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Taxonomic notes on *Parnassius phoebus* (Fabricius, 1793) (Lepidoptera, Papilionidae) with the descriptions of two new subspecies

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Abstract

Two new taxa are described: *Parnassius phoebus khangai* ssp. nova (TL: Mongolia, Khangai Mts. (southern slopes), and *P. phoebus kolesnichenkoi* ssp. nova (TL: Russia, Siberia, the Yenisei river basin, Irkutsk region, Uda river, Nizhneudinsk town vic.). The distinctions and relations of all *phoebus*-taxa known from Altai and Sayan mountain systems, Khamar-Daban and Khangai Ranges are discussed. The situation with *P. p. fortuna* Bang-Haas, 1912 is clarified, the status of the subspecies is confirmed. The well known old locality “Arasagun-gol” is clarified.

Key words *Parnassius*, Siberia, taxonomy, biodiversity, new taxa, zoogeography, Irkutsk, Khangai, Tuva, Altai, *phoebus*, Arasagun-gol.

Introduction

Parnassius phoebus (Fabricius, 1793) represents an important object of study among the butterflies – in almost every existing zoochoron it gives a subspecies distinctly different from others, which makes it indispensable for zoogeographical work. Despite the great variability, 90% of the macropopulation usually has a certain combination of features.

Over the past 20 years, we have studied and described the subspecies from the Mongolian Altai (Churkin 2003a; Yakovlev 2006); one more subspecies (*vaschenkoi* Hirschfeld & Schaffer, 2004) was described based on collections provided by S. Churkin (Hirschfeld & Schaffer 2004).

The summary of new materials from the Altai and Sayan Mountains and Khamar-Daban Range and adjacent Mongolia shows the need to describe one more taxon from the southern Khangai Mts. and to restore another one described from the area adjacent to Khövsgöl Lake in Northern Mongolia.

One more new subspecies was collected in the Uda River basin, near the city of Nizhneudinsk in the Irkutsk region, where it lives together with *P. apollo* L., 1758 (Churkin & Yakovlev 2024). It is

not only the last fact of cohabitation of *P. phoebus* with *P. apollo* that is unusual (it was previously indicated only for the northern part of the Russian Altai: Beloe village in the Altai Province; Cherga village in the Altai Republic (Tshikolovets *et al.* 2009a)), but also the clear characters of the subspecies related to both the Yakutian and Sayanian butterflies.

We will not list the described infrasubspecies names, as well as the complete lists of typical materials with storage locations, since they have already been published more than once in various publications (Tshikolovets *et al.* 2002, 2009a, b).

The usage of the name *Parnassius phoebus* (Fabricius, 1793) is conserved by the decision of International Commission on Zoological Nomenclature (2023: Opinion 2488).

Material and methods

The adults were photographed using Canon 5DII with Sigma-60 Macro.

For wing venation, the Comstock-Needham nomenclature adopted for butterflies (Miller 1970) was used.

The present study is based on the collections of the following institutions: Zoological Institute of Russian Academy of Sciences (ZISP, St. Petersburg), Darwin State Museum (SDM, Moscow), Museum of Natural History St. Alexis Hermitage (MSAH, Yaroslavl reg.), collections of the authors, K. Kolesnichenko (Moscow), V. Tuzov (Moscow), P. Beda (Lyubertsy, Moscow reg.), B. Khramov (S.-Petersburg), P. Beda (Lyubertsy, Moscow reg.), A. Kryukov (Kirov).

In total over 2 000 specimens have been studied.

Holotype and neotype are deposited in the collection of the Darwin State Museum (Moscow), paratypes are in the collections of the authors, in the Museum of Natural History St. Alexis Hermitage as well as in the private collections listed above.

Notes. We are able to publish the inventory numbers to important *Parnassius apollo* L. specimens figured in the previous paper (Churkin, Yakovlev 2024). Two specimens are deposited in SDM, the neotype of *P. a. sibiricus* (Nordmann, 1851) bears the number: main collection OФ 20925-003, the holotype of *P. a. yenisei* Churkin et Yakovlev, 2024 bears the number: main collection OФ 20925-002. The paratypes are in the collections of the authors, in the Museum of Natural History St. Alexis Hermitage as well as in the private collections listed above.

Abbreviations

FW — forewings
HW — hindwings
m — m. a. s.l., metres above sea level
TL — Type locality

1. Historical note

Parnassius phoebus Fabricius, 1793 was described from Altai, type locality – the vicinity of the Ongudai village, according to the recognized allocation of the neotype (Lukhtanov *et al.* 2019). The range of the nominative subspecies covers the main part of the Altai system. South-Eastern Altai (and, apparently, part of the adjacent high mountain ranges) is populated by *P. p. alpestris* Elwes, 1899, whose main range occupies most of the Mongolian Altai, along with the related subspecies. This issue was discussed in detail by the authors of this article (Churkin 2003a; Yakovlev & Doroshkin 2006; Yakovlev 2012) and will not be touched upon in this work.

