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Article

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A new subspecies of Arctic Apollo − *Parnassius arcticus* (Eisner, 1968) (Lepidoptera, Papilionidae) from the Arga-Tas Range (North-Eastern Yakutia)

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Abstract
Basing on the external morphological characters, an isolated population of the Arctic Apollo, *Parnassius arcticus* (Eisner, 1968) (Lepidoptera, Papilionidae), from the Arga-Tas Range mountains (North-Eastern Yakutia, Russia) is described here as a new subspecies, *Parnassius arcticus shavlovi* Yakovlev & Bakhaev, **subsp. nov**.

Key words: biodiversity, fauna, extreme habitats, Papilionoidea, Parnassiini, distribution, taxonomy.

Introduction

Parnassius arcticus (Eisner, 1968) (Lepidoptera, Papilionidae) is a very rare local species, confined to high-mountain gravelly screes of the north-east of the Russian Federation. All the known localities of the species have been presented in detail in a number of articles of the recent years. (Korshunov 1988; Chichvarkhin 2004; Gorbunov 2008; Bakhaev 2017; Yakovlev et al. 2020). At the moment, the subspecies structure and distribution of the Arctic Apollo is as follows:

***Parnassius arcticus* (Eisner, 1968)**
Tadumia simo arctica Eisner, 1968: 15
Type locality: den Bergen östlich von Werchnosensk [Verkhoyansk?, Yakutia, Russia].

***Parnassius arcticus arcticus* (Eisner, 1968)**
Figs 1−4

= ? *Parnassius ammosovi* Korshunov, 1988: 69. Type locality: Russia, Yakutia, Suntar-Khayata Range, 180 km ENE from the Khandyga settlement, river Vostochnaya Khandyga upper flow, 232nd km of the road from Khandyga to Magadan.

Figures 1−4. Wing pattern of *Parnassius arcticus arcticus*, Russia, Yakutia, Suntar-Khayata Range, Khandyga–Magadan rd., Sukhaya riv., h=1400 m, 10-20.vi.1991, leg. B. Khramov: 1−2 − males; 3−4 – females.

Figures 5−8. Wing pattern of *Parnassius arcticus arbugaevi*, Russia, NE Yakutia, Momsky Range, 70 km E of Khonuu village, 1400 m, 22−24.vi.2019, leg. Y. Bakhaev: 5−6, males, Holotype and paratype; 7−8, females, paratypes.

Distribution: Verkhoyansky and Suntar-Khayata Range (North-Eastern Yakutia).

***Parnassius arcticus arbugaevi* Yakovlev & Shapoval, 2020**
Figs 5−8

Yakovlev et al. 2020: 99−103.
Type locality: Russia, North-Eastern Yakutia, Momsky District, 70 km E of Khonuu village.
Distribution: Momsky Range (North-Eastern Yakutia).

The conspecificity of *P. arcticus* and *P. ammosovi* does not look completely convincing due to the fact that there is still no good comparative material from the type locality of *P. arcticus.* Also, the subspecies belonging of the specimen collected on Yablonovyi Pass in Magadan Territory (Gorbunov 2008) is not known.

Material and methods

In summer of 2022, the second author of the article, Yuriy Bakhaev, undertook a research on the isolated high-altitude Arga-Tas Range, where he collected a series of the new subspecies, Arctic Apollo.

Male genitalia were mounted in euparal on slides following Lafontaine and Mikkola (1987) and examined with an Olympus SZX16 microscope. The images were taken with the Olympus SZX16 camera. The images were processed using Adobe Photoshop CC software.

