solonchic chestnut soil. In the mountains north slopes are covered by mountain forests consisting of *Pinus sibirica* Du Tour, *Abies sibirica* Ledeb. and *Picea tianschanica* Rupr. (Bykov) (Pinaceae) (Bolshakov 1987), meadows and thick brakes with *Berberis* (Berberidaceae), *Daphne* (Thymelaeaceae), *Spiraea*, *Crataegus*, *Rosa* (all Rosaceae) etc. South expositions are covered by mountain steppes and semi-deserts. Alpine meadows, stony mountain tundras and glaciers are situated on the crests. The hydrographic network is developed very well; the main rivers are Zhemenei and Uidene.

The biogeographic affiliation of the Saur is controversial. In the beginning of the last century the Saur was regarded as part of Dzhungaria and even Tien-Shan, but later the Saur and Tarbagatai were considered as a separate mountain biogeographic regions on a level with the Altai, Dzhungarsky Alatau and Tien-Shan. De Lattin (1967) includ-

ed Saur Mountains in “Turkestanische Zentrum, Tarbagataische Sekundärzentrum”. Emeljanov (1974) clearly placed it as “Tarbagatai subregion of Altai complex region of Westscythian subprovince of Scythian province”. Kryzhanovsky (2002) included Saur in the “Kazakhstanian province of Centralasian superprovince”. Maloletko (1999) argued that the Saur and the Tarbagatai belong to the system of the Altai mountains and this view was held by leading Russian botanists (Kamelin 2005) who include these ridges within the Altai-Dzhungarian biogeographical region. Later some entomologists working on the fauna of the Altai mountain system accepted the demarcation of the Altai as suggested by phytogeographers (Volynkin & Matov 2011; Yakovlev 2012). Our opinion agrees with this latter demarcation and is confirmed by the absence of some Dzhungarian taxa in the fauna of the Saur and Tarbagatai: the family Riodinidae, the genera *Marginarge* Korb, 2005 and *Karanasa* Moore, 1893 (Nymphalidae: Satyrinae), and the subgenus *Koramius* Moore, 1902 (Papilionidae).

Additionally, there are many typical Siberian species and species with arcto-alpine disjunction in the fauna of the Saur and Tarbagatai where they occur in the southernmost edge of their distributions. The most typical examples are *Parnassius tenedius* Eversmann, 1851 (Papilionidae), *Clossiana freija* (Thunberg, 1791), *C. frigga* (Thunberg, 1791), *Boloria altaica* Grum-Grzhimailo, 1893, *Euphydryas iduna* (Dalman, 1816), *Mellicta menetriesi* Caradja, 1895 (Nymphalidae), and *Agriades glandon* (de Prunner, 1798) (Lycaenidae). Most of them have well-differentiated subspecies in the fauna of the Saur and Tarbagatai (e.g., *C. frigga annae* Suschkin, 1906, *E. iduna jacobsoni* Yakovlev, 2011, *M. menetriesi saurica* Yakovlev, 2007, *Agriades glandon rubini* Churkin, 2007). In our opinion, one of the most important points in the analysis of faunistic similarities and differences, and analyses of their origin, is the evaluation of the relationships of endemic species. The majority of endemics of the Saur and Tarbagatai (*Erebia haberhaueri* Staudinger, 1881, *E. sibirica* Staudinger, 1881, *Oeneis fulla* (Eversmann, 1851), *O. mulla* Staudinger, 1881 (Nymphalidae: Satyrinae)) are closely related to Siberian species. However, the most traditional opinion is that biota of the Saur and Tarbagatai have intermediate positions between biotas of the mountains of Siberia and Central Asia (Yakovlev & Guskova 2012).

The history of the study of butterflies from the Saur Mountains

One of the collectors employed by E. Eversmann was the first person who collected butterflies in the Saur Mts (or in the regions adjacent to the Saur) but now it is impossible to state who it actually was. It is known that the collector Pavel Romanov worked approximately in this region (Altai, SW Siberia) in 1840–1843. Specimens also might come from Alexander Schrenck. E. Eversmann (1843, 1851) described *Pontia leucodice* Eversmann, 1843 (Pieridae), *Hipparchia sunbecca* Eversmann, 1843 (Nymphalidae: Satyrinae), *Lycaena pheretiades* Eversmann, 1843 (Lycaenidae) and *Hipparchia fulla* Eversmann, 1851 (Nymphalidae: Satyrinae) from the area of Noor-Saisan.

The first systematic collecting of Lepidoptera in the Saur was undertaken by J. Haberhauer in 1877–1878. Materials from his collecting trip were the basis for the

works of Speyer (1879) and Staudinger (1881, 1892). Several new taxa of Papilionoidea were described from the Saur: *Pyrgus antonia* Speyer, 1879, *P. staudingeri* Speyer, 1879 (Hesperiidae) (Speyer 1879), *Erebia tyndarus* Esp. var. *sibirica* Staudinger, 1881, *Erebia pawlowskyi* Men. var. *haberhaueri* Staudinger, 1881, *Oeneis mulla* Staudinger, 1881 (Nymphalidae: Satyrinae), *Lyc.[aena] miris* Staudinger, 1881 (Lycaenidae) (Staudinger 1881) and *Coen.[onympha] iphis* Schiff. var. *iphina* Staudinger, 1892 (Nymphalidae: Satyrinae) (Staudinger 1892). Approximately at the same time the Saur was visited by the Rückbeil brothers whose specimens are still deposited in the collection of O. Staudinger and others. Later several taxa were described based on these specimens: *Parnassius apollo tarbagataica* Verity, 1911 (Papilionidae) and *Plebeius zephyrinus tarbagataiensis* Bálint, [1993] (Lycaenidae) (Verity 1911; Bálint et al. [1993]).

In the beginning of the 20th century expeditions lead by S. Tshetverikov and P. Sushkin in 1904 and A. Jacobson in 1910 collected a large amount of material. Specimens collected on these trips are still deposited in the collection of ZISP. P. Sushkin (1906, 1909) described the subspecies *Argynnis frigga annae* (Nymphalidae) and *Lycaena cyane tarbagata* (Lycaenidae); later the type series of the latter taxon was revised (along with designation of a lectotype) by P. Bogdanov (2003). In addition, members of the expedition lead by the Russian geographer V. Sapozhnikov collected in Saur in 1904; specimens collected during this trip are deposited now in the collection of the Zoological Museum of Tomsk University and they are severely damaged.

During the Soviet period the Saur was repeatedly visited by amateur entomologists – a large number of specimens is stored in private collections. Based on specimens collected by V. K. Tuzov two conspecific taxa were described – *Cupido minimus tusovi* Lukhtanov, 1994 = *Cupido tuzovi* Zhdanko, 1994 [1996] (Lycaenidae) (Lukhtanov & Lukhtanov 1994; Zhdanko 1994 [1996]). In the book by V. and A. Lukhtanov (1994), distribution maps of all taxa which inhabit the Russian and Kazakh part of the Altai are given, including species inhabiting the Saur. V. A. Lukhtanov (1990, 1999) described *Glaucopsyche argali arkhar* Lukhtanov, 1990 (Lycaenidae) and *Parnassius phoebus sauricus* Lukhtanov, 1999 (Papilionidae) based on specimens collected during his trips. S. Churkin gave some data on the distribution of Satyrinae and Lycaenidae in the Saur (along with the description of the new subspecies *Agriades glandon rubini* Churkin, 2005) (Lycaenidae) in several publications (Churkin 2005a, b, 2006). A. B. Zhdanko (2005) also provided data on the Saur in his paper on the butterfly fauna of Kazakhstan. *Euphydryas laeta calima* Bolshakov & Korb, 2012 (Nymphalidae) was described based on material from the Saur collected by P. Suschkin and A. Jacobson (Bolshakov & Korb 2012).

Authors of the present study repeatedly worked in the Saur and adjacent regions. R. Yakovlev visited this region in 2000–2003 and 2011–2012, N. Rubin collected there in 2003, 2006 and 2011. Partial results of these collecting trips have already been processed. Two new species were recorded for the Saur for the first time: *Parnassius tenedius* Eversmann, 1851 (Papilionidae) and *Leptidea morsei* (Fenton, 1881) (Pieridae) (Yakovlev 2002). Localities of *Tongeia fischeri* were shown in detail (Yakovlev 2003). Later (Yakovlev 2004, 2007, 2011), three subspecies were described – *Pieris napi*

sauron Yakovlev, 2004 (Pieridae), *Melitaea centralasiae saurica* Yakovlev, 2007, and *Euphydryas iduna jacobsoni* Yakovlev, 2011 (Nymphalidae). In the present work we present the full list of Papilionoidea taxa which are known from the Saur and adjacent territories: the Monrak and Saykan ridges, the south part of the Zaisan valley and the Chilikty valley. It is important to note that here we consider only the Kazakh part of the territory whereas the Chinese part still remains completely unknown.

List of collecting localities and dates by authors (Fig. 1)