P. p. sedakovii was described under the label “Irkutsk” [Ménétriés] in Siemachko, 1850 – the validity of which was confirmed only much later by Yu. Nekrutenko and I. Kerzhner (Nekrutenko & Kerzhner 1986: 776). It should be noted that I. Kerzhner was a member of the Commission of the International Code of Zoological Nomenclature, and his opinion, without a doubt, was the most

authoritative in resolving nomenclature issues. In the mentioned article, the lectotype *sedakovii* was identified, corresponding to the image published in the book by Yu. Semashko. The color image of the lectotype has recently been published (Tshikolovets et al. 2002: XLIII – 1), which corresponds to a relatively light variant of the coloring of butterflies inhabiting Tunkin Range (Tunkinskie Goltsy) (Russia, Buryatia Republic). *Phoebus* is not found in the vicinity of Irkutsk, the opinion that the *sedakovii* types were collected by M. Sedakoff on the Tunkin Range is generally accepted, with which we fully agree.

The taxon *fortuna* Bang-Haas, 1912 was described from “Sajan-Gebiete (Arasagun-gol)” – a very common location on geographic labels of Lepidoptera materials in the early 20th century, the exact identification of which is still unknown (Tshikolovets 2009b). The characteristics of the subspecies are formulated in the original description very clearly: the dense and strongly developed black pattern in the males, large sizes (up to 69 mm in wingspan), almost black females, the females have 2–3 large additional costal red eyes on FW, males also usually have 2 costal red eyes (Bang-Haas 1912: 103).

Later, based on the erroneous assumption of the infrasubspecific status of *sedakovii*, *amalthea* was described by Bryk & Eisner, 1935 from Tunkin Range, vicinity of village Mondy. According to the description, this taxon is clearly close to *fortuna*, but smaller, with small eyes on the HW, while only some females have 1–2 small red costal (smaller) eyes, and the males usually do not have any. The listed characteristics, as well as the type location, correspond to *sedakovii*, thus *amalthea* is rightly considered the junior synonym of the latter.

Two more taxa from the area under consideration have been described recently.

The subspecies *badmaevi* Martynenko & Gluschenko, 2001 from southern Khamar-Daban (TL: Tzakirka river, upper stream, Khangarulsky ridge, Khamar-Daban Mts.) is close to both of the above-mentioned taxa, the type locality is the upper reaches of the Tzakirka River, zoogeographically located in a zoochoron other than the Mondy area. Unfortunately, the authors of this taxon forgot the existence of *fortuna*, which differs from *sedakovii* by the same features as *badmaevi* (Martynenko & Gluschenko 2001).

The subspecies *vaschenkoi* Hirschfeld & Schaffer, 2004 was described from southern Tuva (TL: Samagaltai, Eastern Tannu-Ola Mts.) and is characterized by light males and females, with an abundance of colourful forms.

The variants of the subspecies structure of *phoebus* published in the recent period do not describe the existing picture in the nature – either by mixing all taxa together (Tshikolovets et al. 2002, 2009a, 2009b), or with an abundance of taxonomic errors and without understanding the real zoogeographic boundaries (Weiss 2005). We do not introduce here the obviously outdated concepts (Korshunov 1977; Korshunov & Soljanikov 1976; Korshunov & Gorbunov 1995; Gorbunov 2001).

2. The subspecies structure in the Altai, Sayan and Khangai Mountains

Two subspecies, *phoebus* and *vaschenkoi*, are distinguished by a less dense black color of the main pattern and the lighter females. It should be noted that among the males of both subspecies there are specimens with blurred spots of the submarginal row on the FW, these spots often have sharp arcuate outlines, but the marginal translucent border is relatively wide, the white pupils in the ocelli are well developed, and the background color is slightly creamy (completely corresponds to the neotype: Lukhtanov et al. 2019: fig.2) (Fig. 1: 1–4). Among the males of all other Siberian subspecies, such specimens are practically not found.

In the typical population of *vaschenkoi* such specimens are not rare (unfortunately, they were not included in the photographs published together with the original description). In other males, the same band may be expanded (the feature identified by the authors of the taxon and expressed in the photographs of the specimens provided), demonstrating serious variability. In general, *vaschenkoi* is easily distinguished by the sharply lightened females with a relatively contrasting pattern and large red spots, the males are also clearly lighter than the nominate ones.

In addition to the type series, we have a series collected in the vicinity of the village Sagly (Western Tanuola Range) and Sayan Pass (Sailygkhem-Taiga Range), these series can be attributed to *vaschenkoi*, but the first one demonstrates obvious hybridization with the neighboring *phoebus*, and the females from Sayan Pass are bimorphic, some of them are clearly similar to *alpestris*. The presence of

two sharply different female variants confirms the existence of a significant difference between the two original taxa.

Important observations about host plants were made by S. Vashchenko (Kherson) during his trips to Tuva where he collected the type series of ssp. *vaschenkoi*.

