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## *Plebejus alizadehorum* sp. n. from Western Iran (Lepidoptera: Lycaenidae: Polyommatae: Polyommataini)

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**Abstract.** A new species of polyommataine lycaenid butterfly (Lycaenidae, Polyommataini), *Plebejus alizadehorum* sp. n., is described on the basis of 44 males and 14 females collected in Shaho Mountain, Zagros, Kermanshah Province, Iran, and distinguished from other look-alike polyommataine lycaenids occurring in the region. A new species is compared with the following externally similar sympatric taxa: *Plebejus argus* (Linnaeus, 1758), *Lycaeides argyrognomon* (Bergsträsser, 1789), *L. christophi* (Staudinger, 1875), *L. idas* (Linnaeus, 1761) and *Kretania alcedo* (Christoph, 1877). It differs from the above mentioned species of the genera *Plebejus* Kluk, 1780 and *Lycaeides* Hübner, 1819 by the absence or presence of the discal spot in the forewing ventral surface. *Kretania alcedo* has metallic lunules in the submarginal area of the hindwing ventral surface, which are lacking in the new species. A key to all compared taxa is given for better diagnostics.

**Key words:** Lycaenidae, Polyommataina, *Kretania*, *Lycaeides*, *Plebejus*, taxonomy, Iran.

### *Plebejus alizadehorum* sp. n. из Западного Ирана (Lepidoptera: Lycaenidae: Polyommatae: Polyommataini)

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**Резюме.** Новый вид бабочек-голубянок (Lycaenidae, Polyommataini) *Plebejus alizadehorum* sp. n. описан из Ирана (гора Шахо, Загрос, провинция Керманшах) на основании 44 самцов и 14 самок. Вид сравнивается с внешне похожими таксонами *Plebejus argus* (Linnaeus, 1758), *Lycaeides argyrognomon* (Bergsträsser, 1789), *L. christophi* (Staudinger, 1875), *L. idas* (Linnaeus, 1761) и *Kretania alcedo* (Christoph, 1877). От упомянутых видов родов *Plebejus* Kluk, 1780 и *Lycaeides* Hübner, 1819 новый вид отличается отсутствием или наличием дискового пятна на вентральной поверхности переднего крыла. *Kretania alcedo*, также внешне похожий на новый вид, отличается наличием металлических лунок в субмаргинальной области вентральной поверхности задних крыльев, которые отсутствуют у *P. alizadehorum* sp. n. Для лучшей диагностики составлена определительная таблица для всех сравниваемых таксонов.

**Ключевые слова:** Lycaenidae, Polyommataina, *Kretania*, *Lycaeides*, *Plebejus*, таксономия, Иран.

## Introduction

Two recently published monographs document the taxonomy, nomenclature and bionomics of the diverse Iranian butterfly fauna [Nazari, 2003; Tshikolovets et al., 2014]. In these books it is indicated that *Plebejus argus* (Linnaeus, 1758), a widely distributed polyommataine Lycaenidae species in the Palaearctic region, occurs only in the north-western part of the country. A similar species, *Kretania alcedo* (Christoph, 1877) has a much wider distribution. The two species are recorded syntopically and synchronically in many places.

More than a decade the junior author started to conduct faunistic surveys in Iran, and collected a strange looking polyommataine species in the Shaho Mountain at the border of Kermanshah and Kurdistan provinces. This lycaenid butterfly superficially looked like a mixture of *Plebejus argus* and *Kretania alcedo* as the wings provide phenotypic characters typical for both species. This phenotype is not restricted to a peculiar year, as it has been collected repeatedly during several years, suggesting that it is not a natural hybrid and confirming that this population is a lycaenid butterfly species, hitherto unknown.

In 2020 a special effort was made to collect a larger sample of the species, which proved successful. The aim of the present paper is to classify and describe this species on the basis of the larger sample, and give some remarks on its identity.