- M1** Manrak Mts, 20 km SW Zaisan, 23–24.v.2000, leg. R. V. Yakovlev;
- M2** Manrak Mts, 30 km W Zaisan, 18–19.v.2001, leg. R. V. Yakovlev;
- M3** Manrak Mts, near Kensai, N 47°25', E 84°39', 2.vi.2002, leg. R. V. Yakovlev;
- M4** Manrak Mts, near Zhanaul vill., 1100 m, N 47°14', E 84°35', 3.vi.2002, leg. R. V. Yakovlev;
- M5** E Manrak Mt. R., N 47°18'40", E 84°36'42", 1300 m a.s.l., 31.v., 1–4.vi.2006, 27–29.v.2011, leg. N. Rubin; 7.vi.2012, leg. R. V. Yakovlev;
- M6** NE Manrak Mt. R., Saryshyi environs, 700–900 m a.s.l., 04–05.vi.2006, leg. N. Rubin;
- M8** NW Manrak Mt. R., Kusty River valley, 700–800 m a.s.l., 27.v.2011, leg. N. Rubin;
- S1** Saur Mts, 20 km S Zaisan, 25.v.2000, leg. R. V. Yakovlev;
- S2** Saur Mts, 10 km S Charchutsu, 26.v.2000, leg. R. V. Yakovlev;
- S3** Saur Mts, near Chagan-Obo, 1600–1800 m, N 47°02', E 84°54', 4–6.vi.2002, leg. R. V. Yakovlev;
- S4** Saur Mt. R., Terekty River valley, 1200–1300 m a.s.l., 18–19.vi.2003, leg. N. Rubin;
- S5** Saur Mt. R., Alatai Pass environs, 1500–1900 m a.s.l., 19–20.vi.2003, leg. N. Rubin; N 47°18'; E 85°08', 23.vii.2011, leg. R. V. Yakovlev;
- S6** Saur Mt. R., 2 km W Alatai Pass, 1800–2000 m a.s.l., 20–22.vi.2003, leg. N. Rubin;
- S7** Saur Mt. R., Tas Mt. environs, 2600–2800 m a.s.l., 25.vi–03.vii.2003, leg. N. Rubin; N 47°15', E 85°04', 20–22.vii.2011, leg. R. V. Yakovlev;
- S8** Saur Mt. R., upper Zhinishke River, 1800 m a.s.l., 01.vi.2006, leg. N. Rubin;
- S9** Saur Mt. R., Small Zhemenei River valley, 1100 m a.s.l., 06–07.vi.2006, leg. N. Rubin;
- S10** Saur Mt. R., Zhemenei River valley, 5 km S Zaisan, 700 m a.s.l., 08.vi.2006, 13.vi.2012, leg. N. Rubin;
- S11** Saur Mt. R., upper Karagaily River, 1800 m a.s.l., 10–14.vi.2006, leg. N. Rubin;
- S12** Saur Mt. R., 3 km N Ungirkora, 1300–1500 m a.s.l., 4.vi.2006, leg. N. Rubin;
- S13** Saur Mt. R., Shakpaktas Mt. environs, 2500–2700 m a.s.l., 11–13.vi.2006, leg. N. Rubin;
- S14** Saur Mts, 24 km S Zaisan, upper stream Bolshoi Zhemenei riv., 1650 m, N 47°14', E 84°56', 17–19.vii.2011, leg. R. V. Yakovlev;
- S15** Saur Mts (N slopes near Kenderlik vill.), 1200 m, N 47°21', E 85°15', 23.vii.2011, leg. R. V. Yakovlev;
- S16** Saur Mt. R., 4 km E Zaisan, 600 m a.s.l., 06.vii.2003, leg. N. Rubin;
- Sa1** Saikan Mts, N 47°19', E 85°31', 1700 m, 7–8.vi.2002, leg. R. V. Yakovlev;
- Z1** Zaisan Lake Area, Shorga River valley, 450 m a.s.l., 17.vi.2003, leg. N. Rubin;
- Z2** Zaisan district, 5 km W Kensai, 500 m a.s.l., 16.vi.2006, leg. N. Rubin;
- Z3** Zaisan Lake Area, Espe River valley, 6 km NE Tolagai Mt., 600 m a.s.l., 17.vi.2006, leg. N. Rubin;
- Z4** Zaisan Lake Area, 15 km E Karasu, 600 m a.s.l., N 47°47'96", E 083°39'81", 26, 30.v.2011, leg. N. Rubin;



Fig. 1. Map of the Saur Mountains. **a**, Saur in the map of Central Asia; **b**, map with points of collecting localities.

- Z5** Zaisan Lake Area, 6 km W Zaisan, 600 m a.s.l., 6.vii.2003, leg. N. Rubin;
- Z6** Zaisan Lake Area, Bazar River valley, 17.vi.2003, leg. N. Rubin;
- Z7** Zaisan Lake Area, Karabulak environs, 17.vi.2003, leg. N. Rubin;
- Z8** Zaisan Lake Area, 7 km NE Zaisan, 500 m a.s.l., 30.v.2006, leg. N. Rubin;
- Ch1** Chilikty Depression, 5 km NW Chilikty, 1100 m a.s.l., 09.vi.2006, leg. N. Rubin;
- Ch2** Chilikty Depression, Chagan-Obo River valley, 1600 m a.s.l., 12.vi.2006, leg. N. Rubin.

Annotated list of species

HESPERIIDAE

Erynnis tages (Linnaeus, 1758)

M1, M2, M4, M5, M8, S1, S2, S8, S9, S10, Sa1. Everywhere. Steppe slopes of gullies in foothills, forb meadows in gorges at 500–1500 m.

Carcharodus alceae (Esper, [1780])

M1, Sa1. Locally at 500–1200 m.

Syrichtus cribrellum (Eversmann, 1841)

M5, M9, S1. Locally abundant at 100–1400 m.

Syrichtus tessellum (Hübner, [1803])

S1. Local, rare.

Syrichtus antonia (Speyer, 1879)

M1, M2, M4, M6, M8, S10, Sa1. Common. Stony steppe slopes of foothills of north macro-slopes of the Saur and Manrak at 500–1500 m.

Syrichtus staudingeri (Speyer, 1879)

M1, M8. Local and scanty. Just a few specimens were collected in the north-eastern foothill part of the Manrak. Stony steppes and semideserts in places with very scarce vegetation at 700–1000 m.

Spialia orbifer (Hübner, [1823])

M3, S1, S2, S4, S9. Single specimens on steppe slopes of foothills and in mountain valleys at 500–1400 m.

Pyrgus malvae (Linnaeus, 1758)

M4, S2, S4, S9. Found almost everywhere but only single specimens. Mesophytic sites in river valleys and stream beds at 1000–1800 m.

Pyrgus alveus (Hübner, 1803)

S5. Single specimens in tallgrass meadows of the Terekty gorge north of the Alatai pass at 1500–1800 m.

Pyrgus serratulae (Rambur, 1839)

ssp. *uralensis* Warren, 1926

M1, M2, M5, S4, S5, S8, S11, Sa1, Ch2. Everywhere; characteristic species for these ridges. Forb meadows on mountain slopes at 1000–1900 m.

***Carterocephalus silvicola* (Meigen, 1828)**

S2, S9. Rather common on the northern macro-slope of the Saur in wet meadows along rivers and streams in the lowlands at 800–1100 m.

***Carterocephalus palaemon* (Pallas, 1771)**

S14. A single very worn specimen was found in a meadow in a stream valley.

***Thymelicus lineola* (Ochsenheimer, 1808)**

S14, S15. Rare. Steppe slopes.

***Ochlodes sylvanus* (Esper, [1778])**

S9. Common on the northern macro-slope of the Saur in wet meadows along rivers and streams in the lowlands at 800–1100 m.

***Hesperia comma* (Linnaeus, 1758)**

S5, S14. Rather rare. Steppe slopes.

PAPILIONIDAE

***Iphiclides podalirius* (Linnaeus, 1758)**

M1, M8, M4, S1, S2, S4. Common on clearings along rivers and streams in foothills and the lower mountain zone at 500–1200 m.

***Papilio machaon* Linnaeus, 1758**

M2, M3, M4, M5, M8, S2, S3, S11, S12. Common in the Manrak and Saur at 600–2500 m.

***Parnassius apollonius* (Eversmann, 1847)**

M8, Z4. Rather widely distributed in foothills and in the lower mountain zone of the eastern part of the Monrak but very local. Localities are very different, varying from nearly flat steppe in the valley of the Shorga River to almost upright rocky slopes of the Kusty River canyon. Number of individuals in habitats is small as well as its host plant (sometimes only one plant per 100 m²).

***Parnassius apollo* (Linnaeus, 1758)**

ssp. *tarbagataicus* Verity, 1911

Figs 7, 8

S4, S14. Steppe slopes covered by *Caragana* at 1200–1400 m. Local but numerous in habitats.

Parnassius phoebus* (Fabricius, 1793)*Figs 9–12**ssp. *sauricus* Lukhtanov, 1999

S7, S11. Numerous in alpine meadows and on stony slopes mostly at 2500–2900 m. It is interesting that one male was found on the southern macro-slope on 10 June at 1800 m. Specimens are very variable in habitus, colour pattern varies from completely developed red spots (but the second spot on hind wing small and without red center) to completely reduced (5% of individuals).

Parnassius ariadne* (Lederer, 1853)*Fig. 60**ssp. *clarus* Bryk & Eisner, 1933

M1, M2, M3, M4, M5, S1, S2, S5, S9, S11, Sa1. Everywhere in scrublands, both tall-grass and steppe meadows on mountain slopes at 1000–1400 m. More common in the Manrak where rather humid localities with *Corydalis* (Fumariaceae) are more abundant. Found also on the southern slope of the Saur but in fewer individuals and at higher altitude – 1800–1900 m. Habitats of *Corydalis* are limited as narrow band along the stream (Karagaily River).

Parnassius tenedius* Eversmann, 1851*Figs 13, 14**

Extremely rare. Only two specimens are known from the Saur: ♂, Saur, Temir-Su River, 1911 (collection of Tomsk University) and ♀, Saur, 20 km E Przhevalskoe, 24.06.2002, leg. S. V. Ovchinnikova (collection of Roman Yakovlev, Barnaul).

PIERIDAE***Leptidea sinapis* (Linnaeus, 1758)**

M5, S3, S9. Scrubland slopes in foothills and lower mountain zone at 1000–1300 m. The material was confirmed based on the genitalia structure.

***Leptidea morsei* (Fenton, 1881)**

S3. Very rare. Moist meadows.

***Aporia crataegi* (Linnaeus, 1758)**

M5, S2, S3, S9, S10, Sa1, Ch2. Everywhere. From scrubland slopes of gullies in steppes and foothills to middle mountain zone at 500–1400 m. Often appears in large numbers. N. Rubin observed a migration of this species along the Zhemenei River in 2006 as a solid band (width 10 m) for 5 hours.

***Metaporia leucodice* (Eversmann, 1843)**

S4, S9. Common on the northern macro-slope on scrubland slopes of gullies in foothills and lower mountain zone at 500–1000 m.

***Anthocharis cardamines* (Linnaeus, 1758)**

Subspecific status is unclear, close to Siberian subspecies *progressa* (Sovinsky, 1905). M8, S3, S5. Frequent along rivers and streams in forest mountain zone at 700–1500 m.

***Euchloe creusa* (Doubleday, 1847)**

ssp. *emiorientalis* Verity, 1911

M2, S3, Ch2. Rare, several specimens were found on steppe slopes of the Saur on the right bank of Chilikty valley and in the Eastern Manrak.

***Euchloe ausonia* (Hübner, [1803])**

M2. Very rare. Steppe mountain summits. Probably flies earlier (in the beginning of May).

***Pontia edusa* (Fabricius, 1777)**

Everywhere except high altitudes (up to 2200 m).

***Pontia callidice* (Hübner, [1803])**

S7, S11. Frequent in alpine meadows and in stony mountain tundras at 2000–2700 m. Males display well-developed hilltopping behaviour.

***Pontia chloridice* (Hübner, [1813])**

M1, S9. Rare, several specimens were found on steppe slopes of the Small Zhemenei valley and on the Manrak ridge.

***Pieris brassicae* (Linnaeus, 1758)**

Z4. Common species of foothills at 500–1000 m. More frequent in anthropogenic habitats.