The food plant of the latter was identified as *Sedum* sp., but we cannot exclude that it was *Orostachys* sp. In the vicinity of Sagly he observed two populations of *P. phoebus*, one on “*Sedum*” (low altitudes, ssp. *vaschenkoi*) and another on *Rhodiola* sp. (high altitudes, the larvae were observed). Later some butterflies were collected at 2000 – 2200 m. above sea level but the essential differences with common lowland form were not found (S. Vashchenko, pers. comm., 2003–2005). However, the situation in Sagly needs in further investigations (we marked above the variability of the available series).

To be noted that *Sedum* is recorded as food plant for *P. phoebus* in Altai (Korshunov 2002), and it needs in confirmation: it could be *Orostachys* as in the case of ssp. *khangai* and ssp. *kolesnichenkoi*. It is also possible that *P. phoebus* lives on different host plants in the areas which we considered here as hybridization zones (in West Sayan, see above).

The areal of *phoebus* covers the main part of the Altai, and *vaschenkoi* inhabits the spurs of the mountains around the upper reaches of the Yenisei, while the populations from the ridges of the Western Sayan Mts. show clear hybridization with populations from Eastern Sayan Mts.

This picture is typical for species that have fundamentally different coloring in the west and east of the Altai-Sayan mountain system, when the mountains around the Central Tuva Basin are inhabited by butterflies with an extreme diversity of hybridogenic features, and the signs are generally clinal in nature - for example, *Euphydryas iduna iduna* (Dalman, 1816) (Churkin & Kolesnichenko 2003) or *Agriades glandon* de Prunner, 1798 (Churkin 2005).

We have a small series collected by Ts. Odbayar (Ulanbaator) on Khan-Khuhiin Range (nearby Tzagaankhairkhan somon), which separates Ubsunur basin from the rest of Mongolia. The series is clearly close to *vaschenkoi*, the territory of this ridge should also be included in the range of the subspecies.

One more pair was collected by V. Soljanikov in Darkhat basin, west of Khuvsgul (Khovsgol, Khubsugul) lake, in the very upper reaches of the Yenisei - and this pair, without a doubt, also belongs to *vaschenkoi*, which is of great zoogeographical significance (Fig. 1: 8).

Three more taxa (*sedakovii*, *fortuna*, *badmaevi*) form the second related group, which is distinguished by a rich white background color, a dense and at the same time narrow blackish border and strongly darkened females. Ssp. *sedakovii* (Fig. 1: 9–12) inhabits the Eastern Sayan (in addition to several long series of butterflies collected near the village of Mondy, we have several specimens with Kropotkin's and Munku-Sardyk Ranges).

In addition, we have two long series collected south of Khuvsgul lake: 45 km south (Olkhon loc.) and 90 km southwest of the end of the lake. It is important to note that the second collection point lies on the southern slopes of the ridge that borders Darkhat Valley. Another series of 50 males and two females was collected at the Erygyin-gol river, tributary of Egyin-gol, near Teshig somon in the Bulgan Aimag – near the border with Russia, 180 km southeast of the end of Khubsugul lake and only 120 km south of the type habitat of *badmaevi*. Note that the typical series of the latter was collected over a long stretch of the Dzhida River, starting from Zakamensk city and up to the source - while the distance from Teshig somon to Zakamensk is already slightly more than 60 km, and the Dzhida River itself is a tributary of the Selenga River, like Egyin-gol.

The butterflies from all the listed points are very similar to the *fortuna* types, and fully correspond to the original description (Fig. 1: 13–16) – this is a *sedakovii* enlarged by one and a half times with enlarged red spots of females, while the costal eyes are almost always developed (even males usually have at least one red costal eye on FW). Additionally, we note that the white spots in the space between the submarginal band and the border (if they are expressed) increase sharply in size between M1 and Cu2, while in *sedakovii* they are of more or less the same width along the entire border – that is, FW of *fortuna* is noticeably expanded in the cubital zone.

We have a series of 20 paratypes of *badmaevi* (Fig. 2: 9–10), and the only observed difference is that the white pupils are more often developed in the eyes on HW, the females are often somewhat lighter. According to the original description, the light females, however, are only 10% – indeed, the

females at our disposal are noticeably lighter than those depicted in the original description (Martynenko & Gluschenko 2001).

Thus, *fortuna* is a subspecies, close to *sedakovii*, inhabiting the ridges to south and east from Khuvsgul lake (probably including Bulain-nuruu), including southern macroslopes of Khamar-Daban Range.