## Material and methods

Specimens serving as type material were collected during daytime using butterfly net. Four males and three females were sent to the Hungarian Natural History Museum for further evaluation, where specimens were put under microscope, abdomens were dissected using traditional methods [Winter, 2000]. The dissected genital armature with abdominal segments is kept with the relevant specimen in glycerine containing plastic microvial pinned on the specimen's pin. Only one male specimen's genitalia is mounted on microscopic slide. Terminology for descriptive texts follows Scott [1990].

Type specimens will be deposited in the following institutions and collections:

PPDRI – Institute for Pestilence and Plant Disease Research (Tehran, Iran);

HNHM – Hungarian Natural History Museum (Budapest, Hungary);

AK – private collection of A. Karbalaye (Tehran, Iran);

RA – private collection of Messrs Mohammad Reza and Hossein Imam Alizadeh (Tehran, Iran).

*Plebejus alizadehorum* sp. n.  
(Figs 1–13, 15, 16)

**Material.** Holotype, ♂ (Figs 1, 2), in good condition, set dorsally (PPDRI): “Holotype Iran, Kordestan 10km east of Paveh, M. Shaho 3200–3350m 18.july 2020 Leg. Ahmad Karbalaye”. Paratypes: 1♀, allotype (Figs 3, 4) (PPDRI), 33♂, 7♀ (AK), 4♂, 3♀ (HNHM), 6♂ (Figs 5–8), 3♀ (RA) with the same label. Dissections: HNHM Bálint genitalia preparation numbers 1765 (male; mounted as HNHM Tóth B. genitalia preparation No. 2024), 1766 (female), 1767 (male; mounted as HNHM Tóth B. genitalia preparation No. 2043).

**Classification and generic placement.** The species being described belongs to the tribe Polyommataini because (1) the male possesses androconia dispersed amongst ground and cover scales in the dorsal wing surfaces and (2) the female genital duct is eversible. It is classified as a Polyommataina because the genitalia gnathos is located directly under the lobes of the uncus [Stradomsky, 2016]. It is placed in the genus *Plebejus* Kluk, 1780 (type species: *Papilio argus* Linnaeus, 1758) because the tibia of the middle leg possesses a claw (Fig. 10) and juxta trifurcate (with long central process arising from base) (Figs 12, 13), valval costa terminus dentated (Figs 14, 15) [cf. Forster, 1936; Higgins, 1975].

**Diagnosis.** *Plebejus alizadehorum* sp. n. wing size averages are smaller than all the other look-alike species as *Plebejus argus*, *Lycaeides argyrognomon* (Bergsträsser, 1789), *L. christophi* (Staudinger, 1875) and *L. idas* (Linnaeus, 1761), *Kretania alcedo* (Christoph, 1877) or *K. iranica* (Forster, 1938) native in northern and western Iran. Amongst these species the only similar taxon in size is *Lycaeides christophi* but the wing dorsum is lighter blue in *christophi* males, and the dorsal wing surfaces of *christophi* females are also blue. Comparing the new species with the mentioned *Plebejus* and *Lycaeides* Hübner, 1819 species it can be discriminated immediately by the absence or presence of the discal spot in the forewing ventral surface (Fig. 8). Another species which can be confused with it is *Kretania alcedo*. This species has metallic lunules in the submarginal area of the hindwing ventral surface submarginal area, which are lacking in the new species (Fig. 8). The key composed on the basis of wing characters may help in the identification (see further below). The male genitalia structures are typical *Plebejus* (s. str.) with a trifurcate juxta and with dentation in the valval costa terminus (Figs 12, 13, 15). Female genitalia is also typical *Plebejus* with henia, which is an eversible membranous and flexible tube (Fig. 16).

**Description.** Male. Wings. Forewing costa length measured from base to apex 11–13 mm ( $n = 44$ ), 12.5 mm in the holotype; dorsal wing surface slightly iridescent dark violaceous blue with 2 mm wide black border, blue ground colour suffused with black scales, veins especially black in marginal areas, fringes brown basally and white terminally, but black at vein termini, forewing with discal spot, hindwing with submarginal spots; ventral wing surface white with standard polyommataine pattern, basal area ash grey and submarginal orange pattern reduced, forewing with discoidal spot, hindwing submarginal metallic lunules absent.