***Pieris rapae* (Linnaeus, 1758)**

ssp. *debilis* (Alpheraky, 1889)

Everywhere, from steppes and semideserts of the southern shore of Zaisan lake and Chilikty depression to steppe slopes of foothills and lower mountain zone in all ridges of the investigated territory at 500–1600 m.

***Pieris euorientis* (Verity, 1908)**

ssp. *saaron* Yakovlev, 2004

M4, S3, S5, S8, S11. Common species in the Saur in upper forest zone and in subalpine meadows at 1500–2300 m. On the northern macro-slope it inhabits only the forest zone along the Terekty River; it was not found on the Alatai pass and southwards. On the southern macro-slope very common on slopes in mountain valleys at 1200–2500. Single specimens were found on the Manrak. Fly period: end of May–June.

***Colias erate* (Esper, [1805])**

M1, M4, M8, Z3, S1, Ch2. Common species in steppes and on steppe slopes of foothills and upper mountain zone at 500–1300 m. Common in anthropogenic landscapes.

***Colias hyale* (Linnaeus, 1758)**

M4, M8, S4. Frequent on steppe slopes of foothills and upper mountain zone at 700–1300 m.

***Colias thisoa* Ménétries, 1832**

S5, S6, Ch2. Local but rather frequent in its habitats. Meadows of upper forest zone and subalpic meadows at 1700–2200 m.

***Gonepteryx rhamni* (Linnaeus, 1758)**

M1, M4. Bushy meadows in river valleys and stream beds.

NYMPHALIDAE***Lasiommata maera* (Linnaeus, 1758)**

M1, M5, S2, S4, S5. Common. Bushy slopes of foothills and lower mountain zone, more frequent close to rocks at 1000–1800 m.

***Lasiommata petropolitana* (Fabricius, 1787)**

M4, M5, S2, S3, S6, S8, S9, S11. Common species. Slopes of gullies in foothills, more frequent in forest zone at 1300–2000 m.

***Melanargia russiae* (Esper, [1783])**

S4, S7, S10, S14, S15, Z2, Z3. Common, steppes of Zaisan depression, foothills and steppe meadows in mountains. Single specimens were observed in meadows up to 2400 m.

***Coenonympha tullia* (Müller, 1764)**

ssp. *subcaeca* (Heyne, 1894)

S7. Found at high altitudes in the Saur. Local, found in swampy alpine meadows and mountain stony tundras, sometimes at just melted snowfields at 2600–2800 m.

Coenonympha glycerion* (Borkhausen, 1788)*Figs 27, 28**

ssp. *iphina* Staudinger, 1892

S4, S9, S10, S14. Local and scanty. Moderately wet meadows in depressions between mountains on the northern macro-slope of the Saur at 500–1300 m.

***Coenonympha amaryllis* (Stoll, 1782)**

S4, S10. Common species on steppe slopes of foothills and in upper mountain zone at 500–1300 m.

***Coenonympha pamphilus* (Linnaeus, 1758)**

M4, M8, S2, S10, Ch2. Common on slopes of gullies in foothills and steppe meadows in middle mountain zone at 600–1600 m.

***Coenonympha oedippus* (Fabricius, 1787)**

S4. Single specimens were found in wet meadows in the valley of the Terekty River at 1200 m.

***Coenonympha sunbecca* (Eversmann, 1843)**

Modern records from the Saur are absent. Described from “... in campis aridis ad lacum Noor-Saisan”, probably can be found in the Chinese part of the range.

***Triphysa phryne* (Pallas, 1771)**

M1, M8, S1, S8. Rare. Several specimens were found on steppe slopes of the Eastern Saur and Manrak at 700–1800 m.

***Hyponephele lycaon* (Rottemburg, 1775)**

ssp. *catamelas* (Staudinger, 1886)

S4, S14, S15. Frequent. Steppe slopes in foothills and lower mountain zone, mostly near rock exposures at 700–1300 m.

***Hyponephele lupina* (Costa, 1836)**

ssp. *intermedia* (Staudinger, 1886)

S15, Z2, Z3. Common in steppes and foothills. Stony and clay slopes of gullies at 600–1000 m.

***Hyponephele dysdora* (Lederer, 1869)**

Stated for Saur by Lukhtanov & Lukhtanov (1994: fig. 137). Not found by us.

***Hyponephele interposita* (Erschoff, 1874)**

S15, Z2. Numerous in foothill steppes and semi-deserts. Clay slopes of gullies and droves at 600–1000 m.

***Hyponephele huebneri* Koçak, 1980**

ssp. *ambialtaica* Kosterin, 2002

Stated for the southern part of the Zaysan valley (Lukhtanov & Lukhtanov 1994: fig. 129). Not found by us.

***Hyponephele naricina* (Staudinger, 1870)**

Z3. Found in large numbers in foothill stony semideserts and clay hills of the Eastern Manrak at 600–800 m.

***Hyponephele cadusina* (Staudinger, 1881)**

Stated for the Saur (Lukhtanov & Lukhtanov 1994: fig. 122). Not found by us.

Erebia haberhaueri* Staudinger, 1881*Figs 19, 20**

S5. Moreover, known by the specimens collected by P. Suschkin, A. Jacobson and K. Kolesnichenko from the following localities: S. slope of Saur, Tik-Bulak spring; upper stream of Ujdene River; Mai-Chat loc.; S from Kyzyl-Kiya vill. (Churkin 2005a). Meadows in forest zone at 2200–2500 m.

Erebia sibirica* Staudinger, 1881 stat. rev.*Figs 21–26, 29**

S7. Found in large numbers in alpine and *Carex* meadows at 2500–2800 m.

Systematic notes. The taxon *sibirica* Staudinger, 1881 was described for populations from the Saur and Tarbagatai “... auf dem Tarbagatai in großen Stücken gefangen ...” (Staudinger 1881: 270) in primary combination *Erebia Tyndarus* Esp. *Sibirica*. Later Warren (1936) suggested the combination *Erebia callias sibirica*. Beside this combination Warren treated all Siberian taxa from the *E. tyndarus* (*altajana* Staudinger, 1901 (Altai) and *simulata* Warren, 1933 (E. Sayan)) group as subspecies of *Erebia callias* Edwards, 1871, described from “Mountains Colorado [Aidaho, USA]”. From this moment all records of this group for Kazakh taxa were mentioned as subspecies of *E. callias*. Also several subspecies were described: *Erebia callias tscherskiensis* Dubatolov, 1992 (E. Siberia, Yakutia, Cherskyi Mts, 185 km NW ust’-Nera) and *Erebia callias chastilovi* Churkin, 2003 (Mongolian Altai, 30 km S Biger). P. Bogdanov (2008) was the first person who suggested treating *sibirica* Staudinger, 1881 as a bona species, proved in his opinion by important differences in the arming of valvae. In the same work he described *Erebia churkini* Bogdanov, 2008 from Polar Ural. Later (Yakovlev 2012), the specific status of *E. chastilovi* was confirmed and two taxa from Mongolia were described – *E. chastilovi nomada* Yakovlev, 2012 and *E. przhevalskii* Yakovlev, 2012. This group of taxa requires a major revision.

For verification of P. Bogdanov’s opinion we performed an investigation of habitus characters of a large number of males and females. We also carried out a study of genitalia of 6♂♂ and 2♀♀ of *E. sibirica* from “Saur Mts., Tas Mt., 2350–2600 m, 47°15’N; 85°04’E, 20–22.vii.2011, leg. R.V. Yakovlev”. It was found that external characters are very unreliable; only the less developed brown field on the forewing of both sexes and the specific greyish colouration of the hindwing underside in males can be mentioned as differentiating characters. However, the comparison of genital characters shows significant differences from all Asian and American taxa of the group. Description of genitalia is presented herein.

Male genitalia. Uncus moderately long, slightly curved ventrally, tegumen stout, subunci long, thick, falcate. Valvae moderately wide, smoothly curved in middle third, caudal third on costal edge has specific arming which consists of a massive sharp caudally directed tooth and three small teeth, gradually shortening towards the caudal direction. Arming of valvae slightly varies, it is expressed in teeth length and certain skewness. Phallus short and thick, with obtuse apex, vesica without cornuti. Juxta saddle-shaped, well sclerotised. Saccus medium-sized, directed backwards. Genitalia differ well from *E. callias callias*, *E. callias altajana*, *E. callias simulata*, *E. callias tscherskiensis*, *E. chastilovi* and *E. chastilovi nomada* which have the costal edge of valvae with smaller area of arming. The closest species are *E. przhevalskii* and *E. churkini* which have significant differences: very thin caudal end of valva (4–5 times thinner than middle part of valva) in *E. przhevalskii* and double the largest (proximal) tooth on costal edge of valva, valva thinner and somewhat straight in *E. churkini*.

Female genitalia. With U-shaped antevaginal plate placed on comparatively long basal procession. Bursa with paired band-like signum (bands of sclerotisation very close to each other).

***Proterebia afra* (Fabricius, 1787)**

M4, Sa1. Multiple specimens. Probably peak of flight is in the end of April until the beginning of May. Steppes in foothills and low mountain zone up to 1500 m.

***Arethusana arethusa* ([Denis & Schiffermüller], [1775])**

S14. Steppe slopes, rare.

***Oeneis tarpeia* (Pallas, 1771)**

M1, M2, M4, M5, S1, S2, S4, S8, S9, S11, Sa1. Frequent on steppe slopes in middle mountain zone and in alpine meadows of the Saur and Manrak. More common at 1000–1500 m, but in the area of the Shakpartas Mt. we observed single specimens at 2700 m. Common on the Saikan ridge.

***Oeneis mulla* Staudinger, 1881**

Figs 17, 18

M5, S1, S12. Local. Found in the Saur, Saikan and in the eastern part of the Manrak (Lukhtanov 1984; Lukhtanov & Eitchberger 2000). Inhabits abrupt steppe mountain slopes at 600–1600 m. Males generally prefer rocks on crests of ridges. Defence of individual territory well developed, and they chase not only conspecific individuals but also larger species such as *Papilio machaon* and *Aglais urticae*. Females hide in grass near foots of rocks and on open slopes and prefer not to fly. Peak of flight is in the first half of the day, the rest of the time butterflies spend in niches of vertical walls and in splits of rocks.

***Oeneis fulla* (Eversmann, 1851)**

Figs 15, 16

S7, S8, S13. Common in mountain tundras and in alpine meadows of the Saur at 2000–2800 m. Defence of individual territory by males is well developed as in the

previous species, but specimens of *O. fulla* avoid large rock exposures by inhabiting flatter slopes and tops, and use large stones as look-out-stations. Sitting on the ground, the butterflies immediately expose the maximal area of their wings to the sunlight.

