

A new subspecies of *Papilio machaon* Linnaeus, 1758 (Lepidoptera, Papilionidae) from Gobi desert, Mongolia

Sergei V. Churkin¹, Roman V. Yakovlev^{2,3,4}, Tserenpil Odbayar⁵

1 *The Museum of Natural History St. Alexis Hermitage, Yaroslavl reg., Novoalexevka, 4-1, 152049, Russia*

2 *Altai State University, 61 Lenina Ave., Barnaul, 656049, Russia*

3 *Tomsk State University, 36 Lenina Ave., Tomsk 634050, Russia*

4 *Western Caspian University, 31 Istiglaliyyat Street, Baku, Azerbaijan*

5 *Ulan-Bator, Mongolia, Ulaanbaatar, Sukhebaatar duureg, 2 horoo, 5 horoolol, 31-30*

Corresponding author: Roman V. Yakovlev (yakovlev_asu@mail.ru)

Academic editor: A. Matsyura | Received 10 April 2024 | Accepted 9 May 2024 | Published 14 May 2024

<http://zoobank.org/6FB9DF69-D14D-4CC7-B599-C9520D8EAE94>

Citation: Churkin SV, Yakovlev RV, Odbayar T (2024) A new subspecies of *Papilio machaon* Linnaeus, 1758 (Lepidoptera, Papilionidae) from Gobi desert, Mongolia. *Acta Biologica Sibirica* 10: 383–393. <https://doi.org/10.5281/zenodo.11181305>

Abstract

A new subspecies, *Papilio machaon bilguun* ssp. nov. (Lepidoptera, Papilionidae) from Mongolia, South Gobi (Umnegov) aimak, Nomgon somon is described. The characters of new and neighbouring subspecies are discussed. A hypothesis about the relations and distribution of different taxa is proposed.

Keywords

Biodiversity, taxonomy, Central Asia, Siberia, *orientis*, *oreinus*

Introduction

The new subspecies *Papilio machaon* Linnaeus, 1758 (Lepidoptera, Papilionidae) was found in 2019 by Ts. Odbayar in South-Gobi aimak of Mongolia (Umnegov

Aimak) in the system of mountain spurs of the Gobi Altai. The collected series is unusually large for this territory, where the swallowtails are very rare and are not found at all over vast territories – obviously, there was a year of mass reproduction. The characteristics of the butterflies did not correspond to the known subspecies, but were similar to two specimens (male and female) collected by S. Churkin in the Trans-Altai Gobi (see full labels below) – almost everything that was collected during three long expeditions to Southern Mongolia in 2002–2004.

Material from the Gobi is completely absent in the known collections and has never been studied – at least we don't know such publications: either in the results of Soviet-Mongolian expeditions (Korshunov and Soljanikov 1976; Korshunov 1977) or in the book by V. Tshikolovets (Tshikolovets et al. 2009) there are no collection points indicated for Southern Mongolia.

In the just-released summary of *P. machaon*, on the general map of the subspecies' ranges, almost all of Southern Mongolia is an empty space: according to the map, the swallowtail is absent from this territory (Nazari et al. 2023: 38).

The work carried out has shown that we are indeed dealing with an undescribed subspecies that inhabits (at a minimum) the ranges of the Gobi Altai and the south-eastern spurs of the Mongolian Altai, located inside the Northern Gobi.

Materials and methods

The genitalia were dissected using conventional techniques. The abdomen was heated in hot 10% KOH solution. The adults were photographed using Canon 5DII with Sigma-50 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.).

The holotype will be deposited in the collection of the Darwin State Museum (Moscow), 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.

Result

1. Subspecies structure of *Papilio machaon* Linnaeus, 1758

The recently published book of V. Nazari with the co-authors (Nazari et al. 2023) represents a comprehensive and outstanding study of the complex *Papilio machaon* L., 1758. A great job has been done on carrying out an inventory of all the available valid names and typical places, which saves us from having to deal with this in our article.

We agree with the basic ideas about the complex structure given by Nazari. After studying a large amount of material from Siberia and Northern Russia, we confirm that the main part of this territory is inhabited by one subspecies – ssp. *orientis* Verity, 1911 (Figs 1–2: 1–4) – including Eastern Kazakhstan (southern Altai, Saur, Tarbagatai), all of Siberia and almost the entire north of the Far East.