Results

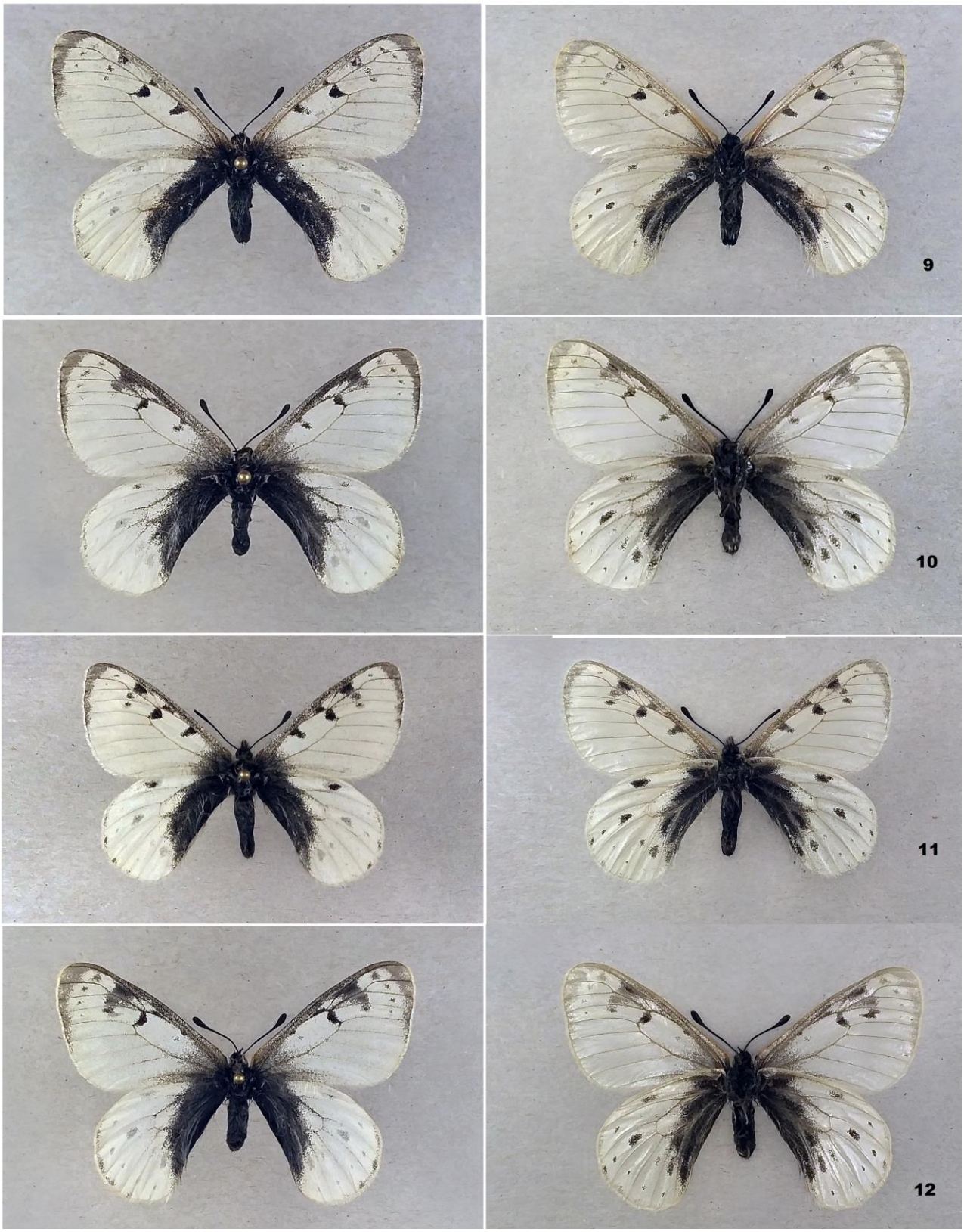
Description of new subspecies

***Parnassius arcticus shavlovi* Yakovlev & Bakhaev, subsp. n.**
http://zoobank.org/urn:lsid:zoobank.org:act:4268E6A7-6D90-4958-B165-A9D59DCEBB6B
Figs 9−19