***Hipparchia autonoe* (Esper, 1783)**

S4, S5, S14, S15, Z3. Numerous in foothill steppes and on steppe slopes at middle altitudes at 1500 m. Usually adhere to clay or stony slopes of gullies and rocky areas in mountains.

***Minois dryas* (Scopoli, 1763)**

S14. Rare, found in forest zone.

***Satyrus ferula* (Fabricius, 1793)**

ssp. *altaica* Grun-Grshimailo, 1893

S15. Common on steppe slopes.

***Pseudochazara hippolyte* (Esper, [1784])**

S4, S15, Z2, Z3. Frequent on stony steppe slopes at 500–1500 m. Males prefer tops of hills and places near crests in mountains.

***Chazara briseis* (Linnaeus 1764)**

ssp. *meridionalis* (Staudinger, 1886)

S14, S15, Z5. Frequent. Stony semideserts and steppes, slopes of gullies, dry gorges in mountains at 500–1500 m.

***Chazara enervata* (Alpheraky, 1881)**

S15, Z2. Common, inhabits stony and clay foothill steppes and semideserts and rocky steppe slopes and gorges in mountains at 500–1300 m.

***Chazara heydenreichi* (Lederer, 1853)**

S15. Habitats similar to the previous species.

***Limenitis helmanni* Kindermann in Lederer, 1853**

Stated for the Saur (Lukhtanov & Lukhtanov 1994: fig. 165). Not found by us.

***Limenitis sidyi* Kindermann in Lederer, 1853**

Stated for the Saur (Lukhtanov & Lukhtanov 1994: fig. 165). Not found by us.

***Limenitis populi* (Linnaeus, 1758)**

S4, S14. Extremely rare, river valleys.

***Neptis rivularis* (Scopoli, 1763)**

Almost everywhere except at high altitudes. Inhabits shrubby slopes of gullies in foot-hill steppes, river and stream valleys in mountains at 500–1500 m.

***Polygonia c-album* (Linnaeus, 1758)**

M1, M3, S1, S3, S9, S14. Almost everywhere but sparse. Found in different habitats except deserts and high altitudes. Frequent in anthropogenic habitats.

***Polygonia interposita* (Staudinger, 1881)**

S9. Sparse, only few specimens were collected in forest zone in the valley of the Small Zhemenei at 1200–1400 m.

***Nymphalis antiopa* (Linnaeus, 1758)**

S14. Rare. Forest zone.

***Nymphalis vaualbum* ([Denis & Schiffermüller], 1775)**

S14. Common in forest zone.

***Nymphalis xanthomelas* (Esper, [1781])**

S14. Common in forest zone.

***Vanessa cardui* (Linnaeus, 1758)**

Everywhere in steppes and semideserts of foothills. Migrating individuals inhabit all altitudes up to the nival zone.

***Aglais urticae* (Linnaeus, 1758)**

Common in forest zone, up to alpine meadows at 1000–2700 m in alpine zone of mountain steppes.

***Inachis io* (Linnaeus, 1758)**

S14. Rare. Forest zone.

Araschnia levana* (Linnaeus, 1758)*Figs 30, 31**

S9. Found only in one place – brake near small stream (inflow of the Small Zhemenei) but in rather large numbers. Recorded here for the Saur for the first time.

***Argynnis pandora* ([Denis & Schiffermüller], 1775)**

M1, S1, S5, S14. Forest zone at 1500–1700 m.

***Argynnis niobe* (Linnaeus, 1758)**

S14. Rare. Forest zone.

***Argynnis adippe* ([Denis & Schiffermüller], 1775)**

S14. Rare. Forest zone.

***Argynnis aglaja* (Linnaeus, 1758)**

S4, S7, S14, S5. Common in forest zone. Frequently rises up to 2500 m.

***Brenthis ino* (Rottemburg, 1775)**

S4, S14. Wet meadows at 1200–1500 m.

***Brenthis daphne* (Bergsträsser, 1780)**

Stated for the Saur (Tuzov 2003). Not found by us.

***Brenthis hecate* ([Denis & Schiffermüller], 1775)**

Stated for the Saur (Tuzov 2003). Not found by us.

***Issoria lathonia* (Linnaeus, 1758)**

Everywhere in all zones except deserts.

***Clossiana selenis* (Eversmann, 1837)**

Fig. 39

ssp. *sibirica* (Erschoff, 1870)

S11, S14. Extremely rare. Recorded for the Saur for the first time.

***Clossiana euphrosyne* (Linnaeus, 1758)**

S9, S14. Wet meadows in river and stream valleys in forest zone at 1500–1700 m.

***Clossiana frigga* (Thunberg, 1791)**

Figs 36–38

ssp. *annae* (Sushkin, 1906)

S7. Found by us only in cirques near the Tas mountain, but judging by its frequency it should inhabit all highlands of the Saur. It may be local but probably can be found in large numbers in suitable habitats. More frequent in boggy meadows but also found in stony tundras and even crests of ridges (but with smoothed relief). We found an interesting peculiarity: both males and females appear almost at the same time but probably the flight period is short. The first mass flight was at the bottom of the cirque but on the next day fresh specimens were only found at 100 m higher altitude (just a few specimens were at the bottom). For a few days butterflies were observed just on crests between cirques and there were no specimens lower down, thus total flight period is about a week.

***Clossiana freija* (Thunberg, 1791)**

ssp. *pallida* (Elwes, 1899)

S7, S13. Multiple specimens, it probably inhabits all parts of the plateau of the Saur. Found in stony alpine meadows and mountain tundras at 2500–2800 m. One of the first species which appears in the first decade of June and flies until the end of June.

Clossiana dia* (Linnaeus, 1767)ssp. alpina* (Elwes, 1899)

S3, S6. Infrequent, just a few specimens were found in the forest zone at 1500–1700 m.

***Boloria altaica* (Grum-Grshimailo, 1887)**

S7. Abundant in wet alpine meadows and mountain tundras over 2500 m.

Euphydryas aurinia* (Rottemburg, 1775)*Figs 32, 33, 61***ssp. calima* Bolshakov & Korb, 2012

Common species from foothills to alpine meadows through the region at 500–2000 m.

Euphydryas maturna* (Linnaeus, 1758)ssp. staudingeri* (Wnukowsky, 1929)

S9. Bushy clearings in valleys of small rivers and streams in forest zone at 1000–1400 m.

Euphydryas iduna* (Dalman, 1816)*Fig. 34***ssp. jacobsoni* Yakovlev, 2011

S7, S13. Very rare, just 3 specimens were collected in mountain tundras at 2500–2600 m. The subspecies was described based on a large series with the following labels: ‘E. Kazakhstan, Saur Mts., upper stream of B. Dzhemenej River, 2150 m, 13–15.vi.1910, A. Jakobson’.

Melitaea didyma* (Esper, [1777])ssp. neera* Fischer de Waldheim, 1840.

M5, M6, M8, S4, S9, S10, Sa1. Rather common in desert foothills and on dry slopes in the lowland of the northern macro-slope of the Saur, Manrak and Saikan at 500–1300 m.

Melitaea ala* Staudinger, 1892*Fig. 35**

S4. Very rare and local, just 2 specimens were collected in steppe dry meadow in the Terekty valley at 1300 m. Reported for Saur by Kolesnichenko (1999).

***Melitaea trivia* ([Denis & Schiffermüller], 1775)**

M1, M8, M4. Rather rare and local, inhabits steppe mountain slopes in lower and middle mountain zone at 1000–1500 m.

***Melitaea phoebe* ([Denis & Schiffermüller], 1775)**

M5, S4, S9, S10, S14. Frequent on slopes of gullies in foothills and in lower and middle mountain zone at 1000–1500 m.

***Melitaea cinxia* (Linnaeus, 1758)**

M2, M5, S1, S2, S4, S6, S9, S12, Sa1. Common species of dry meadows and steppe

mountain slopes in lower and middle mountain zone at 1000–1500 m. In contrast to European populations dark-coloured females rather common.

***Melitaea arduinna* (Esper, [1784])**

M1, M2, M3, M5, M8, S1, S2, S9, S11, S12, Sa1. Frequent on steppe mountain slopes in lower mountain zone at 700–1300 m.

***Melitaea athene* Staudinger, 1881**

M2, M3, M8. Local but widely distributed on the northern slopes of the Manrak, Saur and Saikan in foothills at 500–800 m. Like the others species of the group it inhabits dry stony slopes, both abrupt and flat, and prefers scree slopes (Tuzov 2000).

***Mellicta athalia* (Rottemburg, 1775)**

ssp. *reticulata* Higgins, 1955

M5, S4, S6, S9, S10, S14. Frequent in meadows of the lowland and in forest zone of mountains at 1200–1500 m.

***Mellicta britomartis* (Assmann, 1847)**

M5, S4, S9. Local and scanty in moderately wet meadows in lower mountain zone at 1200–1400 m.

***Mellicta menetriesi* (Caradja, 1895)**

Figs 40, 41

ssp. *saurica* Yakovlev, 2007

M5, S8, S9, S12, Sa1. Common, dry and moderately wet, often rocky, slopes of mountains at 1200–1700 m.

LYCAENIDAE

***Neolycaena rhymnus* (Eversmann, 1832)**

M1, M2, Sa1. Steppe slopes with bushes.

***Neolycaena submontana* Zhdanko, 1996**

Figs 45, 46, 65

ssp. *saurica* Zhdanko, 1998

M1, M2, M3, M6, S1, S2, S10, Sa1, Z2. Abundant on steppe and desert stony slopes in foothills, prefers bushy areas covered by *Caragana* (Fabaceae) at 500–1000 m.

***Neolycaena tengstroemi* (Erschoff, 1874)**

ssp. *balchashensis* Zhdanko, 1998

Z1, Z6, Z7. Frequent in semideserts and dry steppes of the shore of Zaisan lake at 400–600 m.

***Callophrys rubi* (Linnaeus, 1758)**ssp. *sibirica* Heyne, [1895]

M5, S1, S2, S8, S11, S12. Frequent, inhabits brakes in valleys and mountain slopes in forest zone at 1200–1500 m.

***Callophrys suaveola* (Staudinger, 1881)**

M2, M5. Very rare, single specimens occur on mountain slopes, usually on bushes of *Spiraea* at 1200–1500 m. Localities were published by Krupitsky & Yakovlev (2012).