As a result of one of his expeditions, S. Churkin obtained a rare series from the Putorana Plateau, the status of which was discussed with the authors of the book of Nazari – in particular with the respected A. Cotton (Chiang Mai, Thailand), as a result, the subspecies status for this small dark form was considered redundant. We confirm this decision and fully agree that the Putorana Plateau should be included in the range of *orientis*.

Moreover, the book indicates that the identity of the swallowtails from Western Chukotka and Magadan is unclear due to a lack of material. Our research shows that this territory should also be included in the habitat of *orientis*.

Only Eastern Chukotka is inhabited by the American subspecies ssp. *aliaska* Scudder, 1869, and Kamchatka – by ssp. *kamtschadalus* Alpheraky, 1897. Moreover, the entire territory of Russia, bordering Mongolia and, partly, Northern China, from Altai to Dauria, from Barnaul to Khabarovsk, is inhabited by *orientis*.

In Russian Primorye, Korea and eastern China there live ssp. *ussuriensis* Sheljuzhko, 1910 (TL: Grodekovo st. [Pogranichny village, Primorye, Russia]) and ssp. *schantungensis* Eller, 1936 (TL: East China, Qingdao [Qingdao, W. China]), both are easily distinguished from those discussed below. It is difficult to expect that butterflies described from the Pacific coast inhabit the Gobi Desert (Note that several taxa described from China have been synonymized with *schantungensis* – all of them belong to tropical and subtropical fauna, and therefore will not be considered in this article). The range of *ussuriensis* does not border on the possible range of the new subspecies – however, the subspecies structure in Primorye may turn out to be more complex than the authors of the book believe.

The section where we cannot agree with the authors of the above book is ssp. *centralis* Staudinger, 1886, described from the mountains bordering the Fergana Valley. Its range includes the territory from Saudi Arabia to Southern Mongolia! We can only take this as an important conclusion about the relatedness of the populations inhabiting the Arabian deserts and syrts (swampy high-mountain plateaus)

of the Tien Shan. However, biologically and zoogeographically such a unification is meaningless.

Even in the listing of characteristics there are obvious inconsistencies – for example, an important characteristic is indicated as «submarginal band on FW upperside and black basal spot suffused by yellow...» (Nazari et al. 2023: 38), which is simply not true for many Central Asian populations. In addition, it is stated that there is only one generation of swallowtail in the mountains, but this is only true at extreme altitudes. For example, in the mountains surrounding the Naryn river valley (Kyrgyzstan), the first generation of swallowtail exists, and is represented by very original butterflies with a rich yellow colour, completely different from the first generation of swallowtail from Gissar. It was from the Naryn valley that ssp. *oreinus* Sheljuzhko was described, 1919, now contracted to a synonym.

The inclusion of the Dzungarian Gobi territory into the range of ssp. *centralis* (sensu Nazari et al. 2023) was based on one female found by R. Yakovlev on the mountain Uvkhod-Ula (Nazari et al. 2023: 40). In the Dzungarian Gobi, elements of the Turanian fauna were actually discovered, completely similar to those from Eastern Kazakhstan (for example, *Holcocerus holosericeus* Staudinger, 1884, *Barchaniella inspersa* (Christoph, 1887), *Cecryphallus nubila* (Staudinger, 1895) (Cossidae), *Smerinthus kindermannii* Lederer, 1853 (Sphingidae), *Hemaris ducalis* (Staudinger, 1887), *Neopterodonta kuldjaensis* (Graeser, 1892), *Chazara heydenreichi* Lederer, 1853 (Nymphalidae), and *Rimizia miris* Staudinger, 1881 (Lycaenidae)) (Yakovlev 2012, 2015; Yakovlev et al. 2015), however, in such cases we are talking about arid species. In the case of *machaon*, the material is clearly not enough to resolve the issue.

We believe that the combination of several related, but still different subspecies into one (*centralis*) was erroneous and occurred mainly due to the lack of serious material from Russian Central Asia, as well as to ignorance of the zoogeographic division of this region. Further, we will use for comparison not only the characters of the *centralis*, but also the Tien Shan *oreinus* (there is no material from the Chinese Tien Shan, but for comparison, the material from Dzungaria seems more important in this case).