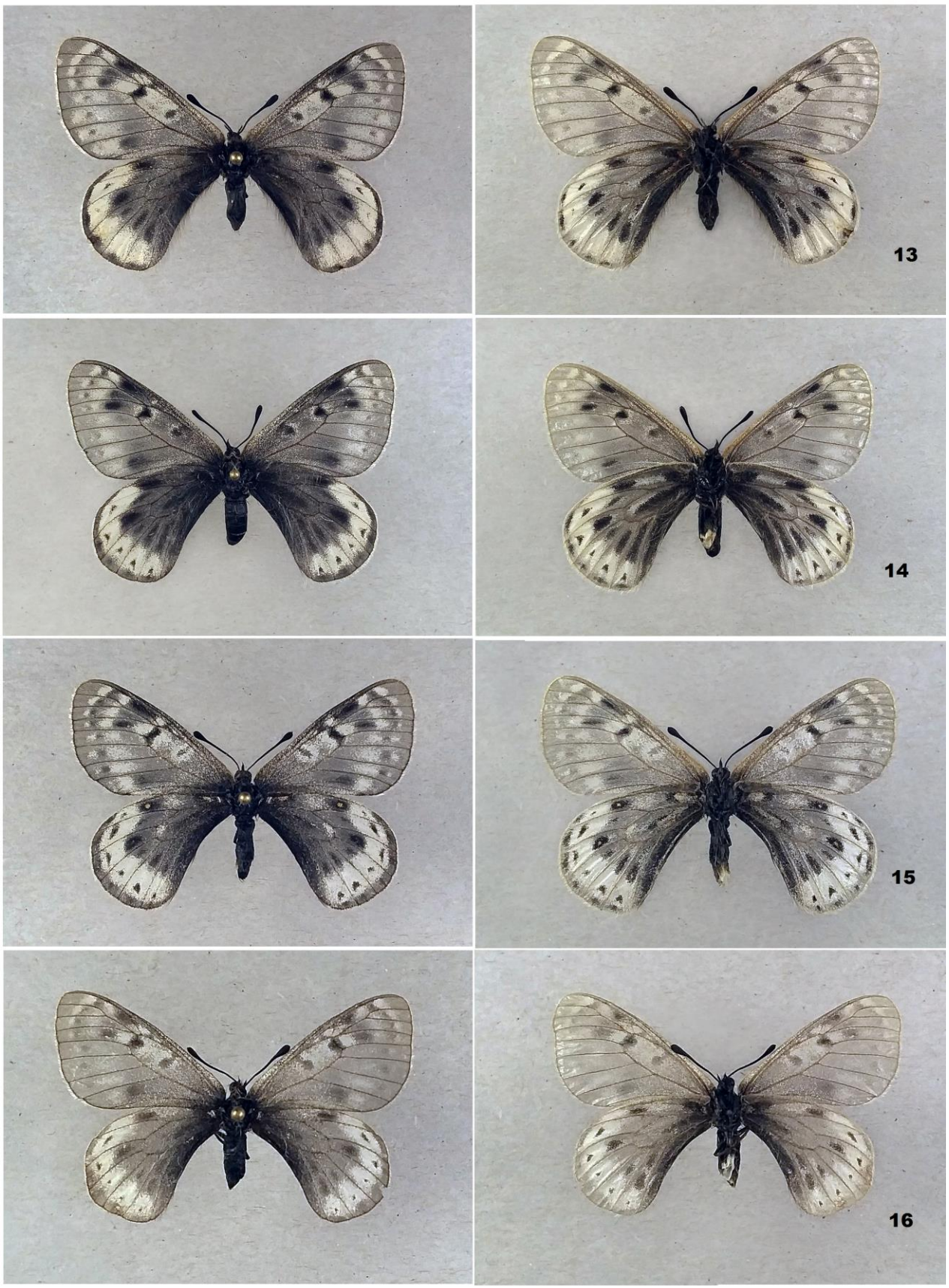
Material examined. Holotype, male, Russia, North-Eastern Yakutia, Verkhnekolymsky District, Arga-Tas Range, uppers of Tuora-Bygyttakh river, H−1100−1300 m, 20−28.vi. 2022, leg. Y. Bakhaev (Zoological Institute, Saint-Petersburg, Russia).