***Lycaena helle* ([Denis & Schiffermüller], 1775)**ssp. *phintonis* Fruhstorfer, 1910

S3, S5, S8, S11. Common species. Inhabits moist meadows in river and stream valleys, subalpine meadows and mountain slopes where scanty in first half of June at 1500–2500 m.

***Lycaena phlaeas* (Linnaeus, 1761)**

S11, S14. Rare species, meadows.

***Lycaena hippothoe* (Linnaeus, 1761)**

S14. Very rare, meadows.

***Lycaena dispar* (Haworth, 1803)**ssp. *rutilus* (Werneburg, 1864)

S14. Very rare, meadows.

***Lycaena alciphron* (Rottemburg, 1775)**

S14. Very rare, meadows.

***Lycaena thersamon* (Esper, [1784])**

M2, M4, S1, S16, Sa1. Locally. On the territory in question it inhabits dry steppes in foothills and steppe mountain slopes at 500–1300 m.

Athamanthia dimorpha* (Staudinger, 1881)*Figs 50, 51, 62**ssp. *saisana* Lukhtanov, 2000

Z3. Local but numerous in its habitats. Inhabits both flat stony steppes and dry mountain slopes with slide-rocks and rock exposures in foothills at 700–1000 m.

Cupido tusovi* Lukhtanov, 1994*Figs 58, 59, 63**

Almost everywhere. Endemic to the Saur, common both on steppe slopes of depressions between mountains and in moderately wet meadows in forest zone and subalpine

meadows at 800–2400 m. Interesting peculiarity is that males from the lowland have more intensive blue suffusion whereas butterflies from subalpine zone lack the suffusion and resemble *C. minimus*.

***Cupido osiris* (Meigen, 1829)**

Almost everywhere. Common on steppe slopes of foothills and in forest zone at 500–1700 m.

***Cupido prosecusa* (Erschoff, 1874)**

Z1, Z8. Scanty, inhabits brakes in lower course of river valleys and shores of Zaisan lake.

***Tongeia fischeri* (Eversmann, 1843)**

Almost everywhere. Common in stony areas on steppe slopes of foothills and rock exposures in forest zone of mountains at 500–1900 m.

***Celastrina argiolus* (Linnaeus, 1758)**

M4, M5. Common but scanty, inhabits different biotopes, prefers brakes in river and stream valleys at 500–2000 m.

***Scolitantides orion* (Pallas, 1771)**

ssp. *johanseni* (Wnukowsky, 1934)

Almost everywhere. Inhabits steppe biotopes both in foothills and mountains, prefers stony areas at 500–2000 m.

***Pseudophilotes vicrama* (Moore, 1865)**

ssp. *schiffmuelleri* (Hemming, 1929)

M5, M8, S4, S10, S14, Sa1. Rather common but scanty. Inhabits dry stony slopes of gullies in foothills and lower mountain zone at 400–600 m.

***Praepilotes anthracias* (Christoph, 1877)**

Recorded for the Zaisan depression (Lukhtanov & Lukhtanov 1994). Not found by us.

***Glaucopsyche alexis* (Poda, 1761)**

M5, S2, S3, S4, S9, S11, S12, S14, Sa1, Ch2. Common species. Inhabits meadows of different types in foothills and forest zone of mountains at 1000–2000 m.

***Glaucopsyche argali* Elwes, 1899**

ssp. *arkhar* Lukhtanov, 1990

Extremely rare and local. Known from several localities on the northern slopes of the Saur and Manrak where it inhabits stony steppe slopes of lower mountain zone at

1000–1500 m. Described from the following localities: 20 km S Zaisan (locus typicus); Manrak, Karataitaldy loc. R. Yakovlev collected 1 ♀ in the type locality on 25.v.2000.

***Phengaris arion* (Linnaeus, 1758)**

M5, S2, S3, S4, S9, S10, S12. Scanty, found on steppe slopes in foothills and in meadows in forest zone at 500–1500 m.

***Phengaris alcon* ([Denis & Schiffermüller], 1775)**

Figs 52, 53

S4 and 5 km N Alatai Pass, 1500–1600 m a.s.l., 19.vi.2003. First record for the Saur. Extremely rare.

***Plebejus argus* (Linnaeus, 1758)**

ssp. *wolgensis* (Forster, 1936)

S3 and everywhere in Zaisan depression. Common, sometimes numerous (SW part of Zaisan depression), inhabits steppes and meadows of different types in foothills at 500–1200 m.

***Plebejus maracandicus* (Erschoff, 1874)**

ssp. *planorum* (Alpheraky, 1881)

Almost everywhere. Common, inhabits different biotopes from semideserts to moderately wet subalpine meadows in forest zone of mountains at 500–1900 m.

***Plebejus idas* (Linnaeus, 1761)**

Fig. 57

S10. Very rare. Only one male on a stony slope.

***Plebejus lepidus* Zhdanko, 2000**

Figs 55, 56, 64

Z1, Z6, Z7. Very local but rather frequent in its habitats. Bushy areas of semideserts and dry steppes in the southern part of Zaisan depression at 500–750 m. Usually adheres to bushes of its host plant *Elaeagnus rhamnoides* (L.) A. Nelson (Elaeagnaceae).

***Plebejides pylaon* (Fischer von Waldheim, 1832)**

M1, M2, M3, S1, S2, S8, S11, Sa1. Local and scanty, found by us on the southern macro-slope of the Saur in forb subalpine meadows at 1800–2000 m.

***Plebejides zephyrinus* (Christoph, 1884)**

ssp. *tarbagataiensis* Bálint, 1992

Reliably known only from the vicinity of Kenderlik Village.

***Eumedonia eumedon* (Esper, [1780])**

M5, M8, S3, S9, S14. Local and scanty. Found mostly on grass meadows along river valleys in mountains at 1000–1400 m.

***Aricia allous* (Geyer, 1837)**

ssp. *strandii* (Obraztsov, 1935)

S11, S14, Z8, Ch2. Local and scanty. Found in different biotopes but mostly on grass meadows along river valleys and stream beds in mountains at 1500–2000 m. One specimen was found in brakes in dry bed of the Zhemenei River N Zaisan at 500 m.

***Aricia agestis* ([Denis & Schiffermüller], 1775)**

Stated for the Saur (Lukhtanov & Lukhtanov 1994). Not found by us.

***Cyaniris semiargus* (Rottemburg, 1775)**

ssp. *altaianus* Tutt, 1909

M5, S3, S4, S12, S14. Common, inhabits steppe slopes of foothills in depressions between mountains and different meadows in forest zone at 1000–1400 m.

***Alpherakya sarta* (Alpheraky, 1881)**

Stated for the Saur (Lukhtanov & Lukhtanov 1994). Not found by us. In the Saur it should inhabit semidesert biotopes in northern foothills.

***Rueckbeilia fergana* (Staudinger, 1881)**

M8. Rare and local. Just one specimen was found in the Manrak on steppe brake slope of gully at 800 m.

***Rimisia miris* (Staudinger, 1881)**

S10, Sa1. Inhabits stony slopes of gullies and dry stream beds in steppes and semideserts at 500–1000 m.

***Glabroculus cyane* (Eversmann, 1837)**

ssp. *tarbagatus* (Suschkin, 1909)

M2, M3, M4, M6, S1, S2. Local and rare, found in stony dry steppe on gullies.

***Albulina orbitula* (de Prunner, 1798)**

ssp. *sajana* (Heyne, [1895])

S5, S11. Frequent. Inhabits moderately wet mountain meadows upper forest edge at 1900–2300 m.

***Agriades glandon* (de Prunner, 1798)**

Figs 47, 48

ssp. *rubini* Churkin, 2005

S7, S11. Rare and local. Inhabits rock exposures and rubbly slide-rocks at 2200–2500. Found in both localities only on exposures of red granite.

***Agriades pheretiades* (Eversmann, 1843)**

Described from “Noor-Zaisan”. The series with label ‘Sar-Tologoi, 7.07.1904’ collect-

ed by P. Suschkin is deposited in ZISP. It is unknown what part of the Sar-Tolgoi pass was explored by P. Suschkin, probably he collected on the territory of China.

***Polyommatus eros* (Ochsenheimer, [1808])**

ssp. *kaabaki* Korb, 2000

M5, S3, S4, S11, S14, S5. Local but frequent in its habitats, inhabits stony steppe meadows on slopes of lower mountain zone, river and stream valleys in forest zone and above forest zone at 1200–2000 m.

***Polyommatus icadius* (Groum-Grshimaïlo, 1890)**

Figs 42–44

S4, S14. Very local at the first site, was found only in one locality on steppe stony slope of southern exposure. Population was confined to a small area of 50 × 100 m. Specimens adhered to small bushes of host plant which grew in very small numbers among rubbly slide-rocks on slope with inclination of about 30°. In the second locality it was more common along a forest road. Subspecific status is unknown.

***Polyommatus icarus* (Rottemburg, 1775)**

Almost everywhere. Frequent, different meadows in river valleys of the lowland and forest zone at 1200–2000 m.

***Polyommatus amandus* (Schneider, 1792)**

M1, M2, M3, M5, S1, S2, S3, S4, S5, S9, Sa1. Frequent, different meadows in river valleys of the lowland and forest zone at 1200–2000 m.

***Polyommatus thersites* (Cantener, [1835])**

ssp. *orientis* (Sheljuzko, 1928)

Everywhere in steppe meadows in river valleys and on mountain slopes in forest zone at 1000–2000 m.

***Polyommatus damon* ([Denis & Schiffermüller], 1775)**

Fig. 54

ssp. *mongolensis* (Koçak, 1980)

S14. Common in meadows and on forest roads.

***Polyommatus damone* (Eversmann, 1841)**

ssp. *sibirica* (Staudinger, 1899)

Reported for the Zhemenei valley (Lukhtanov & Lukhtanov 1994). Not found by us.