***Parnassius intermedius f. fortuna* Bang-Haas, 1912 [*P. phoebus fortuna* Bang-Haas, 1912] = *P. phoebus badmaevi* Martynenko & Gluschenko, 2001, syn. nova.**

Considering that Darkhat Valley is populated by *vaschenkoi*, the conducted research allows us to firmly limit the locality of Arasagun-gol to the territory between Khuvsgul and Northern Khangai, which is logical, considering that one of the few ancient roads to the west of Mongolia from Ulaanbaatar passes through here. Noting the almost complete similarity of some females collected in the Olkhon locality with the types, and the known proximity of Arasagun-gol to Khuvsgul lake from old publications, we believe that **Arasagun-gol is a locality located somewhere between Muren Somon [Village] (located on the main road) and Khatgal Village at the southern end of the lake, to which a branch of the main road goes (approximately 50° 5' N and 100° 6' E).**

South of the *fortuna* range lies the huge Khangai ridge, on the southern macroslope of which (Tuin-gol river valley) the first author collected in 2002 a series of *P. phoebus*. The specimens from this locality appeared in the literature as supposedly new (Weiss 2005: 260), but unfortunately have not yet been described. We correct this oversight below. Worth to note that two more taxa were described from Tuin-Gol: *P. apollo churkini* Möhn, 2003 and *P. nomion chingizkhan* Churkin, 2003.

3. *Parnassius phoebus khangai* ssp. nova.

Fig. 2: 1–4 (upperside); 13–14 (underside).

Holotype: male, Mongolia, Bayanhongor aimak, Khangai Mts., Tuin-gol R., Erdeneztogt somon, 2300–2500 m, 21–23.07.2009, Ts. Odbayar leg.

The holotype is deposited in the collection of SDM, inventory number: main collection OФ 20925-005.

Paratypes: 49 males, 21 females, same data; 10 males, 4 females, Mongolia, Bayanhongor aimak, Khangai Mts., 45 km N Bayan-Knoghgor, Tuin-gol R., 2200–2500 m, 21–25.07.2002, S. Churkin & V. Pletnev leg.; 1 male, 1 female, same loc., 2000 m, 18.07.2003, S. Churkin leg.; 5 males, 2 females, Mongolia, Bayanhongor aimak, Khangai Mts., Tuin-gol R. (upper stream), 2600–3000 m, 26. 07. 2002, S. Churkin & V. Pletnev leg.; 9 males, 1 female, Mongolia, Bayanhongor aimak, Khangai Mts., Tuin-gol R., 23 km W Erdeneztogt somon, 2500 m, 24.07.2009, Ts. Odbayar leg.; 6 males, 3 females, Mongolia, Archangai aimak, NW Khangai Mts., 80 km WNW Tzetzterleg, Chuluut r., 2000 m, 28.06.2000; 11 males, 6 females, Mongolia, Zavkhan aimak, W. Khangai, Arshantyn r., 2700–3000 m, 23–28.06.2004, S. Churkin leg.

Description

Holotype FW length – 32 mm, male paratypes 26–34 mm, female paratypes – 27–35 mm.

Antennae, palpi and body colouration seem to have no taxonomically valuable characters.

Male.

The wings are clear white above with noticeable darkened veins.

FW: translucent marginal band dense and blackish. The fringes are blackish with barely noticeable lightening between the veins. The submarginal row consists of well-dense narrow, sometimes arched, non-contrasting spots, M2–M3 spot is slightly shifted towards the base. The whitish submarginal spots between marginal band and submarginal row are narrow, the upper 3–4 spots are often isolated from each other, the costal spot is shifted towards the base. There is no obvious widening of the spots in the lower part of this row (if these spots are expressed). Black spots in the cell and at its end are contrasting and of normal size. In the postdiscal row, two costal spots are developed, the upper one sometimes reddish.

HW with dense basal-anal black suffusion and two red spots. The size of these spots is small, 1.5–2.0 mm in diameter, sometimes 2.5 mm in diameter, usually without white dots inside.

Underside: size of the spots is slightly smaller than on the upper surface. Red spots are sometimes lightened inside. A spot with a red patch is developed in the postdiscal zone Cu2–2A.

Four reddish basal spots are developed on the HW.

Variability is usual for the species: rarely a border with poorly distinguishable lightening between the veins, sometimes the submarginal band is partially reduced, sometimes thickened. The size of the red spots is slightly variable.

Some specimens with developed submarginal row of blackish spots on the HW upperside.

Female.

General pattern as in male, but all spots are enlarged, upperside discal surface often with diffuse, dark suffusion. The marginal band is wider than in males and extends to the anal angle. The submarginal dark row is also enlarged and stretched to the end of the wing – forming, together with the marginal band, a number of narrow light internal spots. Costal submarginal spots are enlarged, reddish with a somewhat diffuse rings around. An additional black spot is developed in the submarginal zone from the anal edge of the FW. The postdiscal zone is darkened, sometimes in the form of additional blackish spots.

HW: the red spots are larger, sometimes with barely noticeable white strokes inside. The submarginal dark pattern is always developed and non-contrasting. Two small anal-cubital blackish spots.

On the underside, basal red spots are fully developed, 1–2 additional postdiscal spots with red centers.