Summarizing all of the above, only the distribution area of *orientis* borders the Northern Gobi in the north and east, while the distribution area of *oreinus* (*centralis* auct.) is separated from Southern Mongolia by a wide strip of real desert, and the exchange of genes in this direction has long been impossible.

2. *Papilio machaon bilguun* ssp. nova.

<http://zoobank.org/B138D9A1-CAE0-449A-8FC9-2E6C6529F358>

Figs 1 (upperside)–2 (underside): 5–8.

Holotype: male, S. Mongolia, South-Gobi (Umnegov aimak), Nomgon sum, Naryin Teeg Mt., 12.07.2019, 1650 m, Odbayar Tz. leg.

Paratypes: 25 males, 9 females, same data, Odbayar Tz. leg.; 2 males, S. Mongolia, South-Gobi (Umnegov aimak), 14 km SW Gashuun Sukhait border post, 1050 m, 9.07.2019, Odbayar Tz. leg.; 1 male, S. Mongolia, South-Gobi (Umnegov aimak), Zuun Saikhan Mts., 2290 m, 13.07.2019, Odbayar Tz. leg.

Additional material: 1 female, Mongolia, Gobi-Altai Aimak, 30 km S Biger, 2700 m, 3-10.07.2002, S. Churkin leg.; 1 male, Gobi-Altai Aimak, 30 km SE Bugat somon, 1250 m, 5.07.2003, S. Churkin leg.

Description (second generation only).

Holotype FW length 42 mm, male paratypes 37–46 mm (40–42 as usual), female paratypes 38–49 mm (42–44 as usually).

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

Male.

General tone of upperside desaturated light yellow. Black pattern relatively sharp, not enlarged – in general, colouring not monotonous, different parts of wings with different colouration and colour intensity (typical of *schantungensis*, but in this case it is not so obvious).

FW upperside. Basal darkening with slight yellowish suffusion (looking grey), spots in the cell and on the cell's margin black with vague borders. Submarginal band not contrasting, bluish with blackish margins, narrow, gradually widened towards the anal side. The cell's borders and veins (except anal vein) widely blackened in postdiscal area. Marginal row of yellow spots narrow, apical spot in this row obviously enlarged and usually slightly stretched. Costal margin of apex with yellowish spot, rounded black spot under this spot.

HW upperside. Basal suffusion of black scales narrow, spreading along anal margin of wing. Crossvein with black spot. Submarginal band bluish, brighter and thicker than on FW. Submarginal/marginal black pattern thin and narrow. Tails long, often without slight thickening at tips; along inner edge of tail there – narrow yellow stripe, reaching almost to its tip.

Anal spot elongated, or (much less often) rounded, with thin blue inner edge, black border around the spot of normal length, elongated yellow field on outside of spot large, long and conspicuous.

Underside. Coloration pattern as on upperside, but faded and not so distinctive, black margin of FW highlighted, red spots on HW postdiscal band hardly noticeable, blue stripe moderately expressed, not so faded. The cells border and adjacent veins with developed black colour.

Male genitalia. Taxonomically important distinctions not found (3 pieces dissected). The shape of valva the same as in other subspecies. Harpe with teeth typical for the species, proportion of harpe holding rod and total harpe length around 0.4 and even less (seems unusual for *machaon*, looking too short, however, the character is not studied in other subspecies because Nazari and al. measured the actual length which seems normal for *machaon*).

Female similar to male, but lighter, blackish area around the veins in the post-discal zone reduced, general colour whitish-yellow, overall tone of black pattern generally lighter. Submarginal bluish band thicker than that of male. Black ring around red anal spot often (not always) reduced (as observed in related species).

Diagnosis.

The new subspecies differs from the eastern ssp. *schantungensis* and northern ssp. *orientis* by the reduced black pattern and the sandy colouration, from *orientis* (Figs 1–2: 1–4) it can be easily distinguished because of the long tails with developed yellow margin on the border.

It differs from the western *oreinus/centralis* (Figs 1–2: 9–12) by the shape of the submarginal bluish band of the FW which is narrow and only gradually widened towards the anal side of the wing. The Central Asian butterflies have this band sharply widened after the first costal spot, and then almost not changing in width, this feature is noted both in the mountains and throughout the Fergana Valley.