***Aricia nicias* (Meigen, 1829)**

Fig. 49

ssp. *bittis* (Fruhstorfer, 1915)

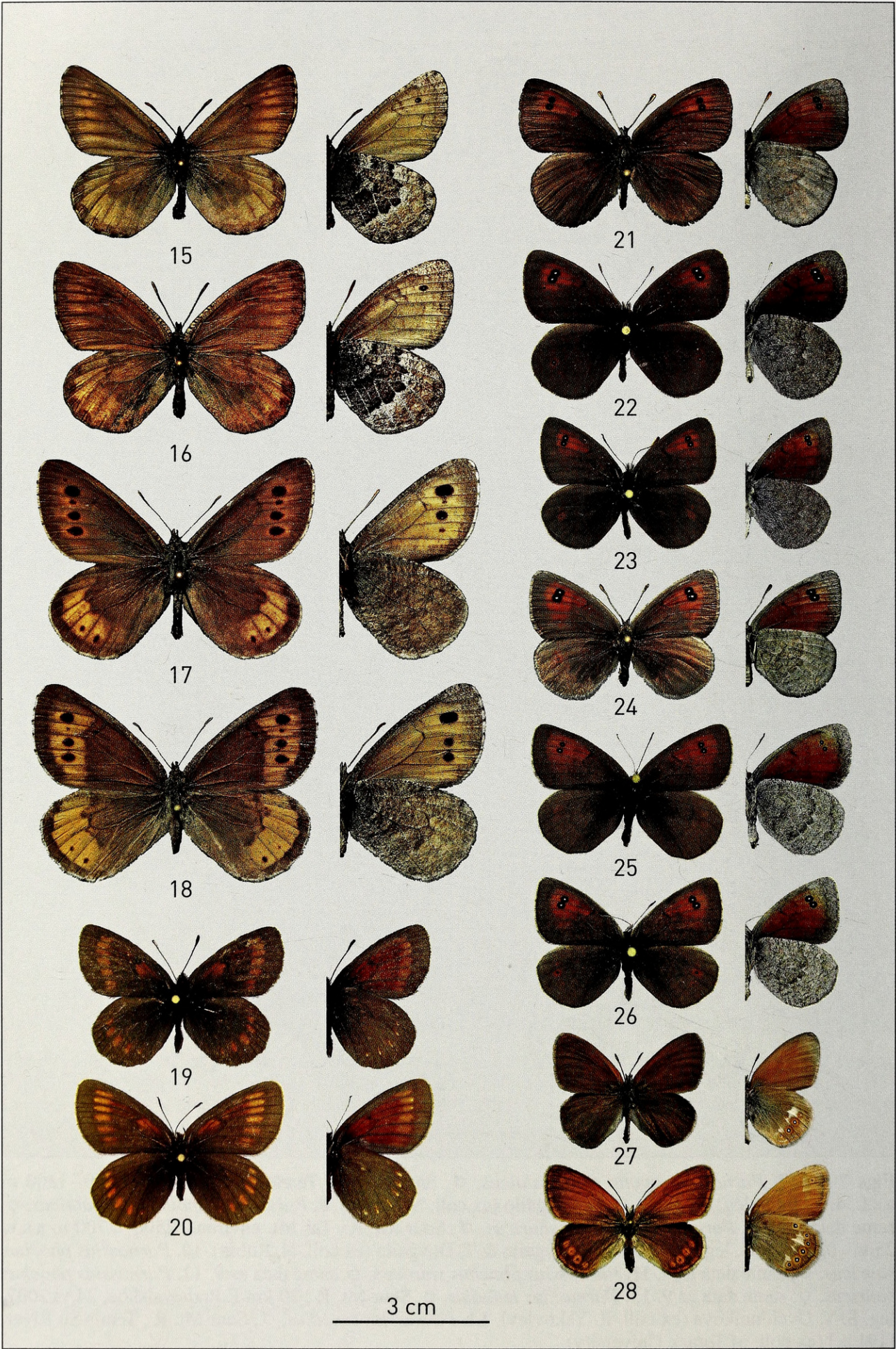
S14. Common in forest clearings. New species to the fauna of the Saur.



Figs 2–6. 2. Saur Mt. R., Chilikty Depression, 1.vi.2006 (photo: N. Rubin); 3. Saur Mt. R., Chagan-Obo River, 11.vi.2006 (photo: N. Rubin); 4. Saur Mt. R., Tas Mt., 8.vi.2006 (photo: N. Rubin); 5. Saur Mt. R., upper stream of Karagaily River, 12.vi.2006 (photo: N. Rubin); 6. Saur Mt. R., Shakpaktas Mt. environs, alpine zone, 10.vi.2006 (photo: K. Dovgailo).



Figs 7–14. 7. *Parnassius apollo tarbagataicus*, ♂, Saur Mt. R., Terekty River valley, 1200–1300 m a.s.l., 4.vii.2003, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). 8. *Parnassius apollo tarbagataicus*, ♀, same data as 7. 9. *Parnassius phoebus sauricus*, ♂, Saur Mt. R., Tas Mt. environs, 2500–2700 m a.s.l., 25.vi–03.vii.2003, leg. N. Rubin, K. Dovgailo & T. Dovgailo (ex coll. N. Rubin). 10. *Parnassius phoebus sauricus*, ♂, same data as 9. 11. *Parnassius phoebus sauricus*, ♀, same data as 9. 12. *Parnassius phoebus sauricus*, ♀, same data as 9. 13. *Parnassius tenedius*, ♀, Saur Mt. R., 20 km E Przhivalskoe, 24.vi.2002, leg. S. V. Ovchinnikova (ex coll. R. Yakovlev). 14. *Parnassius tenedius*, ♂, Saur Mt. R., Temir-Su River, [191...] (ex coll. of Tomsk University).



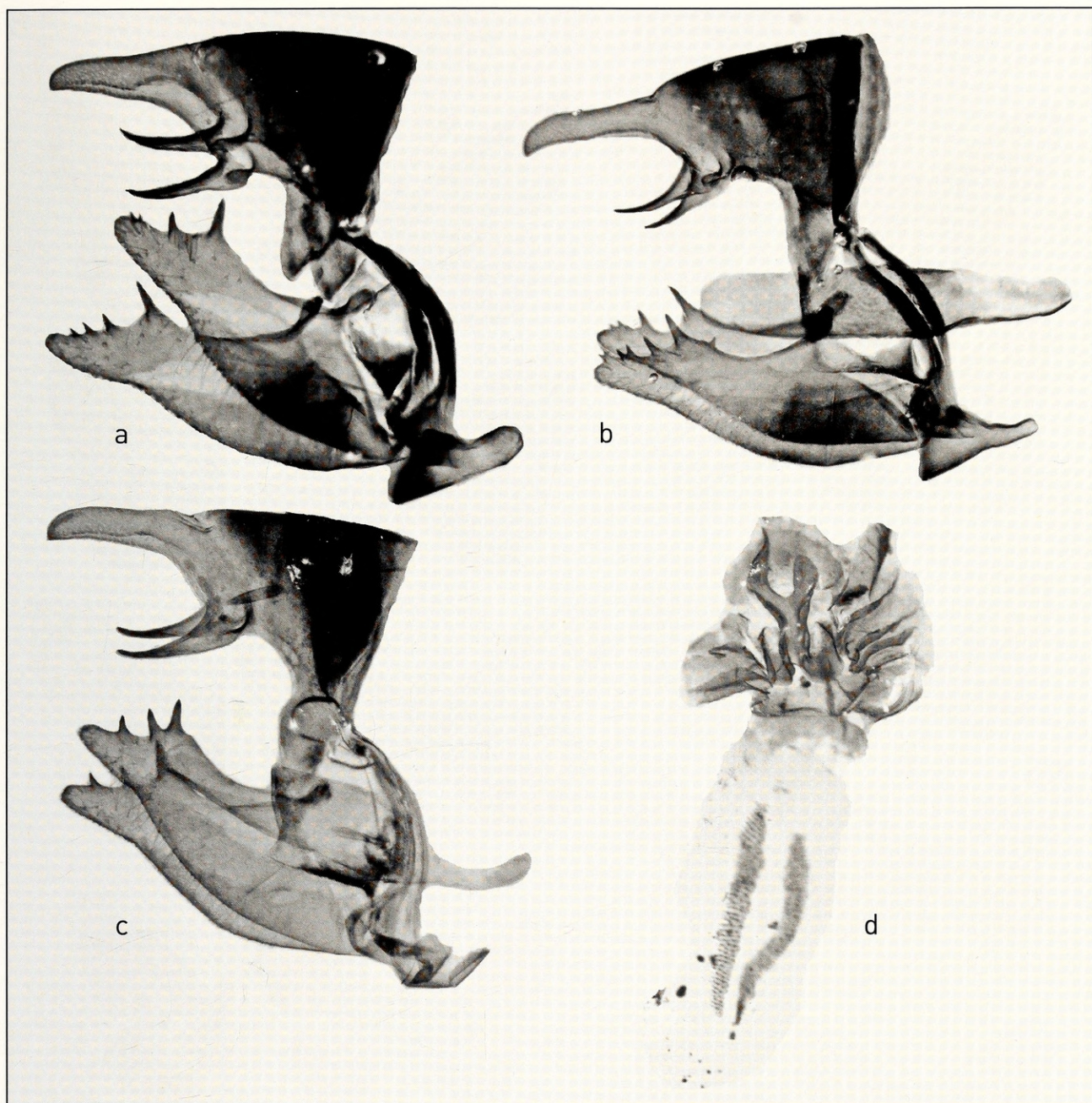


Fig. 29. Genitalia of *Erebia sibirica* Staudinger. **a–c**, ♂♂, lateral projection; **d**, ♀, frontal projection.