Genitalia (Figs 12, 13). In ventro-dorsal view labides long and S-shaped, bases wide with outwardly pointed apices, falces straight and short, valva with heavily sclerotized costa; in lateral view tegumen large, uncus strong with slightly bent arms pointed apically, valva longer than upper capsula, widest at middle area, costa terminus sclerotized with dentation, protrusions gradually getting larger from costa to lower margin (Fig. 15); aedeagus slender, suprazonal element slightly shorter than that of subzonal and apically narrowing.

Female. Forewing costa length measured from base to apex 11–12.5 mm ( $n = 14$ ), wings as in male, but dorsal wing surface colouration brown, submarginal pattern supplemented with orange lunules.

Genitalia. Henia in dorsal or ventral aspect overall wide and ending distally in bulbous expansion with a sclerotized plate. Ventrum with a pair of sclerotized falps, extending over most of henia's length, gradually diminishing in width from distal end to base (Fig. 16).

**Bionomics.** Imagines fly at an elevation above 3000 m in green belts near the ground around an *Astragalus* species from the Hymenostegis-group that shows rapid diversification [Bagheri et al., 2017] (Figs 17, 18). Males showed typical lekking behaviour [cf. Piszter et al., 2016]. At the collecting site the following butterfly species were recorded during the flight period of the species: *Gonepteryx rhamni transiens* Verity, 1913 (Pieridae: Coliadinae), *Polygonia egea* (Cramer, 1775) (Nymphalidae: Nymphalinae), *Pontia chloridice* (Hübner, [1813]) (Pieridae: Pierinae), *Polyommatus icarus* (Rottemburg, 1775) (Lycaenidae: Polyommataina), and *Satyrium marcidum* (Riley, 1921) (Lycaenidae: Theclinae).

**Type locality.** Shaho Mountain, ca 10 km south east of the Paveh town, Zagros Mountains, Iran, 35°02'23.35"N / 46°26'46.62"E, at an altitude of 3200–3350 m (Fig. 19).

