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First record of an albino *Pseudochazara amymone* (Brown, 1976) (Lepidoptera, Nymphalidae, Satyrinae) with notes on its ecology and behaviour

Первое нахождение альбиноса *Pseudochazara amymone* (Brown, 1976) (Lepidoptera, Nymphalidae, Satyrinae) с замечаниями по экологии и поведению

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Abstract. The albino male of a rare and poorly known species *Pseudochazara amymone* (Brown, 1976) (Lepidoptera, Nymphalidae, Satyrinae) is described for the first time. The history of its study and the variability of *Pseudochazara* species are discussed. The notes on the ecology and behaviour of *P. amymone* in Southern Albania are provided.

Резюме. Впервые описан самец — альбинос редкого и малоизученного вида *Pseudochazara amymone* (Brown, 1976) (Lepidoptera, Nymphalidae, Satyrinae). Обсуждается история исследований *P. amymone* и изменчивость видов рода *Pseudochazara*. Представлены замечания по экологии и поведению вида в Южной Албании.

Until recent time *Pseudochazara amymone* (Brown, 1976) (Lepidoptera, Nymphalidae, Satyrinae) has been treated as a myth of the European butterfly fauna. It was described in 1976 by John Brown by 4 males from Greece (type locality are «the mountains just N of Ioannina, Epiros, Greece, 650 m»). During more than 3 decades any evident or confirmed data on this species were not published. Despite the fresh records of this species in Greece mentioned by L.N. Pamperis [2009] its rediscovery was doubt and rejected by some authors [Cuvelier, 2010; Eckweiler, 2012]. Thus, the photos of some *amymone* presented in the second edition of Pamperis's book are regarded to the other endemic Balkan taxon (*Pseudochazara mniszechii tisiphone* Brown, 1980, det. W. Eckweiler). The absence of new material determined the different opinions of species status, for instance, it was speculated to be a rare natural hybrid [Pamperis, 2009; Kudrna et al., 2011].

The situation was changed after the encounter and further detailed investigations of this species held mainly in 2011–2013 by different European entomologists in Albania. The first confirmed record of *amymone* was taken in 2010 by W. Eckweiler and then in 2011 by the same author who didn't publish the exact geographic point of its finding in order to save its habitat and population and to prevent the collector's interest [Eckweiler, 2012]. The original photos of imagines and male genitalia were firstly provided in this paper. Though his locality was a secret, the photos of its biotope inspired different amateur collectors and professional entomologists to search the species in the same landscapes of the southern districts of Albania.

The new data on *amymone* was presented in the thorough researches of M. Gascoigne-Pees et al. [2014] and Verovnik et al. [2014]. The first paper contains a detailed description of the preimaginal stages, habitat and behavior of the species in Albania. For instance, it was shown that this Grayling is oligophagous in captivity and feeds on different grasses (*Festuca* and *Dactylis* spp.). Besides, some new localities of *amymone* was found and the population density was overestimated. This data allowed to upgrade its status from «Vulnerable» (VU) according to the IUCN Red List [van Swaay et al., 2010] to «Endangered»(EN) due to small area of occupancy, limited number of locations and predicted continuing decline caused by the habitat destruction. Continuing the survey of new distributional data, Verovnik et al. [2014] found the species from at least 3 separate areas and at a total of 18 different sites. Both papers also include morphological analysis of external features and comparison with the specimens of syntopic *Pseudochazara mniszechii tisiphone* that is more common and widespread there. The morphological research including androconia analysis and some new records in Albania were also included in the paper of Cuvelier and Mølgaard [2015] that is totally devoted to *amymone* populations investigations. The occurrence of the species in Korçe district was also confirmed by the series of surveys aimed to the continual improvement of knowledge of Albanian butterfly fauna by N. Micevski and his co-authors [2015].