In addition, the basal spot on the FW upperside is grayish but not clearly yellowish. The slight uneven colouration resembles *schantungensis*, making a noticeable habitual difference from the Central Asian and Iranian specimens.

The reduction of the black border around the red spot and its elongated shape require further study. The shape of the spot apparently varies within subspecies – however, one cannot help but notice that in some of the *schantungensis* the spot is elongated, while *oreinus/centralis* is characterized by the opposite shape: the spot is stretched along the wing.

Etymology. The subspecies is named after Bilguun Odbayar (6 March 1989–1 September 2019), the tragically died and the beloved son of Odbayar Tserenpil and Batchimeg Bayar. The young man was a biologist who worked with stem cells. He loved reading, loved animals and loved life.

Biology.

The main population lives in the valley of a small stream with small bushes of *Caragana* sp. and meadows, the butterflies were flying together with *Vanessa indica* (Herbst, 1794) (Nymphalidae), *Aricia chinensis* (Murrey, 1874) and *Plebejus* sp. (Lycaenidae).

One male (two more were noticed but not caught) was collected on small sandy hills with stones near the border outpost on the border with China. In the mountains Zuun Saikhan it was flying on dry meadows together with *Pseudochazara hippolyte* (Esper, [1784]) and *Coenonympha amaryllis* (Stoll, 1782) (Nymphalidae).

Food plant unknown.

Distribution.

The known territory includes the Gurvan-Saikhan Range (the eastern part of the Gobi Altai system, a separate zookhoron) and adjacent areas of the Gobi.

We also have at our disposal a small series collected on the Khasagt Range (Khan Taishiryn) by S. Churkin – these specimens are similar to *bilguun*, differing in an even finer pattern, additional material is needed to clarify the situation.

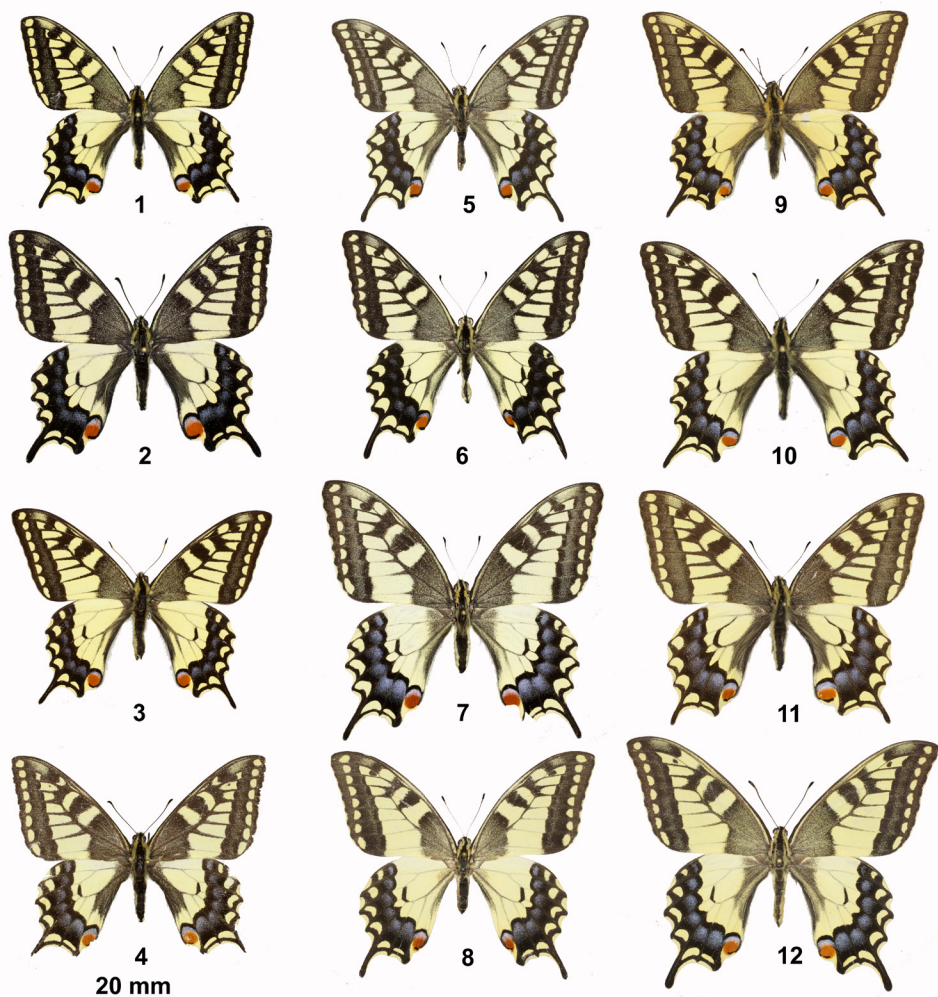


Figure 1. *Papilio machaon*, adult specimens, upper side:

1 – *Papilio machaon orientis*, male, SW Mongolia, Khovd aimak, Baitag Mts., Buduun Khar-gaityn r., 2600–2700 m, 2–3.07.2018, S. Churkin leg.;

2 – *P. m. orientis*, female, same data as 1;

3 – *P. m. orientis*, male, Russia, Far East, Amur reg., Blagoveshchensk vic., 10.05.1998, A. Kuzmin leg.

4 – *P. m. orientis*, female, Mongolian Altai (southern slopes), Alag Khairkhan Mts., 2650 m, 11.06.2004, Churkin S. leg.

5 – *Papilio m. bilguun* ssp. nova, holotype, male, S. Mongolia, South-Gobi (Umnegov aimak), Nomgon sum, Naryin Teeg Mt., 1650 m, Odbayar Tz. leg.

6 – *P. m. bilguun* ssp. nova, paratype, male, same data as 5.

7 – *P. m. bilguun* ssp. nova, paratype, female, S. Mongolia, South-Gobi (Umnegov aimak), Nomgon sum, Naryin Teeg Mt., 1650 m, Odbayar Tz. leg.

8 – *P. m. bilguun* ssp. nova, paratype, female, same data as 3. Continued on the next page.

Figure 1. Continued from the previous page.

9 – *P. m. oreinus*, male, Kyrgyzstan, Tian-Shan Mts., Naryn-Too Mts., 10 km N Akmuz, 17.07.1998, 2800 m, S. Churkin leg.

10 – *P. m. oreinus*, male, Kazakhstan, N. Dzhungaria, Koksu r., Rudnichnyi vic., 1100 m, 26.06.1999, S. Churkin leg.

11 – *P. m. oreinus*, male, Kyrgyzstan, Tian-Shan Mts., Kyrgyzsky Mts., Chon-Kurchak loc., 1300 m, 5.08.1999, S. Churkin leg.

12 – *P. m. oreinus*, female, Kyrgyzstan, Tian-Shan Mts., Kazarman vic., 1800 m, 20–21.06.2016, S. Churkin leg.



Figure 2. *Papilio machaon*, adult specimens, under side. See description to the Fig. 1.

It is important to note that the known range of the new taxon coincides with the range of the recently described *Melitaea devyatkini* Kolesnichenko, 2018. This species was discovered deep in the Gobi Desert (near the border post noted above). Later, Odbayar Ts. found a new place at the top of the Gurvan-Saikhan Range, at an altitude of about 2000 meters, at the same time, the Gobi and mountain populations are very similar and belong to the same subspecies with a slight phenotypic difference (mountain butterflies are statistically redder with a slightly more developed black pattern) (K. Kolesnichenko, pers. message).

Discussion

1. Separate but undoubted specimens of *orientis* have been collected in the following localities adjacent to the Gobi: Arshantyn Nuruu Mts. at the northwestern tip of the Mongolian Altai, Alag Nuruu Mts. on the southern slope of the Mongolian Altai (Figs 1–2: 4), the Tuin-Gol river valley, on the southern slope of Khangai, env. Ulaanbaatar. Serial material from the following regions also belongs to *orientis*: Southern Buryatia, the Chita region (Talacha river, etc.), the Amur region (environment of Blagoveshchensk, Kostyukovka village, etc.), part of the Khabarovsk Territory (Bureya river, etc.).

Both generations of *orientis* are known, and both are easily distinguished from the second generation of the new subspecies; no transitions have been detected.

In addition, S. Churkin collected on the Baitag Range, isolated inside the Dzungarian Gobi (range height 3000 meters above sea level, see Churkin & Kolesnichenko, 2019) a small series of swallowtails, clearly close to ssp. *orientis* (Figs 1–2: 1, 2), these data have not been published before. Note that this population is completely isolated from all the others, and a different butterfly flies in the dry mountains inside the same Dzungarian Gobi – possibly related to specimens from semi-desert regions of Kazakhstan (see above, the distance from Baitag Range to Uvkhod-Ula Mt. is about 60 km).