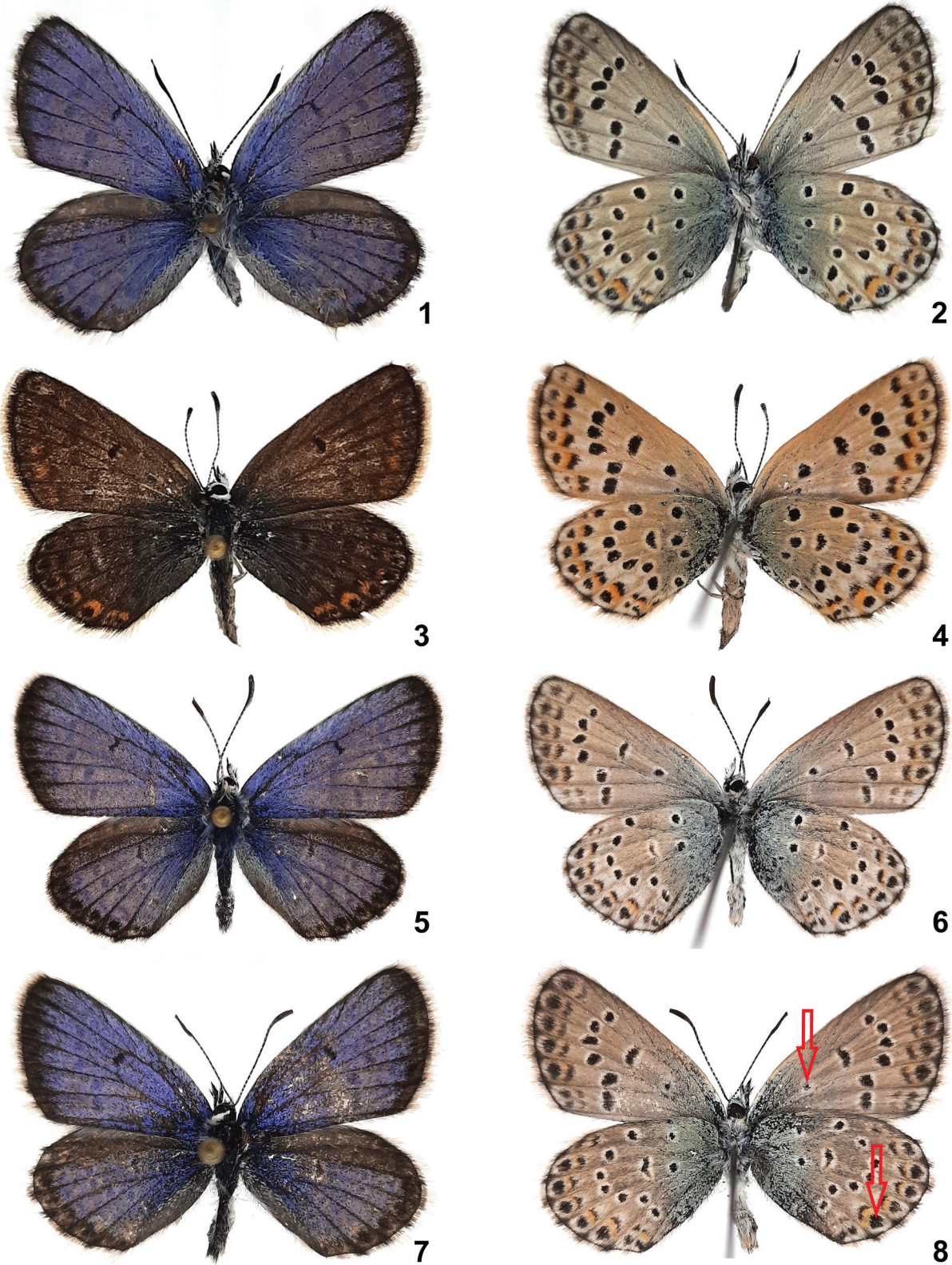
**Etymology.** The new species is named in honour of the brothers Alizadeh, Mohammad Reza and Hossein Imam (Tehran, Iran), who beside the junior author took part in the expeditions when the species was discovered and collected.