Variability. There is no form with a completely blackened postdiscal area, some specimens have a diffuse gray-black suffusion, like butterflies from the Mongolian Altai Mts. (ssp. *tsenguun*).

Diagnosis.

Males are similar to *sedakovii* males, smaller than *fortuna*, red spots on the HW are smaller, the submarginal band on the FW is blurred, arcuate spots are rare and non-contrasting if developed, the upper light submarginal spot is sharply shifted towards the base, the lower submarginal spots are barely widened, if developed.

Females are different from females of all close subspecies – the main form without dense complete darkening of the entire postdiscal area on the FW and the main part of the HW. This darkening leaves a loose diffuse spot and a number of vague submarginal spots. Let us remind that pictured here female of *badmaevi* belongs to the light form, which, according to the original description, constitutes no more than 5% in this form (Fig 2: 10). In the type series of the new subspecies, no forms similar to the typical *fortuna* were found at all, and the light form in this population are smoky females resembling *tsenguun* or *alpestris*. In addition, females of the new subspecies are distinguished by a clearly smaller size of red spots, which are no larger than those of *sedakovii*.

The subspecies of the *sedakovii* group are poorly differentiated, but none of them can be completely reduced to the neighboring one without losing part of the biological meaning contained in each of the taxa.

Etymology. Toponymic name.

Bionomics. Mountain slopes, usually with rock outcrops, of varying steepness. At low altitudes in the valley of the river Tuin-gol flies together with *P. nomion* Fischer von Waldheim, 1823, the food plant for both species – *Orostachys* sp. (*Crassulaceae*). Hybridization has been noted, and it is this, in our opinion, that leads to the appearance of males with an additional submarginal row of blackish spots on the HW in a variety of Khangai populations, but especially in Tuin-Gol (Churkin 2004). The populations from the flattened ridge of the mountain range (altitudes up to 3000 m) are statistically smaller and darker, but no significant differences are observed.

We have at our disposal several not fresh males from the northern macroslope (40 km south of Tsetserleg), similar to *fortuna*.



Figure 1. *Parnassius phoebus*, adult specimens:

- 1 – *Parnassius phoebus phoebus*, male, Russia, Altai, Seminsky Mts., Shebalino vic., 16.06.1992, S. Dialektov leg.
 2 – *P. p. phoebus*, male, same loc., 1000 m, 12.06.1979, V. Kipnis leg.
 3 – *P. p. phoebus*, female, same data as 1.
 4 – *P. p. phoebus*, female, same data as 2.
 5 – *P. p. vaschenkoi*, male, paratype, Russia, Tuva, East Tanuoa Mts. (southern sl.), Samagaltai vic., 1–3.06.2001, S. Vaschenko leg.
 6 – *P. p. vaschenkoi*, female, paratype, same data as 5.
 7 – *P. p. vaschenkoi*, female (rare form), paratype, same data as 5.
 8 – *P. p. vaschenkoi*, female, Mongolia, Darkhat valley (western from Khuvsgul), Dood-Nur L., 9.07.1966, V. Soljanikov leg.
 9 – *Parnassius phoebus sedakovii*, male, Russia, Buryatia, East Sayan, Mondy vic., Khulugaisha Mt., 2100 m, 15–23.06.2002, S. Obukhov leg.
 10 – *P. p. sedakovii*, male, same loc., 2400 m, 24–25.06.2002, S. Obukhov leg.
 11 – *P. p. sedakovii*, female, same data as 1.
 12 – *P. p. sedakovii*, female, same data as 2.
 13 – *P. p. fortuna*, male, Mongolia, S from Khuvsgul L., Olkhon loc., 50°06'N; 100°03'E, 1700 m, 2–4.07, 2006, Ts. Odbayar leg.
 14 – *P. p. fortuna*, male, same data as 5.
 15 – *P. p. fortuna*, female, same data as 5.
 16 – *P. p. fortuna*, female, same data as 5.

Distribution. Khangai Range. From the north and east the distribution area borders on the area of *fortuna*. The characters of females show that until recently, there has been possible the exchange of genes with populations of *tsenguun* inhabiting the southeastern ridges of the Mongolian Altai system. The latter fact is reliably confirmed by the presence on the southern macroslope of many taxa from the south of Mongolia, while the fauna of the northern macroslope is as close as possible to the fauna of East Sayan and Dauria.

We have at our disposal a small series collected by V. Soljanikov in the southwest of the Khangai ridge (6 males, 3 females, W. Khangai Mts., Khukhu Nuur L., 20–22.07.1966). The females are much lighter in color; there are specimens very reminiscent of *vaschenkoi* with bright spots and almost no dusting (Fig. 2: 11). The status of this population need further study.

4. *Parnassius phoebus kolesnichenkoi* ssp. nova.

Fig. 2: 6–8, 12 (upperside); 15–16 (underside).

Holotype: male, Russia, Irkutsk reg., 475 km NW Irkutsk, Nizhneudinsk distr., Uda R., Bolshoi Uk loc., 9–16.06.2011.