Paratypes. 76 males, 19 females, the same locality and data (Zoological Institute, Saint-Petersburg, Russia; private collection of Roman V. Yakovlev, Barnaul and Yuri I. Bakhaev, Lipetsk).

Description. Male. Wingspan of holotype 43 mm, paratypes – 34−46 mm. Antennae coal-black, shorter than half of fore wing in length. Head, thorax and abdomen covered with coal-black scales. Fore wing white from above, with dense sputtering of black scales basally, black scales sputtering also along costal margin from root to apex of wing, clearly expressed black stroke in centre of discal cell, black cuneal or round spot at top of discal cell, series of two-three (partially fused) black strokes between radial veins postdiscally, series of two-four small black strokes between radial cells postdiscally (closer to outer margin of wing), outer margin of wing (from apex to Cu_1) semi-transparent, with sputtering of black scales, fringe white. Fore wing from underside with completely the same pattern as on wing from upside. Hind wing from upside white, with vast black portion, occupying area from anal margin and wing base to middle of discal area and portion along Cu_2 vein, postdiscal area in cell Sc+R−Rs and cell M_1−M_2 with tiny dark spots translucent from underside; in some males, black spot on wing upside only in cell Sc+R−Rs, very thin rim along wing margin from Rs to M_2 (rarely, M_3) (in almost half of specimens, rim torn into separate strokes), fringe white. Hind wing from underside with more contract pattern than from upside: postdiscally in cell Sc+R−Rs and cell M_1−M_2 well developed small black spots (often developed in cells M_3−Cu_1, Cu_1−Cu_2 and Cu_2−2A as well); in most specimens, tiny black spots developed submarginally in cells between medial and cubital veins, small black spots between medial veins along wing margin.



Figures 9−12. Wing pattern of males of *Parnassius arcticus shavlovi*, Russia, North-Eastern Yakutia, Verkhnekolymsky District, Arga-Tas Range, uppers of Tuora-Bygyttakh river, H 1100−1300 m, 20−28.vi.2022, leg. Yu. Bakhaev: 9. Holotype, 10−12. Paratypes.



Figures 13−16. Wing pattern of females of *Parnassius arcticus shavlovi*, Russia, North-Eastern Yakutia, Verkhnekolymsky District, Arga-Tas Range, uppers of Tuora-Bygyttakh river, H 1100−1300 m, 20−28.vi.2022, leg. Yu. Bakhaev: 13−16. Paratypes.

Male genitalia (Fig. 17) is similar to the nominotypical *P. arcticus*. Uncus forked, short, with uncinate apices diverged to sides; valve cup-like, with even edges, apically semicircular; conical harpe on inner surface of valve, slightly protruding beyond the apex of valve; juxta oval, with pair of flask-shaped processes directed dorsally; saccus robust, conical; phallus thin, slightly curved along all length, apically needle-like, 1/3 longer than valve.