The surveys of the species were carried out in Korçe district of Albania in 13–20.VII.2016 in five separate gorges

SE of Korçe. The field observations confirmed the previous results of species research in this area regarding its population status, quantity and biological specific characteristics. Thus, the most dense *amymone* populations were found in two gorges situated 1–2 km E of Boboshtice village where this species was find at 1150–1250 m a.s.l. at the SSW expositions of steep slopes with sparse vegetation (Fig. 1). As it was found out by other expeditions, *amymone* imagines are flying together with *P. m. tisiphone* here, but inhabit few sites on ophiolyte slopes and rarely feed on *Acantholimon* flowers. This plant is preferred by females for nectaring, and males like to feed on yellow-flowering *Centaurea* sp. Butterflies of both sexes found sitting upon the reddish-grey substrate being totally invisible due to the perfect camouflage against the colouration of the rocks. Eckweiler [2012] characterized it precisely as «shy» butterfly in opposite to *P. m. tisiphone* which is much common here. Very few specimens were found mud-puddling on the wet ground near some small streams at the bottom of the gorges. The cloudy and rainy weather didn't allow to estimate the exact quantity of the species in the Boboshtice gorges, but one day observations (20 July 2016) during 8 hours expressed about 14 specimens on the square of 100 x 20 m. This area covers a SSW slope of the rock formations at 1200–1220 m a.s.l.). Gascoigne-Pees et al. [2014] wrote that the ratio of *P. m. tisiphone* : *P. amymone* was roughly 10 : 1. According to my observations, it was approximately 30 : 1 at these slopes. The amymone population in the other gorge 1–3 km E of Drenove village possesses lower density. On the route of 5 km at the foothills of SW slopes and on the slopes of the rocks at 1100–1250 m a.s.l. 6 *amymone* specimens were recorded here during all the week of observations. Males settled on the stones and also were sitting and mud-puddling on the wet soil, but females were mainly found among *Acantholimon* associations. Only single male was also found in the gorge 1.5 km NE of Drenove at the same steep rocky slope of the similar geological substrate. No *amymone* was found in the gorge 1 km S of Boboshtice where the slopes are composed of calcareous rocks and strongly disturbed by sheep and goat pastures. The densities of adult *amymone* is low comparing with the other *Pseudochazara* species possibly due to the suboptimal habitat or short flight period [Gascoigne-Pees et al., 2014].

During the field observation one albinistic male of *P. amymone* was found 19 July 2016 feeding on *Centaurea* flowers at 1250 m a.s.l. of SSW slopes 1.5 km E of Boboshtice. This specimen has similar features of *amymone* adults with a normal colouration, but all elements are yellowish or even whitish (Fig. 2). The following description of this aberration is provided here.

Antennae yellowish grey below with short, well defined oval antennal yellowish brown club. Eyes glabrous. Head with vertex and frons brownish yellow; eye chestnut yellow, partly ringed with white; labial palpae white with brown and white hair-scales. Thorax and abdomen are yellowish brown, the legs are grey. Upperside of the albinistic male with cosra distinctly arched in the middle; forewing is more elongated and narrow than in males with normal colouration. Ground colour of the forewing is yellowish brown with light reflections. The postdiscal area of the forewing is covered by light fulvous ochre band which encloses two pale ochre ocelli with poorly expressed grey pupils. It is chequered with light brown at veins. Narrow brownish sex-brand crosses forewing along median vein. Hindwing is lighter than forewing but with pale fulvous ochre postdiscal area which is more extensive between Rs and Cu_2 veins. The postdiscal band is not interrupted by darker nervures as it is in normal coloured males. The band includes a single white-pupilled ocellus closer to the anal angle. Outer margin is scalloped and defined by narrow grey line. Underside ground colour is grayish with pale orange and fulvous spots in the postdiscal area without definite margins. The darker ocelli are surrounded by grey circles and are also pupilled. There are two white spots between the ocelli. The hindwing is generally grayish with poorly expressed orange spots in the postdiscal part and darker veins. The anal spot is invisible. No stripes, bands or margins are expressed on the underside. The marbled cryptic colouration of the forewing underside is entirely absent. The fringes of all wings are whitish ochre and not chequered.

The analysis of the species variation was carried out by Gascoigne-Pees et al. [2014] and Cuvelier and Mølgaard [2015]. It was shown that the species possess a high degree of cryptic adaptation to the substrate colour of serpentine rocks. As for some other *Pseudochazara* taxa (*P. graeca* (Staudinger, 1870) in Greece or *P. nukatli* Bogdanov, 1997 in Daghestan, Russia) the imagines of populations can have distinctive wing colouration regarding the colour of the ground in their biotope. Such kind of clinal variation is also suitable for *P. amymone* in different sites of the Albanian range. The main variable features of the wing elements and colouration are the white pupils in the black ocelli on the hindwing, the number of white spots on the upperside forewing, the shape of the dentate bands separating the dark basal from the postdiscal areas, their width and shade etc. The variability is also expressed in females (Fig. 3). Also the size and the shape of the wings are not constant (elongated or less angular). However, no light coloured or albinistic *Pseudochazara* individuals have been found yet. The detailed review of genus *Pseudochazara* of the western part of Palaearctic and in Asia [Bogdanov, 2004, 2007] also does not provide any information about the albinism of its representatives. In some museum and private collections I found only light and not fresh specimens that were collected in the end of their flight period. But they don't show any evidence of albinism being discolored by external environmental factors during their flight activity. For example, such specimen of *Pseudochazara thelephassa* (Geyer, [1827]) I collected in Nakhchivan Republic in the middle of the August 2016 (Fig. 4) whereas its adults usually begin to fly in Nakhchivan in the end of May [plate 18 in Bogdanov, 2007].