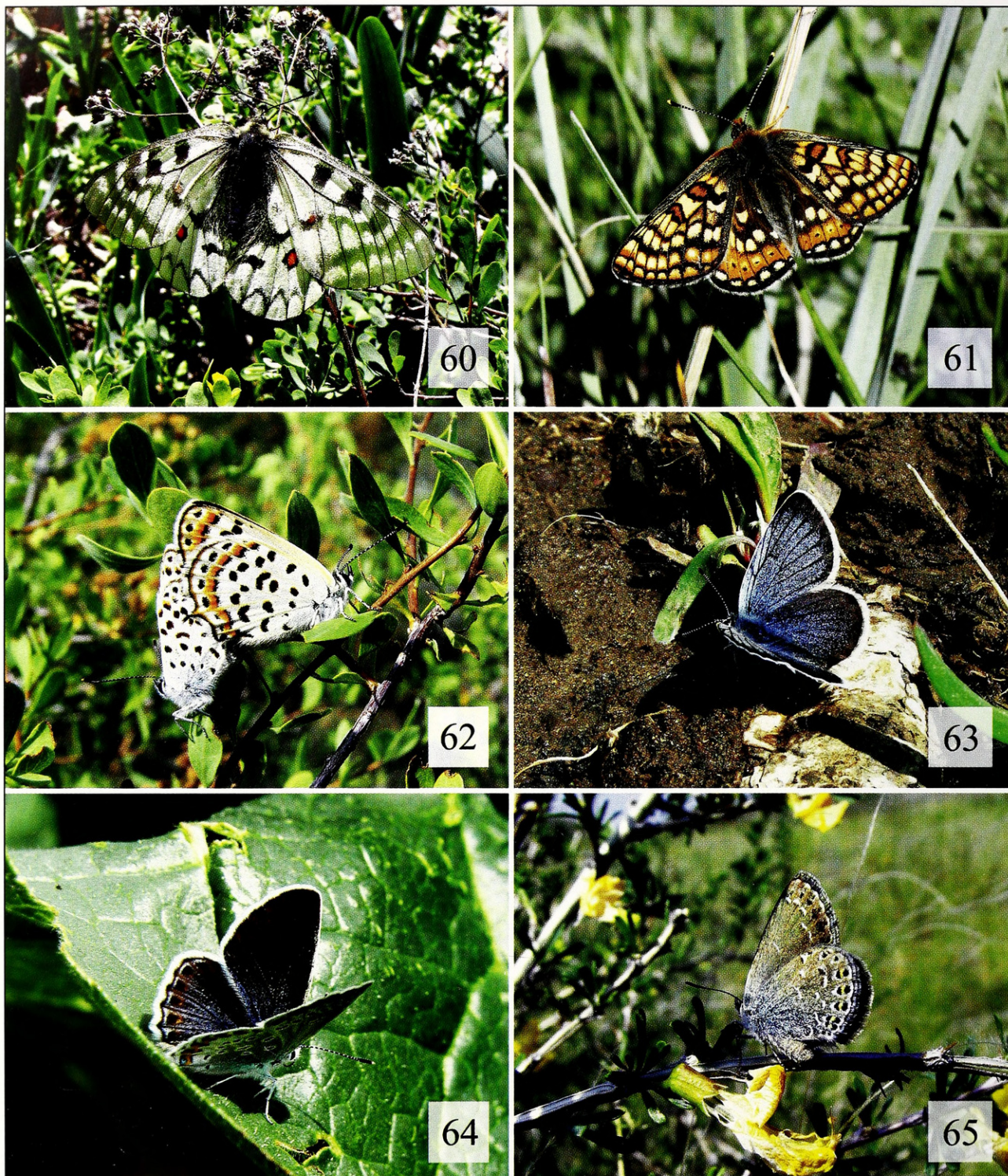
← **Figs 15–28.** **15.** *Oeneis fulla*, ♂, Saur Mt. R., Shakpaktas Mt. environs, 2600–2700 m a.s.l., 10–14. vi.2006, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **16.** *Oeneis fulla*, ♀, Saur Mt. R., Tas Mt. environs, 2800 m a.s.l., 27.vi.2003, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **17.** *Oeneis mulla*, ♂, E Manrak Mt. R., N 47°18'40", E 84°36'42", 1500 m a.s.l., 1–4.vi.2006, leg. K. Dovgailo (ex coll. N. Rubin). **18.** *Oeneis mulla*, ♀, E Manrak Mt. R., N 47°18'40", E 84°36'42", 1400–1600 m a.s.l., 27–29.v.2011, leg. N. Rubin (ex coll. N. Rubin). **19.** *Erebia haberhaueri*, ♂, Saur Mt. R., Alatai Pass, 2010 m a.s.l., N 47°18', E 85°08', 23.vii.2011, leg. R. Yakovlev (ex coll. R. Yakovlev). **20.** *Erebia haberhaueri*, ♀, same data as 19. **21.** *Erebia sibirica*, ♂, Saur Mt. R., Tas Mt. environs, 2500 m a.s.l., 25.vi.2003, leg. N. Rubin (ex coll. N. Rubin). **22.** *Erebia sibirica*, ♂, Saur Mt. R., Tas Mt. environs, N 47°15', E 85°04', 2350–2600 m a.s.l., 20–22.vii.2011, leg. R. Yakovlev (ex coll. R. Yakovlev). **23.** *Erebia sibirica*, ♂, same data as 22. **24.** *Erebia sibirica*, ♀, Saur Mt. R., Tas Mt. environs, 2000 m a.s.l., 21.vi.2003, leg. K. Dovgailo (ex coll. N. Rubin). **25.** *Erebia sibirica*, ♀, same data as 22. **26.** *Erebia sibirica*, ♀, same data as 22. **27.** *Coenonympha glycerion iphina*, ♂, Saur Mt. R., Terekty River valley, 1300 m a.s.l., 18.vi.2003, leg. N. Rubin (ex coll. N. Rubin). **28.** *Coenonympha glycerion iphina*, ♀, Saur Mt. R., Terekty River valley, 1300 m a.s.l., 4.vii.2003, leg. N. Rubin (ex coll. N. Rubin).



Figs 30–41. **30.** *Araschnia levana*, ♂, Small Zhemenei River valley, 1100 m a.s.l., 06–07.vi.2006, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **31.** *Araschnia levana*, ♀, same data as 30. **32.** *Euphydryas aurinia calima*, ♂, E Monrak Mt. R., N 47°18'40", E 84°36'42", 1350 m a.s.l., 27–29.v.2011, leg. N. Rubin & Yu. Sobolevskaya (ex coll. N. Rubin). **33.** *Euphydryas aurinia calima*, ♀, same data as 32. **34.** *Euphydryas iduna jakobsoni*, ♂, Saur Mt. R., upper stream of Karagaily River, 2000 m a.s.l., 10–12.vi.2006, leg. Yu. Sobolevskaya (ex coll. N. Rubin). **35.** *Melitaea ala ala*, ♂, Saur Mt. R., Terekty River valley, 1200–1300 m a.s.l., 4.vii.2003, leg. N. Rubin (ex coll. N. Rubin). **36.** *Clossiana frigga annae*, ♂, Saur Mt. R., Tas Mt. environs, 2500–2700 m a.s.l., 25.vi–03.vii.2003, leg. N. Rubin, K. Dovgailo & T. Dovgailo (ex coll. N. Rubin). **37.** *Clossiana frigga annae*, ♂, same data as 36. **38.** *Clossiana frigga annae*, ♀, same data as 36. **39.** *Clossiana selenis sibirica*, ♂, Saur Mt. R., upper stream of Karagaily River, 1900 m a.s.l., 10–12.vi.2006, leg. N. Rubin (ex coll. N. Rubin). **40.** *Mellicta menetriesi saurica*, ♂, E Manrak Mt. R., N 47°18'40", E 84°36'42", 1300 m a.s.l., 30.v–4.vi.2006, leg. N. Rubin, K. Dovgailo (ex coll. N. Rubin). **41.** *Mellicta menetriesi saurica*, ♀, E Manrak Mt. R., N 47°18'40", E 84°36'42", 1300 m a.s.l., 27–29.v.2011, leg. N. Rubin & Yu. Sobolevskaya (ex coll. N. Rubin).



Figs 42–59. **42.** *Polyommatus icadius*, ♂, Saur Mt. R., Terekty River valley, 1200–1300 m a.s.l., 4.vii.2003, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **43.** *Polyommatus icadius*, ♀, same data as 42. **44.** *Polyommatus icadius*, ♂, Saur Mt. R., 24 km S Zaisan, upper stream of Bolshoi Zhemenei River, 1650 m, N 47°14', E 84°56', 17–19.vii.2011, leg. R. Yakovlev (ex coll. R. Yakovlev). **45.** *Neolycaena submontana saurica*, ♂, NE Manrak Mt. R., Saryshyi environs, 700–900 m a.s.l., 04–05.vi.2006, leg. N. Rubin (ex coll. N. Rubin). **46.** *Neolycaena submontana saurica*, ♀, same data as 45. **47.** *Agriades glandon rubini*, paratypus, ♂, Saur Mt. R., Tas Mt. environs, 2300 m a.s.l., 25.vi.2003, leg. N. Rubin (ex coll. N. Rubin). **48.** *Agriades glandon rubini*, paratypus, ♀, same data as 47. **49.** *Aricia nicias bittis*, ♂, Saur Mt. R., 24 km S Zaisan, upper stream of Bolshoi Zhemenei River, 1650 m, N 47°14', E 84°56', 17–19.vii.2011, leg. R. Yakovlev (ex coll. R. Yakovlev). **50.** *Athamanthia dimorpha saisana*, ♂, Zaisan Lake Area, Espe River valley, 6 km NE Tolagai Mt., 600 m a.s.l., 17.vi.2006, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **51.** *Athamanthia dimorpha saisana*, ♀, same data as 50. **52.** *Phengaris alcon*, ♂, Saur Mt. R., Terekty River valley, 1200 m a.s.l., 18–19.vi.2003, leg. N. Rubin (ex coll. N. Rubin). **53.** *Phengaris alcon*, ♀, same data as 52. **54.** *Agrodiaetus damon mongolensis*, ♂, Saur Mt. R., 24 km S Zaisan, upper stream of Bolshoi Zhemenei River, 1650 m, N 47°14', E 84°56', 17–19.vii.2011, leg. R. Yakovlev (ex coll. R. Yakovlev). **55.** *Plebejus lepidus*, ♂, Zaisan Lake Area, Shorga River valley, 450 m a.s.l., 17.vi.2006, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **56.** *Plebejus lepidus*, ♀, same data as 55. **57.** *Plebejus idas*, ♂, Saur Mt. R., Zhemenei River valley, 5 km S Zaisan, 700 m a.s.l., 8.vi.2006, leg. N. Rubin (ex coll. N. Rubin). **58.** *Cupido tusovi*, ♂, E Manrak Mt. R., N 47°18'40", E 84°36'42", 1300 m a.s.l., 30.v–4.vi.2006, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin). **59.** *Cupido tusovi*, ♀, Saur Mt. R., Alatai Pass environs, 1500–1900 m a.s.l., 19–20.vi.2003, leg. N. Rubin & K. Dovgailo (ex coll. N. Rubin).



Figs 60–65. 60. *Parnassius ariadne clarus*, ♀, E Manrak, 31.v.2006 (photo: N. Rubin). 61. *Euphydryas aurinia calima*, ♀, E Manrak, 29.v.2011 (photo: N. Rubin). 62. *Athamanthia dimorpha saisana*, in copula, NW Manrak, 17.vi.2006 (photo: N. Rubin). 63. *Cupido tusovi*, ♂, Saur, Small Zhemenei River valley, 06.vi.2006 (photo: N. Rubin). 64. *Plebejus lepidus*, ♀, Zaisan Lake Area, Shorga River valley, 17.vi.2006 (photo: K. Dovgailo). 65. *Neolycaena submontana saurica*, ♂, NE Manrak, 8.vi.2006 (photo: N. Rubin).

Conclusions

Altogether 159 butterfly species (Hesperiidae: 15; Papilionidae: 7; Pieridae: 17; Nymphalidae: 71; Lycaenidae: 49) have been recorded in the Saur Mountains. Four species, *Araschnia levana*, *Clossiana selenis*, *Phengaris alcon* and *Aricia nicias* are reported for the Saur for the first time. The butterfly fauna of the Saur comprises the following elements: Transpalaeartic, West Palaeartic, Dzhungarian and Siberian, as well as endemic species (5 species, or 3% of the total).