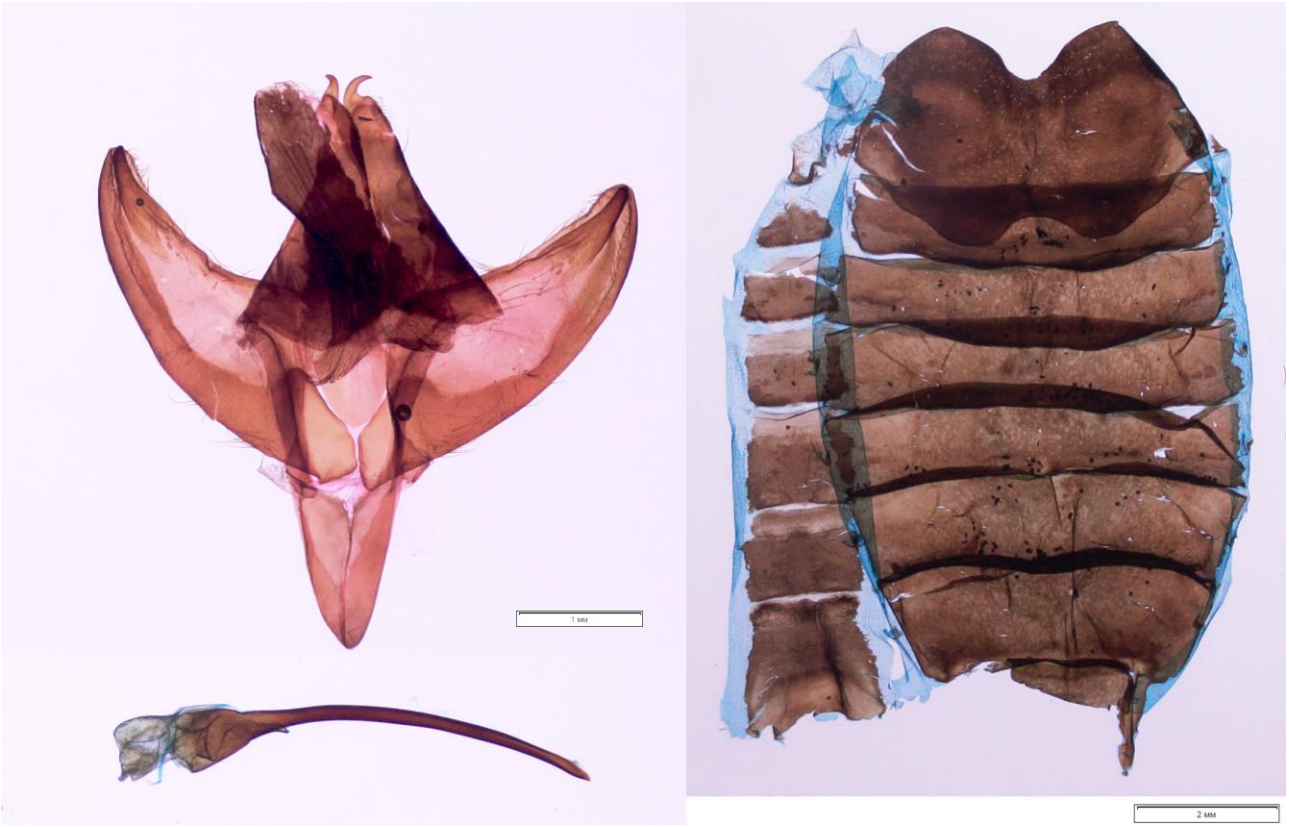


Figure 17. Male genitalia of *P. arcticus shavlovi* (paratype): frontal projection, slide #178 (A. Naydenov).

Female. Wingspan 35−46 mm. Antennae coal-black, shorter than half of fore wing in length. Head, thorax and abdomen covered with coal-black scales. Fore wing from upside with intensive black sputtering at root, costal margin with black sputtering; in vast majority of specimens, black sputtering distributed throughout wing field, except for some light spots and bands; black spot of medium size in middle of discal cell, large black spot at top of discal cell; postdiscally from costal margin to M2 – band of fused black spots; postdiscally closer to outer margin – relatively wide light band (or light portion), submarginally – expressed thin (often, fragmentary) light band, outer margin of wing semitransparent, with intensive grey sputtering, fringe white. Fore wing from underside with the same pattern as from upside, but significantly lighter. Hind wing from upside often with very wide dark-grey root portion (sometimes occupying all root, discal and partially postdiscal areas), large black spots (round of shaped as wide longitudinal strokes) postdiscally in cells Sc+R−Rs, M_1−M_2, M_3−Cu_1 and Cu_1−Cu_2; postdiscally (closer to outer margin of wing) – wide light band with small black strokes in the range of cells from Rs−M_1 to Cu_1−Cu_2 (steadily developed in cells Rs−M_1 and M_1−M_2, rarely – in all cells), outer margin dark-grey or black, fringe white. Hind wing from underside in general with the same pattern as on upside but slightly lighter and more contrasting (in root area, discal cell and cell Sc+R−Rs with developed long bright black longitudinal strokes).