## Discussion

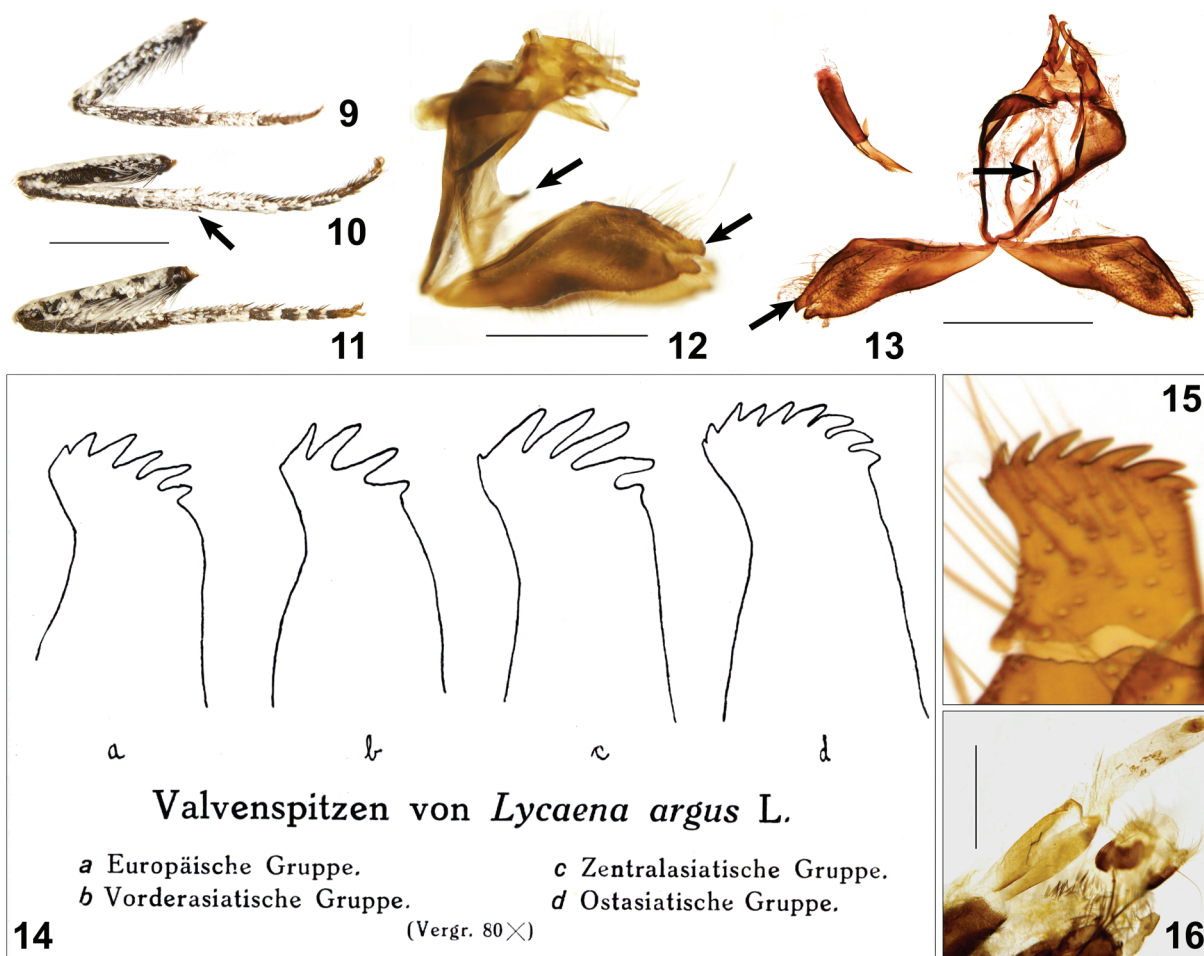
Forewing ventral surface discoidal patch. In the taxonomic literature the presence or absence of the discoidal patch in the forewing ventral surface has been considered as diagnostic in discrimination. On species level the most notable case is the pair of *Polyommatus icarus* and *P. thersites* (Cantener, [1835]) [Chapman, 1913], but this trait is used also on the generic level [Higgins 1975]. However in our cold shock experiments carried on *P. icarus* it has been revealed that this trait is variable, if not the most sensitive [Kertész et al., 2017], and a relatively rare but well known from without such basal spots (f. *icarinus*) is sometimes found in wild populations as well. We hypothesize that the extreme climatic conditions of the habitat has a profound influence on the population and that it leads to the appearance of this trait. It is worth mentioning that in the clade of *Plebejus-Lycaeides* [Talavera et al., 2013], none of the species possesses a discoidal patch in the forewing ventral surface postbasal area.

Hindwing ventral surface submarginal metallic lunules. The complete absence of the metallic lunules in the ventral surface of the hindwings is also a peculiar





Figs 1–8. Type specimens of *Plebejus alizadehorum* sp. n.  
1–2 – holotype: 1 – dorsal view, 2 – ventral view; 3–4 – paratype (allotype), female: 3 – dorsal view, 4 – ventral view; 5–8 – paratypes, males: 5, 7–8 – dorsal view, 6 – ventral view. Arrows in Fig. 8 indicate the forewing postbasal discoidal spot and the hindwing submarginal lunules without metallic scales.  
Рис. 1–8. Типовые экземпляры *Plebejus alizadehorum* sp. n.  
1–2 – голотип: 1 – вид сверху, 2 – вид снизу; 3–4 – паратип (аллотип), самка: 3 – вид сверху, 4 – вид снизу; 5–8 – паратипы, самцы: 5, 7–8 – вид сверху, 6 – вид снизу. Стрелками на рисунке 8 показано постбазальное дискоидное пятно переднего крыла и субмаргинальные лунки задних крыльев без чешуек с металлическим блеском.



Figs 9–16. Various structures of *Plebejus alizadehorum* sp. n.