The holotype is deposited in the collection of SDM with the number: main collection OФ 20925-004.

Paratypes: 5 males, 9 females, same data; 5 males, 1 females, same loc., Mara st., 7–14.06.2006, S. Vaschenko leg.; 2 males, 4 females, same data, 10–26.06.2006, S. Vaschenko leg.; 3 males, same loc., Kurjaty st., 6.06.2006, S. Vaschenko leg.; 3 males, 8 females, same loc., 8–12.06.2011, A. Kryukov leg.

Description

Holotype FW length – 33 mm, male and female paratypes 30–35 mm (32–34 mm, as usually).

Antennae, palpi and body colouration seem to have no taxonomically valuable characters.

Male.

The upperside is milky white, the veins are often not outlined at all.

FW: The translucent dark marginal band is narrow, loose, usually barely reaching Cu1, if it is darker and thicker, lightening between the veins are noticeable. The fringes are white with sharp bleaching between the veins. The submarginal row of spots is usually either absent or very short; in a third of specimens it reaches Cu1 in the form of diffuse blackish spots. Black spots in the cell and at its end are contrasting and of normal size. In the postdiscal row, two costal spots are developed, usually small, reduced (the lower one – up to complete disappearance); the upper spot may have a red patch.

HW with a diffuse basal-anal black suffusion and two small red spots; white dots are usually absent or barely visible.

The underside has the same pattern, the size of the spots is slightly smaller than on the upper surface. Red spots are sometimes lightened inside. The postdiscal Cu2–2A small triangular spot with a red patch is developed. The basal spots at the base of the wing are partially reduced – the lower two spots are often barely noticeable or completely absent (Fig 2: 15–16).

Variability moderately weak. Sometimes the submarginal row is more developed, sometimes some of the spots in it have an arcuate shape, without acquiring a dense black color. HW red spots may have white pupils inside.

Occasionally, the lower basal spots on the underside are more developed.

Female.

All spots are enlarged, the marginal border is wider than in males and extends to the anal angle. All black spots are somewhat blurred, with diffuse boundaries. The submarginal dark band is widened and stretched to the anal end of the wing; inside there is a number of small, often disappearing light spots. Costal submarginal spots are expanded with red patches, as a rule, the third additional spot between them is undeveloped or very small. Almost the entire cell and the space up to the costal spots are light and whitish, as is the small zone around the postdiscal anal spot. The rest of the space is darkened – from a diffuse gray suffusion to a very dense black, in the latter case the butterfly looks very contrasting.

On the HW, the red spots are larger than in males, sometimes with barely noticeable white patches inside. The submarginal dark pattern on the HW is always developed and non-contrasting. In the postdiscal zone there are 1–2 additional spots. In light forms, almost the entire wing is whitish; in contrasting forms, only the zone from the base and cell to the red spots is whitened.

The underside have well-developed basal spots; the red patch are always developed in the postdiscal spots on both wings.

Variability clearly higher than among the males, but at the same time the females of this taxon are very recognizable. FW postdiscal spots sometimes with red patches; some of the whitish submarginal spots on the FW may be completely absent. In a third of females, a dark streak is visible between the HW red spots, sometimes it looks very contrasting (f. *conjuncta*).

Diagnosis.

A deeply isolated subspecies, both geographically and in characteristics. In terms of the degree of reduction of the black pattern, it resembles the subspecies from Yakutia and Magadan. It differs from the group of subspecies *phoebus-vaschenkoi* in the absence of developed white pupils in red spots in males (and, with minor exceptions, in females) – light-colored representatives of both latter subspecies always have large white pupils and a sharp reduction in the submarginal band. From subspecies of the *fortuna* group it differs also by the contrasting fringes (white with black inserts), diffuse and reduced submarginal pattern, lightened or contrasting females.

Some males closely resemble ssp. *interpositus* Herz, 1903 from Yakutia, the closest of the northern subspecies (however, the straight line distance to the nearest Yakutian populations is at least 2200 km, the new subspecies is easily distinguished by the absence of white pupils in red spots, *interpositus* females are almost entirely whitish on the upperside).

In general, the males of *kolesnichenkoi* relates with *interpositus*, while new females relates with *sedakovii* group.