Diagnosis. The new subspecies clearly differs from the known subspecies in a series of characters.
From *P. arcticus arcticus*:

- the new subspecies on an average is larger in size: male wingspan is 34−46 mm, females – 35−46 mm (in *P. arcticus arcticus*: 32−41 mm and 37−40 mm, respectively);

Figure 18. *P. arcticus shavlovi* in nature, male (photo by Yu. Bakhaev).

Figure 19. *P. arcticus shavlovi* in nature, female (photo by Yu. Bakhaev).

Figures 20−21. Landscapes on the Arga-Tas Range (photo by Y. Bakhaev).

Figure 22. *P. arcticus shavlovi* (male) on the flower of *Smelowskia jacutica* (photo by Y. Bakhaev).

- in the males of the new subspecies, the black spots on the fore wing postdiscally and especially, submarginally, are significantly less developed (in *P. arcticus arcticus*, the rows of black spots are developed steadily);
- in the males of the new subspecies, the black spot on the hind wing in cell M_1–M_2 is absent steadily; additionally, in most specimens there is no black spot in cell Sc+R–Rs (in *P. arcticus arcticus*, the black spots of the submarginal row on the hind wing are well expressed);
- along the outer margin of the hind wing in most males there are small black spots (in *P. arcticus arcticus*, the outer margin of the wing is white);
- in the females of the new subspecies, the black sputtering on the wings from upside is much more expressed; the orange nucleoli in the black spots of the postdiscal row on the hind wing are very rare (in *P. arcticus arcticus*, the black sputtering on the wings from above is significantly less expressed; in most specimens, there are orange nucleoli in the black spots of the postdiscal row on the hind wing).

Figure 23. Host plants of *P. arcticus shavlovi*: *Corydalis gorodkovii* (photo by Y. Bakhaev)

Figure 24. Host plants of *P. arcticus shavlovi*: *C. gorodkovii* with leaves damaged by the Arctic Apollo larvae (photo by Y. Bakhaev).

From *P. arcticus arbugaevi*:

- in the males of the new subspecies, the black spot is steadily present in the discal cell on the fore wing (in *P. arcticus arbugaevi,* the black spot in the discal cell on the fore wing is steadily absent);
- in the males of the new subspecies, the black spot on the hind wing in cell M_1–M_2 is steadily absent; additionally, in most specimens there is no black spot in cell Sc+R−Rs (in *P. arcticus arbugaevi,* the black spots of the submarginal row on the hind wing are clearly expressed);
- in most of the males, along the outer margin of the hind wing there are small black spots (in *P. arcticus arbugaevi,* the outer margin of the wing is white);
- in the females of the new subspecies, the black sputtering on the wings from upside is less expressed, the pattern of fore and hind wings is more contrasting, on the fore wing there are well developed postdiscal and submarginal light bands (in *P. arcticus arbugaevi,* the black sputtering on the wings from upside is significantly more intense, the pattern (especially, on the fore wing) is more blurred, not distinctive; there are no postdiscal and submarginal light bands on the fore wing).

Bionomy. The adults were indicated in the middle of June on gravel screes at altitudes of 1100−1300 m (Figs 20−21). The adults were observed feeding on the flower of *Smelowskia jacutica* (Botsch. & Karav.) Al-Shehbaz & S.I. Warwick (Brassicaceae) (Fig. 22). The leaves damaged by the caterpillars of *P. arcticus shavlovi* were found on *Corydalis gorodkovii* Karav. (Papaveraceae) (Figs 23−24).

Etymology. The subspecies is named after Roman Shavlov (Yakutsk) − an amateur zoologist well known in Yakutia, a friend on one of the authors of this article.

Distribution. Known only from Arga-Tas Range in North-Eastern Yakutia.