Albinism is a hereditary lack of pigmentation caused by enzyme deficiency involving the metabolism of mela-

Fig. 1. Biotopes of *Pseudochazara amymone* in gorges 2 km E Boboshtice village (Albania).
Рис. 1. Биотопы *Pseudochazara amymone* в ущельях в 2 км восточнее пос. Бобоштице (Албания).

nin. The type of albinism can be characterized in terms of whether the lack of pigmentation is restricted to part of the organism or the entire organism. The proximate cause of albinism is generally attributed to lack of activity of the enzyme tyrosinase, a key component of the pathway leading to the formation of melanin [Bechtel, 1991].

However, the total or partial albinism is known in the other Satyrinae species. Thomas C. Emmel [1969] estimated the natural mutation rates for albinism in two species of the Nearctic genus *Cercyonis*. He calculated an approximate rate of spontaneous mutation for the expression of albinism by dividing the number of known mutant individuals by the total number of individuals

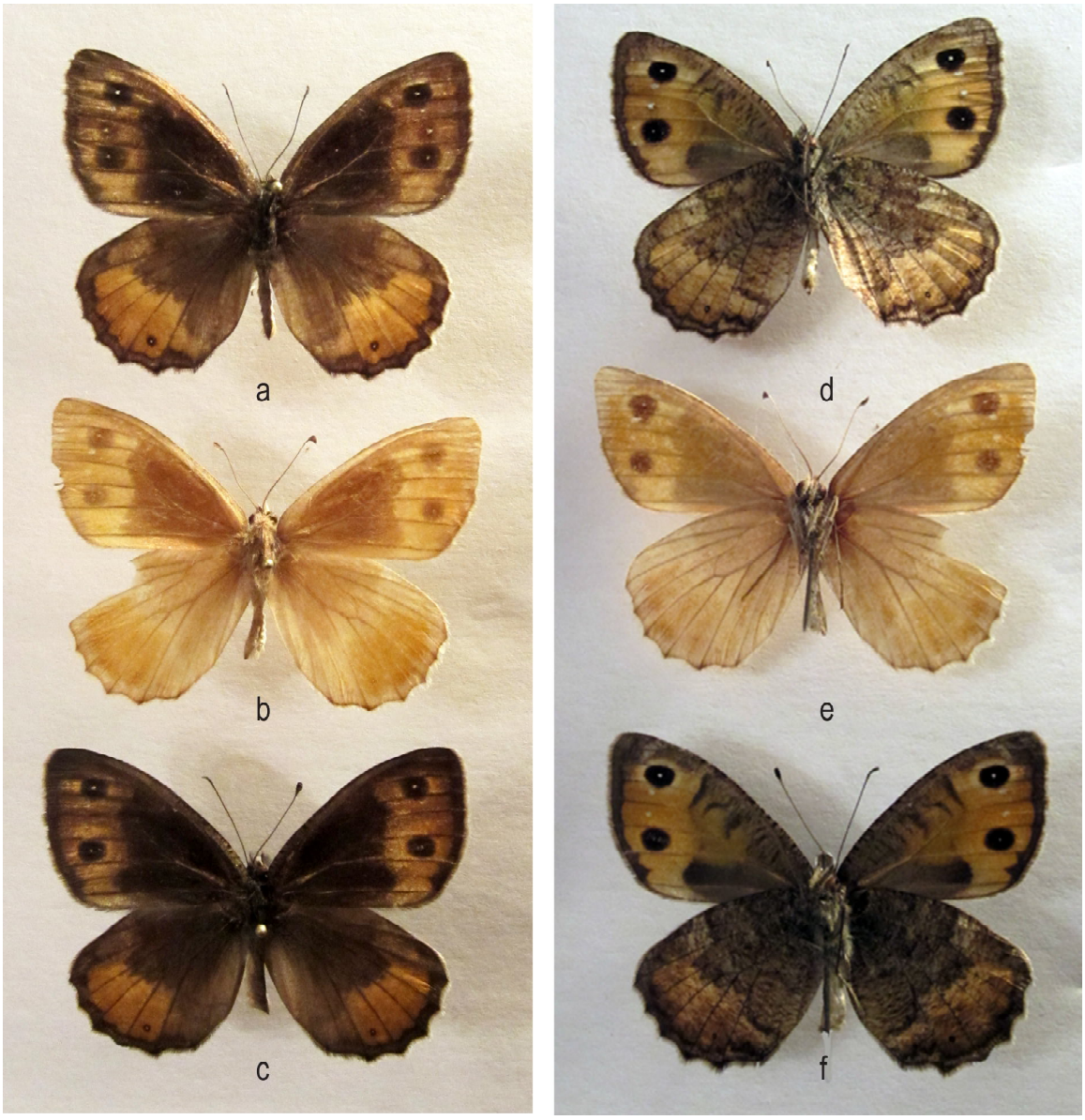

Fig. 2. Wings upperside (a–c) and wings underside (d–f) of *Pseudochazara amymone* males. a, c, d, f — males with normal colouration (18 July 2016, 5 km E Drenove village, Albania), b, e — albinistic male (20 July 2016, 2 km E Bobostice village, Albania).

Рис. 2. Верхняя сторона (a–c) и нижняя сторона (d–f) крыльев самцов *Pseudochazara amymone*. a, c, d, f — самцы с нормальной окраской (собраны 18 июля 2016 г. в 5 км восточнее пос. Дренове в Албании), b, e — самец-альбинос (20 июля 2016 г., 2 км восточнее пос. Бобоштице в Албании).

observed. There were one total albino *C. oetus* to 12 000 individuals observed. Emmel estimated the probable maximum natural mutation rate for albinism as 10^{-5}. He also compared it with the similar known data on *Drosophila* (Diptera), *Bombyx mori* (Lepidoptera) and man and found out that this rate is the same.

The most known samples of albinism are presented in Maniolini species. The obvious albinistic individuals of *Pyronia tithonus* (Linnaeus, 1771) have ground colour replaced by silvery grey (this aberration is called «albinotica Goodson») or fulvous patches replaced by white (aberration «albidus Cockerell»). The variation of *Maniola jurtina* (Linnaeus, 1758) was intensively studied by ecological geneticists and other specialists. Emmel [1969] discusses in detail the variation that occurs in *M. jurtina* and gives over 70 names for the forms he described. Albinism, which may «sometimes result from genetic influence» [Emmet, Heath, 1989] expresses in the ground colour becoming a shade of golden grey (aberration «grisea-aurea Oberthür») or silver-grey (aberration «grisea-argentacea Oberthür») [Howarth, 1973]. The albino of *Hipparchia semele* (Linnaeus, 1758) which is closer to *Pseudochazara* species than Maniolini representatives is also known and called «ab. decolorata Howarth».