9 – front leg; 10 – middle leg with claw (indicated by arrow); 11 – hind leg; 12 – male genitalia capsule and aedeagus, lateral view (juxta with central process and valva costal terminus with dentation indicated by arrows); 13 – ditto, dorso-ventral view, aedeagus removed and placed in top left (juxta with central process and valva costal terminus with dentation indicated by arrows); 14 – various *Plebejus* male genitalia valva costal terminus with dentation in larger magnification; fine line drawings of Forster [1936: 110] with legends: “Valvenspitzen von *Lycaena argus* L.” = valva termini of *Lycaena argus* L., “a Europäische Gruppe” = a: European group, “b Vorderasiatische Gruppe” = b: Western Asian group, “c Zentralasiatische Gruppe” = c: Central Asian group and “d Ostasiatische Gruppe” = d: Eastern Asian group; 15 – digital microscopic image of the valva costal terminus of *P. alizadehorum* sp. n., male, paratype (HNHM, gen. prep. no. Bálint 1767); 16 – *Plebejus alizadehorum* sp. n., female genitalia henia with terminal sclerotized plates. Scale bars: 9–11 – 1.2 mm; 12 – 0.6 mm; 13 – 1 mm; 16 – 1 mm.

Рис. 9–16. *Plebejus alizadehorum* sp. n., детали строения.

9 – передняя нога; 10 – средняя нога с коготком (обозначен стрелкой); 11 – задняя нога; 12 – генитальная капсула самца и эдеагус, вид сбоку (юкста с центральным отростком и костальный край вальвы с зубчатостью обозначены стрелками); 13 – то же, дорсо-вентральный вид, эдеагус извлечен и помещен вверху слева (юкста с центральным отростком и костальный край вальвы с зубчатостью обозначены стрелками); 14 – костальный край вальвы гениталий самцов различных *Plebejus* с зубцами при большем увеличении; рисунки Форстера [Forster, 1936: 110] с подписями: «Valvenspitzen von *Lycaena argus* L.» = valva termini *Lycaena argus* L.; «a Europäische Gruppe» = a: европейская группа, «b Vorderasiatische Gruppe» = b: западноазиатская группа, «c Zentralasiatische Gruppe» = c: центральноазиатская группа и «d Ostasiatische Gruppe» = d: восточноазиатская группа; 15 – цифровое изображение костального края вальвы *P. alizadehorum* sp. n., самец, паратип (HNHM, препарат № Bálint 1767); 16 – *Plebejus alizadehorum* sp. n., гениталии самки с терминальной склеротизированной пластинкой. Масштабные линейки: 9–11 – 1.2 мм; 12 – 0.6 мм; 13 – 1 мм; 16 – 1 мм.

trait. In the *Plebejus-Lycaeides* clade it is an important female character as has been demonstrated by Fordyce et al. [2002]. The lack of the pattern postulates two remarks, (1) *P. alizadehorum* sp. n. has a completely different mating strategy as described in the mentioned paper or (2) the observations were misinterpreted in that paper. According to our spectroscopic investigations run on five *Lycaeides* that occur in the Mongolian steppe, the metallic lunules in the submarginal region did not reveal any species specific characteristics but the dorsal wing surfaces all possess a species specific structural colouration.

Male genitalia. In the male genitalia *P. alizadehorum* sp. n. shows a trifurcate juxta, which is the unique characteristic of the genus *Plebejus* s. str. (= *Argus*-species group) [Higgins, 1975; Bálint, Johnson, 1997; Zhdanko, 2004]. Another characteristic trait of the genus is the distal (terminal) dentation of the valva costa (“markedly serrated dorsal apical process of valva” of Zhdanko [2004]). This character was briefly analysed by Forster [1936] who found the number, shape and size of the protrusions to be geographically diagnostic. The new species contradicts Forster’s finding as it represents the Eastern Asiatic group





Figs 17–18. The habitat of *Plebejus alizadehorum* sp. n. in Shaho Mountain, ca 10 km south east of the Paveh town, Zagros Mountains, Iran. 17– the upper part of the valley close to the summit, the clusters of *Astragalus* are well visible where the males were lekking; 18 – panoramic view of the habitat.