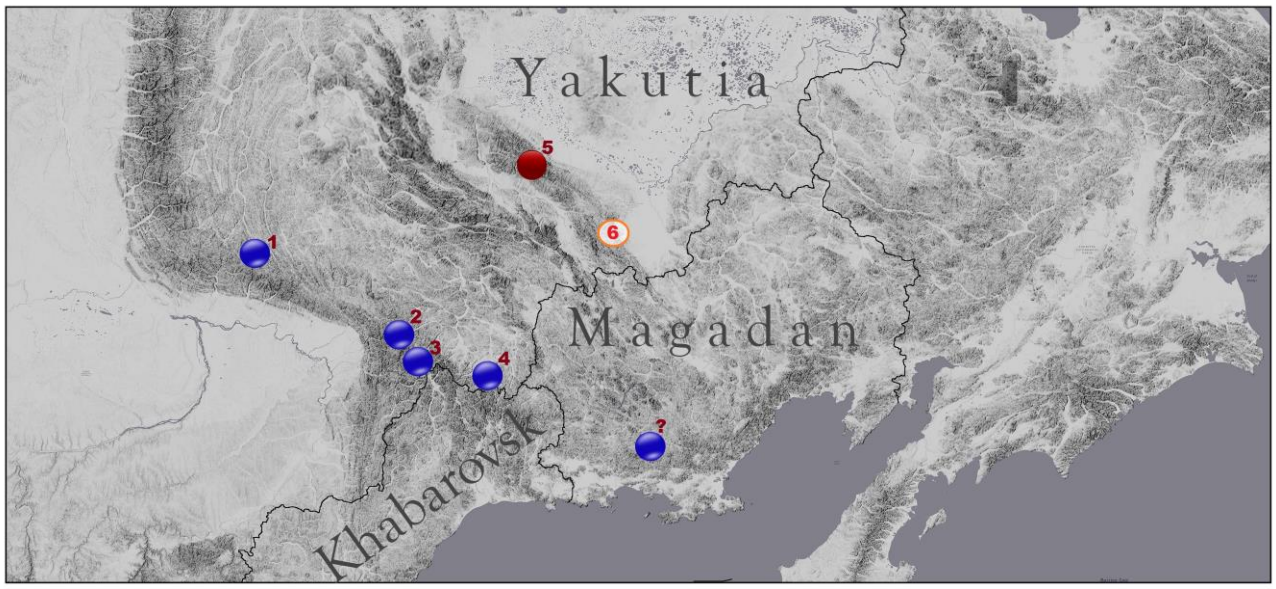


Figure 25. Distributional map of *P. arcticus*: 1 - upper of Kele river, Verkhoyansky range, Yakutia. The place from where this species was described by Curt Eisner in 1968, by two males; 2 - middle part of Kurbelyakh river, Suntar-Khayata Range, Yakutia. Several observations of the species in small series by lepidopterists from the beginning of the 90s of the last century to the present time; 3 - the vicinity of Mus-Khaya Mountain, Suntar-Khayata Range, Yakutia. Single observation of the species in a large series by Slovak lepidopterists in the 90s of the last century; 4 - Nezhdaninskoe village area, Suntar-Khayata Range, Yakutia; Several observations of the species in small series by Yuri Bakhaev in 2010−2018; 5 - uppers of Khulurin river, Momsky Range, Yakutia. Observation of the species in 2019 by Yuri Bakhaev in a small series, subspecies *arbugaevi*; 6 - uppers of Tuora-Bygyttakh River, Arga-Tas Range, Yakutia. Observation of the species in 2022 by Yuri Bakhaev in a large series − the subspecies *shavlovi*, describing here; ? - Yablonevyi Pass, Magadan region. Observation of one adult by local entomologist in the 90s of the last century. The fact is in question.

Discussion. It seems surprising that the new subspecies *P. arcticus shavlovi* was formed in the same mountain range as *P. arcticus arbugaevi* (Fig. 25). But there is a large distance between their places (more than 230 km), and most importantly, a biotopic gap (red line) (Fig. 26): a low-mountain zone. As it is known, *P. arcticus* lives only in the highlands (a zone of stony tundra at a height of more than 1100 m). So, the high-mountain areas of the Arga-Tas Range are an isolate, which contributed to the formation of quite significant differences at the subspecies level over time.