Figure 2. *Parnassius phoebus*, adult specimens:

- 1 – *Parnassius phoebus khangai* ssp. nova, holotype, male, Mongolia, Bayanhongor aimak, Khangai Mts., Tuin-gol R., Erdeneztogt somon, 2300–2500 m, 21–23.07.2009, Ts. Odbayar leg.
- 2 – *P. p. khangai* ssp. nova, paratype, male, Mongolia, Bayanhongor aimak, Khangai Mts., 45 km N BayanKnohgor, Tuin-gol R., 2200–2500 m, 21–25. 07. 2002, S. Churkin leg.
- 3 – *P. p. khangai* ssp. nova, paratype, female, same data as 1.
- 4 – *P. p. khangai* ssp. nova, paratype, female, same data as 2.
- 5 – *Parnassius phoebus kolesnichenkoi* ssp. nova, holotype, male, Russia, Irkutsk reg., 475 km NW Irkutsk, Nizhneudinsk distr., Uda R., Bolshoi Uk loc., 9–16.06.2011.
- 6 – *P. p. kolesnichenkoi* ssp. nova, paratype, male, same loc., 10–26.06.2006, S. Vaschenko leg.
- 7 – *P. p. kolesnichenkoi* ssp. nova, paratype, female, same data as 7.
- 8 – *P. p. kolesnichenkoi* ssp. nova, paratype, female, same data as 6.
- 9 – *P. p. fortuna* (paratype of *badmaevi*), male, Russia, Khमार-Daban Mts. (southern sl.), Tsakirka r., 1600–2200 m, 20–29.06.2000, Yu. Glushchenko leg.
- 10 – *P. p. fortuna* (paratype of *badmaevi*), female, same data as 9.
- 11 – *P. p. khangai*?, female, Mongolia, W. Khangai Mts., Khukhu Nuur L., 20–22.07.1966, V. Soljanikov leg.
- 12 – *P. p. kolesnichenkoi* ssp. nova, paratype, female, Russia, Irkutsk reg., 475 km NW Irkutsk, Nizhneudinsk distr., Uda R., Bolshoi Uk loc., 9–16.06.2011.
- 13 – *P. p. khangai* ssp. nova, holotype, male, same data as 1 (underside of 1).
- 14 – *P. p. khangai* ssp. nova, paratype, male, same data as 2 (underside of 2).
- 15 – *P. p. kolesnichenkoi* ssp. nova, holotype, male, same data as 5 (underside of 5).
- 16 – *P. p. kolesnichenkoi* ssp. nova, paratype, male, same data as 6 (underside of 6).

Etymology. The new taxon is named after Kirill Anatolievich Kolesnichenko (Moscow State University), the professional entomologist and best specialist of palaearctic *Melitaea* Fabricius, 1907.

Bionomics. Cliffs, rocky outcrops. Food plant – *Orostachys* sp. (probably, *O. spinosa* (L.) C.A. Meyer, *Crassulaceae*). Lives together with *P. apollo* and *P. nomion*. It is possible that there is one female in the series – a hybrid with *apollo*.

Distribution. Known only from the type locality.

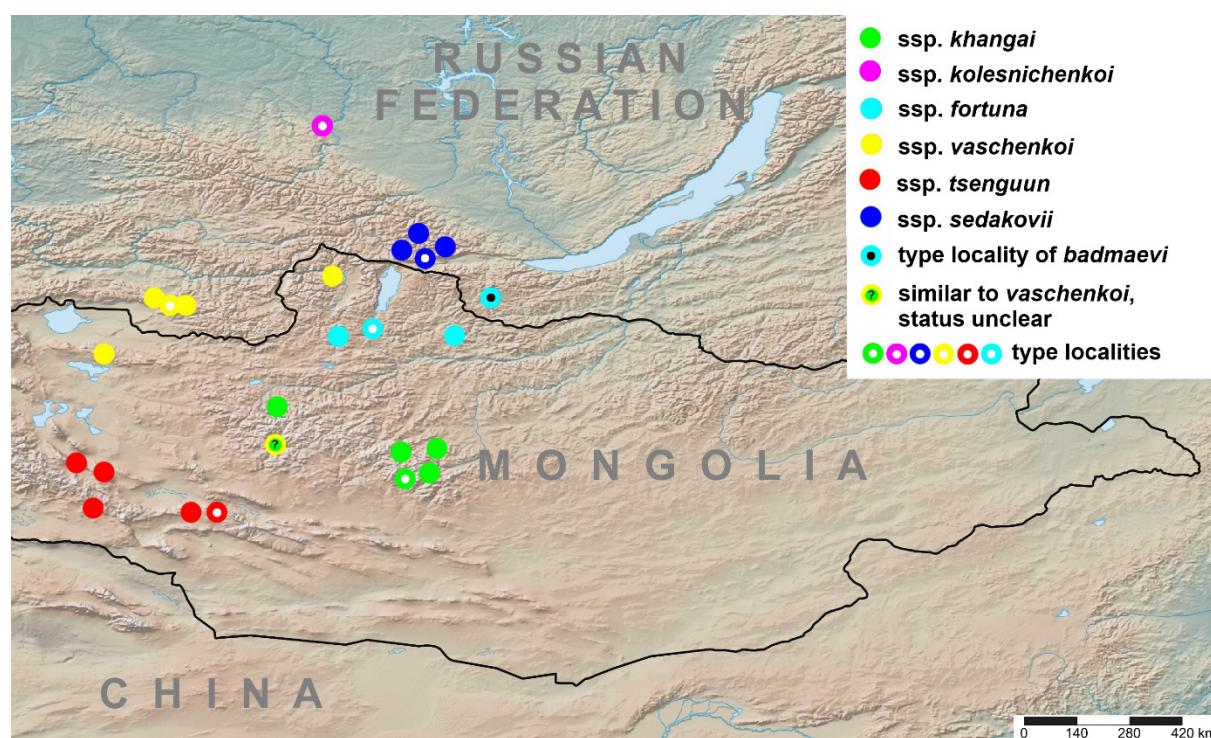


Figure 3. Distributional map.