Рис. 17–18. Местообитание *Plebejus alizadehorum* sp. n. в горах Шахо, примерно в 10 км к юго-востоку от Паве, горы Загрос, Иран. 17– верхняя часть долины, хорошо видны скопления астрагала в местах, где летают самцы; 18 – панорамный вид среды обитания.

because the valval costa terminus is similarly dentate (Figs 14, 15). Further investigation is necessary to ascertain and document the individual variation of the dentation within populations and in wider geographical areas.

Identification. As it was outlined under the entry diagnosis, the new species is easy to discriminate from other lycaenid butterflies occurring in the region. Its discriminating characters are summarized in the following key to the males of *Plebejus*, *Lycaeides* and *Kretania* species occurring in western Iran. We present this key, because males are easier to encounter in the field. Females are cryptic, more difficult to collect, and identification may pose a problem. However, the presence of the discoidal spot in the postbasal area of the forewing ventral wing surface together with the lack of submarginal metallic lunules in the hindwing ventral wing surface makes *P. alizadehorum* sp. n. females easy to discriminate from any other *Plebejus*, *Lycaeides* or *Kretania* species (Figs 3, 4). As a final note we want to remark that the taxonomy of *Lycaeides argyrognomon* and *L. idas* east of the Caucasus is extremely complex and needs revision [Tshikolovets et al., 2009: 110–118]. In the last decades several taxa discussed by Forster [1936] as subspecies have been elevated to species rank or placed in different combinations, and many new names have been introduced [cf. Samodurov et al., 2000].

**Key to the males of *Kretania*, *Lycaeides* and *Plebejus* occurring in Kurdistan Province, Iran**

- 1. Dorsal wing surface violet blue or brown ..... 2
  - Dorsal wing surface deeper or lighter ink blue ..... 4
- 2. Dorsal wing surface violet or brown, forewing ventral surface without discoidal patch and postmedian lunules differently oval shaped and arranged not so close to each other ..... 3
  - Dorsal wing surface dark violet blue with forewing discal line and wide black border in both wings, forewing ventral wing surface with discoidal patch and large postmedian lunules similarly circular or oval shaped

- and arranged close to each other .....
  - ..... *Kretania alcedo* (Christoph, 1877)
- 3. Dorsal wing surface light violet with thin black border ..... *Kretania zephyrinus* (Christoph, 1884)
  - Dorsal wing surface brown without black border .....
    - ..... *Kretania iranica* (Forster, 1938)
- 4. Dorsal wing surface lighter violet blue with very thin black border, discal line missing ..... 5
  - Dorsal wing surface with darker violet blue, thin discal line, black veins in the submarginal region and pronounced black border ..... 7
- 5. Ventral wing surface submarginal orange lunules bright in colour and often extended in size ..... 6
  - Ventral wing surface submarginal orange lunules faded in colour and reduced in size .....
    - ..... *Lycaeides christophi* (Staudinger 1875)
- 6. Ventral wing surface ground colour lighter dove grey, hindwing postmedian arrow-head markings vestigial ..... *Lycaeides argyrognom* (Bergsträsser, 1779)
  - Ventral wing surface ground colour darker dove grey or light brown, hindwing postmedian arrow-head markings well visible .... *Lycaeides idas* (Linnaeus, 1761)



Fig. 19. The geographical location of the type locality. Рис. 19. Географическое положение типового местонахождения.