It is very likely that, with the exception of the disputed territory of the Dzungarian Gobi, the rest of southern Mongolia is inhabited by a new subspecies – referring to the dry mountains in the Gobi Desert with biotopes suitable for swallowtail.

2. We believe that light colouration with the reduction in black pattern is associated with arid conditions, and it is incorrect to unite all similar populations from Saudi Arabia to the Gobi based on these characteristics. The shape of the submarginal stripe seems to be a much more important feature than the overall colour – and here it should be noted that in the Iranian butterflies this stripe is also narrow (Nazari et al. 2023: 39), unlike the Central Asian populations!

There is another serious sign - in butterflies from Iran and adjacent territories, the apical yellow spot in the marginal band is noticeably enlarged, as well as in *bilguun*. Meanwhile, in both the arid *centralis* from Central Asia and the mountain *oreinus* from the Tien Shan, this spot is narrow, more or less of the usual size, and

the submarginal stripe is sharply expanded, like a ledge, immediately after the beginning (Nazari et al. 2023: 40).

It can be assumed that all the arid populations had their origin in the more ancient fauna of Iran, and then spread throughout Asia as the land became desertified. Then the old connections were broken, the exchange of genes with neighboring autochthonous populations changed the sum of characters, and the single areal was broken too. We assume that in this case, the signs of the red anal spot, the development of the black pattern (reduced in *bilguun* females) and the uneven colouring indicate the kinship specifically with the Chinese populations (representing differences from the Iranian ones), which can be verified by detailed DNA studies.

The proposed hypothesis looks logical and explains the entire sum of the observed phenomena.

The subspecies differences in the first generations of swallowtails are significantly higher, at least in Asia. This is true for *oreinus*, *orientis*, *ussuriensis*, *schantungensis* – unfortunately, in this case the first generation is unknown to us.

Acknowledgements

Many thanks to Vasiliy Tuzov and Kirill Kolesnichenko (Moscow) for their advice during the work. We are grateful to Anna Ustjuzhanina (Tomsk) for language improvements.

References

- Churkin SV, Kolesnichenko KA (2019) A new species of *Lycaena* Fabricius, 1807 (Lepidoptera, Lycaenidae) from Mongolia with a review of genitalia characters of the related taxa. *Zootaxa* 4555 (4): 548–560. <https://doi.org/10.11646/zootaxa.4555.4.6>
- Korshunov YP, Gorbunov PY (1995) Butterflies of the Asiatic part of Russia. Ural State University, Ekaterinburg, 202 pp. [In Russian]
- Korshunov YP (2002) Butterflies of northern Asia. KMK Press, Moscow, 424 pp. [In Russian]
- Miller LD (1970) Nomenclature of wing veins and cells. *Journal of Research on the Lepidoptera* 8(2): 37–48.
- Korshunov YP (1977) Diurnal butterflies (Lepidoptera, Rhopalocera) of the Mongolian People's Republic, II. *Insects of Mongolia* 5: 649–681. [In Russian]
- Korshunov YP, Soljanikov VP (1976) Diurnal Butterflies (Lepidoptera, Rhopalocera) of the Mongolian People's Republic. *Insects of Mongolia* 4: 403–458. [In Russian]
- Nazari N, Cotton AM, Coutsis JG, Shapoval N, Todisco V, Bozano GC (2023) Guide to the butterflies of the Palearctic Region. Papilionidae, part IV. Tribe Papilionini: Papilio (partium). *Omnes Artes*, Milano, 91 pp.

- Tshikolovets VV, Yakovlev RV, Balint Z (2009) The Butterflies of Mongolia. Kyiv-Pardubice, 320 pp.
- Yakovlev RV (2012) Checklist of Butterflies (Papilionoidea) of the Mongolian Altai Mountains, including descriptions of new taxa. *Nota lepidopterologica* 35(1): 51–96.
- Yakovlev RV (2015) Cossidae (Lepidoptera) of Mongolia. *Check List* 11(5): 1736. <http://dx.doi.org/10.15560/11.5.1736>