Acknowledgements

We are indebted to Petr Ustyuzhanin, Alexandr Shmakov, Kirill Dovgailo, Sergej Smirnov, Dmitrij German, Anatoliy Krupitsky, Vyacheslav Doroshkin, and to our drivers M. Sidorov and V. Yevdoshenko. We also thank two anonymous reviewers whose comments helped improve the manuscript.

References

- Bálint, J., A. Kertész & V. A. Lukhtanov 1993. A survey of the Subgenus *Plebejides* Sauter, 1968 (Lepidoptera, Lycaenidae). – Entomologicheskoe Obozrenie (1992) **71** (4): 863–886. [In Russian].
- Bogdanov, P. V. 2003. Type material of *Clossiana frigga annae* (Suschkin, 1906) (Lepidoptera, Nymphalidae). – Trudy Gosudarstvennogo Darvinovskogo muzeya **6**: 125–126. [In Russian].
- Bogdanov, P. V. 2008. Review of Satyrid Butterflies of *Erebia callias* Edwards, 1871 (Lepidoptera, Satyridae) with description of new species from the Polar Ural. – Trudy Gosudarstvennogo Darvinovskogo muzeya **12**: 161–173. [In Russian].
- Bolshakov, N. M. 1987. Dendroflora of Saur-Tarbagataj Mountains area. – Novosibirsk. 174 pp. [In Russian].
- Bolshakov, L. G. & S. K. Korb 2012. To the systematics and nomenclature of fritillares of the *Euphydryas aurinia* (Rottemburg, 1775) – group from Siberia and Central Asia (Lepidoptera: Nymphalidae). – Eversmannia **31–32**: 38–48. [In Russian].
- Churkin, S. V. 2003. New taxa of butterflies (Lepidoptera, Rhopalocera) from Mongolia. – Helios **4**: 160–178.
- Churkin, S. V. 2005a. Notes on the *Erebia maurisius* complex with the descriptions of two new subspecies (Lepidoptera, Satyridae). – Helios **6**: 146–168.
- Churkin, S. V. 2005b. A review of *Agriades glandon* (de Pruner, 1798) from the Asian part of Russia and Mongolia with notes on the zoogeography of the complex (Lepidoptera, Lycaenidae). – Helios **6**: 3–38.
- Churkin, S. V. 2006. A review of the *Athamanthia dimorpha* (Staudinger, 1881) species group with the description of two new subspecies (Lepidoptera, Lycaenidae). – Helios **7**: 43–76.
- de Lattin, G. 1967. Grundriß der Zoogeographie. – Veb Gustav Fischer Verlag. 602 pp.
- Emeljanov, A. F. 1974. Proposals of Classification and Nomenclature of Areal. – Entomologicheskoe obozrenie **53** (3): 497–522. [In Russian].
- Eversmann, E. 1843. Quaedam Lepidopterorum species novae, in montibus Uralensibus et Altaicis habitantes, nunc descriptae et depictae. – Bulletin de la Société des Naturalistes de Moscou **15**: 535–555.
- Eversmann, E. 1851. Description de quelques nouvelles espèces de Lépidoptères de la Russie. – Bulletin de la Société des Naturalistes de Moscou **24** (1): 610–644.
- Kamelin, R. V. 2005. New Flora of Altai (aims and conception of new floristic revision) Pp. 55–97. – In: R. V. Kamelin, M. G. Kuzev, D. V. Tikhonov, D. N. Shaulo, A. I. Shmakov & R. L. L. Viane, Flora Altaica **1**. – Azbuka Barnaul. [In Russian].
- Kolesnichenko, K. A. 1999. A review of the East Palaeartic taxa of the *Melitaea didyma* (Esper, 1779) group. 1. The *M. ala* Staudinger, 1881–*M. chitralensis* Moore, 1901-complex. – Atalanta **30** (1/4): 87–117.
- Krupitsky, A. V. & R. V. Yakovlev 2012. Description of a new subspecies of *Callophrys suaveola* (Staudinger, 1881) (Lepidoptera, Lycaenidae) from Mongolian Altai with notes on a distribution of *C. suaveola*. – Caucasian entomological bulletin **8** (2): 261–263.

- Kryzhanovsky, O. L. 2002. Structure and distribution of the entomofauna of the World. – KMK-Press, Moscow. 237 pp. [In Russian].
- Lukhtanov, V. A. 1984. A review of the Palaearctic satyrids of the genus *Oeneis* Hübner (Lepidoptera, Satyridae). I. *O. hora* Gr. Gr. species group. – Entomologicheskoye obozreniye **63** (4): 776–789. [In Russian].
- Lukhtanov, V. A. 1990. New taxa of satyrid and blue butterflies (Lepidoptera, Satyridae, Lycaenidae) from Middle Asia and Kazakhstan. – Vestnik zoologii **1990** (6): 13–23. [In Russian].
- Lukhtanov, V. A. 1999. Neue Taxa und Synonyma zentralasiatischer Tagfalter (Lepidoptera, Papilionoidea). – Atalanta **30** (1–4): 135–150.
- Lukhtanov, V. A. & U. F. J. Eitschberger 2000. Illustrierter Katalog der Gattungen *Oeneis* und *Davidiana* (Nymphalidae, Satyrinae, Oenini). – Goecke & Evers, Keltern. 12 pp. + 26 cpls.
- Lukhtanov, V. A. & A. G. Lukhtanov 1994. Die Tagfalter Nordwestasiens. (Lepidoptera, Diurna). – Herbiopoliana, Buchreihe zur Lepidopterologie, Markt-leuthen. – Vrlg. U. Eitschberger **3**. 440 pp.
- Maloletko, L. M. 1999. Structure of Altai Mountains System and nomination of its parts. – Geographiya i prirodopolzovanie Sibiri. Barnaul: 23–45. [In Russian].
- Speyer, A. 1879. Neue Hesperiden des paläarktischen Faunengebiets. – Stettiner Entomologische Zeitung **40**: 342–352.
- Staudinger, O. 1881. Beitrag zur Lepidopteren-Fauna Central-Asiens. – Stettiner Entomologische Zeitung **42** (7/9): 253–300.
- Staudinger, O. 1892. Lepidopteren des Kentei-Gebirges. – Deutsche Entomologische Zeitschrift, Iris **5**: 300–393.
- Suschkina, P. 1906. Ueber eine neue *Argynnis*-Form aus Tarbagatai (Lepidoptera, Nymphalidae). – Russkoe entomologicheskoye obozreniye **6** (1–2): 5–7.
- Suschkina, P. 1909. *Lycaena cyane tarbagatai*, n. subsp. – Entomologische Rundschau **26**: 59.
- Tuzov, V. K. (ed.) 2000. Guide to the butterflies of Russia and adjacent territories (Lepidoptera, Rhopalocera). Vol. 2. – Pensoft, Sofia-Moscow. 580 pp.
- Tuzov, V. K. 2003. Nymphalidae. Part I. Tribe Argynnini: *Argynnis*, *Issoria*, *Brenthis*, *Argyreus*, [6]. Pp. 1–64. – In: G. C. Bozano (ed.), Guide to the Butterflies of the Palearctic Region. – Omnes Artes, Milano.
- Verity, R. 1905–1911. Rhopalocera palaearctica. [1]. Papilionidae et Pieridae. – Firenze, Publ. by the author 86 + 368 pp.
- Volynkin, A. V. & A. Yu. Matov 2011. A new *Syngrapha* Hubner, [1821] from the Altai Mountain Country (Lepidoptera Noctuidae). – Zootaxa **3110**: 46–52.
- Warren, B. C. S. 1936. Monograph of the genus *Erebia*. – London, Tr. Brit. Mus. (Nat. Hist.). 7 + 407 pp.
- Yakovlev, R. V. 2002. New data on the fauna of butterflies (Lepidoptera, Rhopalocera) in the East Palearctic Region. – Euroasian Entomological Journal **1** (2): 173–176. [In Russian].
- Yakovlev, R. V. 2003. Revision of Fischer's Blue *Tongeia fischeri* (Eversmann, 1843) (Lepidoptera, Lycaenidae). – Helios **4**: 181–197.
- Yakovlev, R. V. 2004. A new subspecies of *Pieris (napi) euorientis* (Verity, 1908) from the Saur Mountains (East Kazakhstan). – Helios **5**: 232–236.
- Yakovlev, R. V. 2007. Two new taxa of the genus *Melitaea* Fabricius, 1807 (subgenus *Melicta* Billberg, 1820) (Lepidoptera: Nymphalidae) are described from Western Mongolia and Eastern Kazakhstan. – Eversmannia **9**: 34–39. [In Russian].
- Yakovlev, R. V. 2011. New taxa of Rhopalocera from Siberia and Kazakhstan (Lepidoptera, Satyridae and Nymphalidae) – Atalanta **42** (1–4): 225–230.
- Yakovlev, R. V. 2012. Checklist of Butterflies (Papilionoidea) of the Mongolian Altai Mountains, including descriptions of new taxa – Nota lepidopterologica **35** (1): 51–96.
- Yakovlev, R. V. & E. V. Guskova 2012. Saur and Tarbagataj biogeographically: part of Altai, part of Dzhungaria or transition zone between Siberia and Middle Asia? – Materials of the conference “Animal world of Kazakhstan and adjacent territories”, Almaty: 186–187. [In Russian].
- Zhdanko, A. B. 1994 [1996]. New species of the Lycaenidae (Lepidoptera, Lycaenidae) from Asia. – Selevinia **1994** (1): 73–74.
- Zhdanko, A. B. 2005. Butterflies (Lepidoptera, Papilionoidea, Hesperioidea) of Kazakhstan. – Tethys entomological Research **11**: 125–146. [In Russian].



Rubin, Nikolai I and Yakovlev, Roman V. 2013. "Checklist of the Butterflies (Papilionoidea) of the Saur Mountains and Adjacent Territories (Kazakhstan), Including Systematic Notes About the *Erebia Callias* Group." *Nota lepidopterologica* 36, 137–170.

View This Item Online: <https://www.biodiversitylibrary.org/item/179933>

Permalink: <https://www.biodiversitylibrary.org/partpdf/147298>

Holding Institution

Smithsonian Libraries and Archives

Sponsored by

Biodiversity Heritage Library

Copyright & Reuse

Copyright Status: In Copyright. Digitized with the permission of the rights holder

License: <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Rights: <https://www.biodiversitylibrary.org/permissions/>

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at <https://www.biodiversitylibrary.org>.