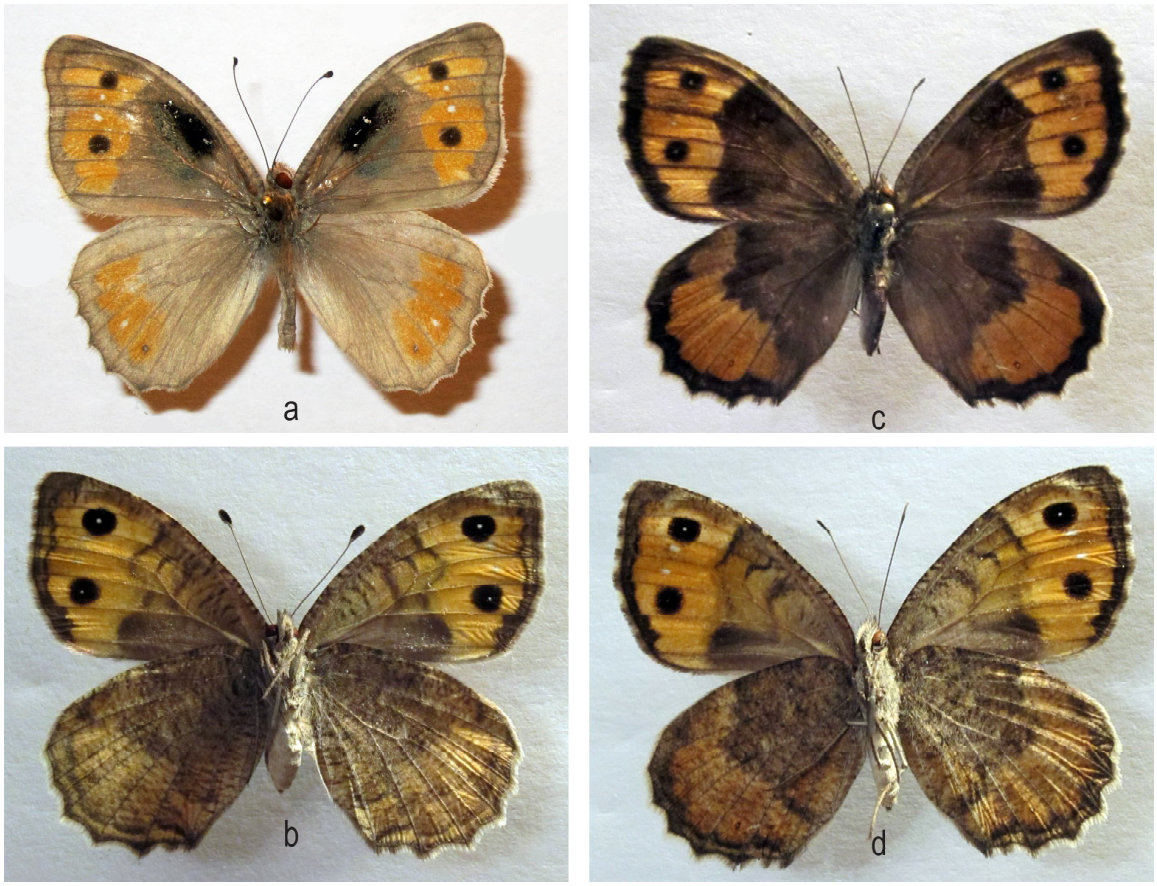

Fig. 3. *Pseudochazara amymone* females (16 July 2016, 1.5 km E Boboshtice village, Albania). a, c — wings underside; b, d — wings upperside.

Рис. 3. Самки *Pseudochazara amymone* (16 июля 2016 г., 1.5 км восточнее пос. Бобоштице в Албании). a, c — нижняя сторона крыльев, b, d — верхняя сторона крыльев.

Fig. 4. *Pseudochazara thelephassa* males: a — male with a normal dark colouration (23 July 2007, Amaghu village, Armenia); b — male with a light colouration (9 August 2016, Pazmari village, Nakhchivan Republic, Azerbaijan).

Рис. 4. Самцы *Pseudochazara thelephassa*: a — самец с нормальной тёмной окраской (23 июля 2007 г., Армения, пос. Амагу); b — самец со светлой окраской (9 августа 2016 г., Азербайджан, Нахичевань, пос. Пазмари).

The captured *amymone* adult belongs to the total albinistic type because the reduction of dark pigment is expressed in the whole organism of this specimen. The shape and position of wing scales of the *amymone* albino are not deformed or modified and similar to those of individuals with the normal dark colouration. It was previously found out that androconia scales are quite different by their shape and colour.

They can be attributed to types 6 and 7 according to the criteria of Gross [1978]. Normally coloured males have both grey and dark drown scales of the sex brand [Cuvelier, Mølgaard, 2015]. The albino male has yellowish brown androconia scales broad in the basal stalk and becoming narrower to the apex closer to the type 7 of Gross's classification.

The potential frequency of albinistic individuals could hardly be correctly estimated now because of the species rarity. Less than 300 specimens have recently been found and studied by different specialists or amateur collectors.

It is known that such unusual coloration possesses a certain danger for individuals that are badly adapted to the environment. The albino individuals are well marked in the geological substrate and could be avoided by the other sex individuals of the same species in their natural habitat. However, the butterfly was feeding and flew as other *amymone* individuals there; the androconia scales that attract females are not modified. The individual is slightly worn that confirms that it was emerged 1–2 days earlier and could been disturbed by different predators being clearly visible upon the reddish grey rocky ground.

My field studies and finding a unique specimen of this rare species indicates a perspective of more detailed study and its protection in the future. In addition, it is important to conduct comparative studies of albinism characters in the genus *Pseudochazara* and to identify the possible reasons of its occurrence.

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