7. Ventral forewing surface discoidal area without any pattern, ventral hindwing submarginal area with metallic lunules ..... *Plebejus argus* (Linnaeus, 1758)  
 – Ventral forewing surface discoidal area with spot in the postbasal region, ventral hindwing submarginal area without metallic lunules .....  
 ..... *Plebejus alizadehorum* **sp. n.**

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## References

- Bagheri A., Maassoumi A.A., Rahiminejad M.R., Brassac J., Blattner F.R. 2017. Molecular phylogeny and divergence times of *Astragalus* section *Hymenostegis*: An analysis of a rapidly diversifying species group in Fabaceae. *Scientific Reports*. 7: 14033. DOI: 10.1038/s41598-017-14614-3
- Bálint Zs., Johnson K. 1997. Reformation of the *Polyommatus* Section with a Taxonomic and Biogeographic Overview (Lepidoptera, Lycaenidae, Polyommataini). *Neue entomologische Nachrichten*. 40: 1–68.
- Chapman T.A. 1913. An unrecognized European *Lycaena*, identified as *Agriades thersites* (Boisd. MSS) Cantener. *Transactions of the Entomological Society, London*. 60(4): 662–667, pls. 81–85. DOI: 10.1111/j.1365-2311.1913.tb03110.x
- Fordeyce J.A., Nice C.C., Forister M.L., Shapiro A.M. 2002. The significance of wing pattern diversity in the Lycaenidae: mate discrimination by two recently diverged species. *Journal of Evolutionary Biology*. 15(5): 871–879. DOI: 10.1046/j.1420-9101.2002.00432.x
- Forster W. 1936. Beiträge zur Systematik der Tribus Lycaenini unter besonderer Berücksichtigung der *argyrognomon* under der *argus* Gruppe. *Mitteilungen der Münchener Entomologischen Gesellschaft*. 26(2): 41–150.
- Higgins L.G. 1975. The classification of European Butterflies. London: Collins. 320 p.
- Kertész K., Piszter G., Horváth Z.E., Bálint Zs., Biró L.P. 2017. Changes in structural and pigmentary colours in response to cold stress in *Polyommatus icarus* butterflies. *Scientific Reports*. 7: 1118. DOI: 10.1038/s41598-017-01273-7
- Nazari W. 2003. Butterflies of Iran. Tehran: National Museum of Natural History. 32 + 542 p., 1–74 pls.
- Piszter G., Kertész K., Bálint Zs., Biró L.P. 2016. Variability of the Structural Coloration in Two Butterfly Species with Different Prezygotic Mating Strategies. *PLoS ONE*. 11(11): e0165857. DOI: 10.1371/journal.pone.0165857
- Samodurov G.D., Zhdanko A.B., Tuzov V.K., Dantchenko A.V. 2000. Genus *Plebejus*. In: Guide to the Butterflies of Russia and adjacent territories. Volume 2: Libytheidae, Danaidae, Nymphalidae, Riodinidae, Lycaenidae. Sofia-Moscow: Pensoft: 158–169.
- Scott J.A. 1990. Morphology: Adult structure and function. In: Butterflies of Europe. Volume 2. Introduction to Lepidopterozoology. (O. Kudrna ed.). 1990. Wiesbaden: Aula-Verlag: 108–151.
- Stradomsky B. 2016. A molecular phylogeny of the subfamily Polyommatainae (Lepidoptera: Lycaenidae). *Caucasian Entomological Bulletin*. 12(1): 145–156. DOI: 10.23885/1814-3326-2016-12-1-145-156
- Talavera V., Lukhtanov V.A., Pierce N.E., Vila R. 2013. Establishing criteria for higher-level classification using molecular data: the systematics of *Polyommatus* blue butterflies (Lepidoptera, Lycaenidae). *Cladistics*. 29(2): 166–192. DOI: 10.1111/j.1096-0031.2012.00421.x
- Tshikolovets V., Naderi A., Eckweiler W. 2014. The Butterflies of Iran and Iraq. Pardubice: Tshikolovets Publications. 366 p., I–LXV pls.
- Tshikolovets V.V., Yakovlev R.V., Bálint Zs. 2009. The Butterflies of Mongolia. Kiev – Pardubice: Tshikolovets Publications. 320 p. I–XLIII pls.
- Winter W.D. 2000. Basic Techniques for Observing and Studying Moths and Butterflies. Los Angeles: The Lepidopterists' Society Publ. 444 p.
- Zhdanko A.B. 2004. A revision of the suprageneric taxa of the lycaenid tribe Polyommataini (Lepidoptera, Lycaenidae). *Entomological Review*. 84(7): 782–796.

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