Discussion

As noted, *P. phoebus* in Southern Siberia and Mongolia is represented by several subspecies complexes (Fig. 3).

Despite the similarity of the *sedakovii* complex taxa, we consider the idea of combining all three subspecies to be incorrect. Most specimens of each subspecies are easily identified, and – most importantly – by removing subspecies, we will lose the ability to describe both the processes occurring within the species and to conduct further research into the zoogeography and history of Siberia (due to the lack of an accepted system of names and associated complexes of traits/genes).

Let us note a very important fact from Khangai, where *phoebus* lives from 2000 m to 3000 m, without forming any special forms, the same phenomenon is known for Mondy village (Southern Buryatia), where butterflies become statistically slightly smaller and darker with increasing altitude. Even more serious work using mathematical methods was done by A. Martynenko and Yu. Glushchenko, who collected butterflies on the Dzhida River over several dozen kilometers with a large difference in altitude, and also did not discover any special high-mountain forms (Glushchenko & Martynenko 2000; Martynenko & Glushchenko 2001). The butterflies become somewhat smaller and generally darker, but there is no change in subspecies characteristics.

This information brings us back to the taxa *alpestris* and *phoebus*, flying in Altai and representing two fundamentally different subspecies, the ranges of which currently intersect near Aktash village (Russia, Altai Republic, Ulagan Distr.).

For a long time, the range of *alpestris* was considered too small, and it was therefore considered a "form" – a term that raises questions when used in taxonomy (Kaabak et al. 1997). It was later shown that the main range of *alpestris* and its related subspecies is the entire eastern macroslope of the huge Mongolian Altai, in comparison with which the range of *phoebus* seems small (Churkin 2003). The limitation of systematic constructions within the framework of state borders was the basis of the mistake made.

It is obvious that these two subspecies were formed during the glaciation in two different places: the foothills northern from Altai (*phoebus*) and the foothills of Mongolian Altai (eastern macroslope of the latter, *alpestris*). Then, after the disappearance of the isolation barriers, the colonization of the open high-mountain territories began, which *alpestris* succeeded in doing – the reason for this must be its formation in harsher conditions, adapted for survival at altitude.

For the same reason, the fauna that formed in the harsh conditions of the Alai Valley populated the Eastern Pamir, spread into the Tien Shan and to the Darvaz Mountains – in contrast to the northern Alai fauna, which survived the ice ages in more comfortable conditions along the edge of the Fergana Valley, whose ability to settle as the glaciers retreated was clearly weaker (Churkin 2009).

The glaciers retreated and advanced again, which formed a very complex biogeographic structure of the Mongolian Altai (Kamelin 2005; Yakovlev 2012). As a result, *alpestris* populated the highest mountain areas of the Altai system – and apparently, at some point, got to the Saur ridge in Eastern Kazakhstan and Northwestern China (where its own subspecies was formed: *P. phoebus sauricus* Lukhtanov, 1999) (Lukhtanov 1999; Rubin & Yakovlev 2013, Huang 2023), the last assumption requires confirmation.

In addition, we suppose that ssp. *phoebus* (relates with *Sedum* – or *Orostachys*) and ssp. *alpestris* (relates with *Rhodiola*) quickly accumulated the differences during the glaciations because their host plants adopted for very different altitudes/conditions.

It is very likely that one more element needs to be added to the specified scheme for the formation of the subspecies structure – ssp. *vaschenkoi*, formed somewhere along the southern edge of the Tannu-Ola Ranges and the western part of the Khangai Mts. This could explain why the Khuhu Nur material is so similar to *vaschenkoi* and so different from ssp. *khangai*. If this hypothesis is correct, then grouping *phoebus* and *vaschenkoi* together is incorrect.

Thus, we are now observing the hybridization and interpenetration of populations that differed very sharply in the past and were formed under different conditions within isolated areas.

The position of ssp. *kolesnichenkoi* in this system it appears to unite the northern representatives of the species with the group *sedakovii*. However, the situation may be significantly more complex due to the taxon's unusual biology and its current complete isolation.

The unusual reduction of some of the red spots on the underside of HW in males is also observed in many populations of male *apollo* in Siberia, but it has not been found in other populations of *phoebus*. The only working hypothesis to explain this unusual fact is horizontal gene transfer between *apollo* and *phoebus*, which in this case live together on the same food plant.

Despite its relative completeness, the subspecific structure of the species in Southern Siberia cannot be considered complete.

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