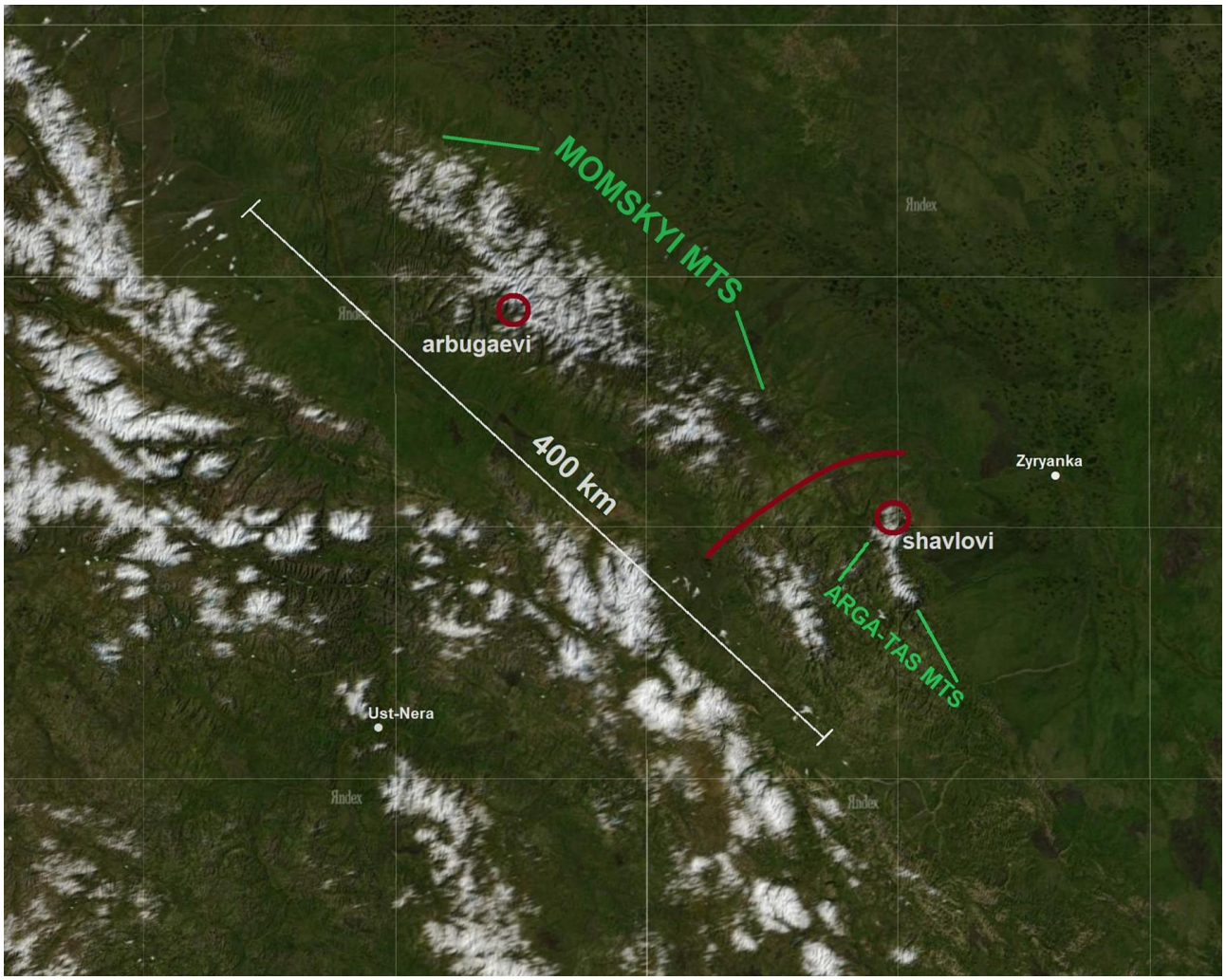


Figure 26. Detailed distributional map of *P. arcticus arbugaevi* and *P. arcticus shavlovi*.

Acknowledgements

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