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NOTES ON THE PREIMAGINAL STAGES AND THE TYPE LOCALITY OF *CISSATSUMA BEREZOWSKII* KRUPITSKY, 2018 (LEPIDOPTERA: LYCAENIDAE)

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Summary. Morphology of the larva and pupa and biology of the recently described elfin hairstreak *Cissatsuma berezowskii* Krupitsky, 2018 are studied for the first time. The exact type locality of the species (Guihuagou vill., ca. 20 km SSE Songpan City, Sichuan Province, China) is clarified.

Key words: elfin hairstreaks, Theclinae, Eumaeini, host plant, morphology, larva, pupa, distribution, China.

А. В. Крупицкий, Н. А. Шаповал, Г. Н. Шаповал. Заметки о преимагинальных стадиях и типовом местонахождении *Cissatsuma berezowskii* Krupitsky, 2018 (Lepidoptera: Lycaenidae) // Дальневосточный энтомолог. 2022. N 466. С. 9-15.

Резюме. Впервые изучена морфология гусеницы и куколки, а также биология недавно описанной хвостатки *Cissatsuma berezowskii* Krupitsky, 2018. Выяснено точное типовое местонахождение вида (деревня Гуйхуагоу, 20 км ЮЮВ г. Сунпань, провинция Сычуань, Китай).

INTRODUCTION

The Palaearctic elfin butterflies are one of the less studied groups of lycaenids. This term unites three genera, namely *Ahlbergia* Bryk, 1947, *Cissatsuma* Johnson, 1992 and *Novosatsuma* Johnson, 1992, comprising about 50 described species inhabiting mountains of East Asia. Most species of the Palaearctic elfin butterflies are known from China, mainly from the provinces Sichuan and Yunnan. The preimaginal stages are described only for four species of *Ahlbergia*, namely *A. frivaldszkyi* (Lederer, 1853), *A. ferrea* (Butler, 1866), *A. haradai* Igarashi, 1973 and *A. liyufeii* Huang et Zhou, 2014, and one species of *Cissatsuma*, *C. zhoujingshuae* Huang et Zhou, 2014 (Igarashi, 1973; Omelko & Omelko, 1995; Korshunov, 2002; Huang & Zhou, 2014).

Cissatsuma berezowskii Krupitsky, 2018 was recently described from the Songpan County, northern Sichuan Province, China, based on two specimens collected by the Russian explorer M.M. Berezovsky at the end of XIX century (Krupitsky, 2018). It differs from the morphologically similar species *C. albilinea* (Riley, 1939) from central Sichuan in the absence of white postdiscal line on the ventral side of the hindwing in both sexes, dark blue discal field on the dorsal side of the forewing of the female, and details of genitalia morphology, namely the elongated triangular valva in the male and long slender ductus bursae with long orthogonal lamella postvaginalis in the female. No recent records of this species have been published.

In the present paper, we describe the larval and pupal morphology and biology of *C. berezowskii*. Additionally, we clarify the type locality and distribution of this species.

MATERIAL AND METHODS

In June 2019, the first author had an opportunity to visit Songpan County in Sichuan Province of China. The survey was conducted from 19 to 28 June 2019 in three sites near Chuanzhusi town, situated in an area where the type specimens of *C. berezowskii* were collected by Berezovsky according to their labels ("Songpan"). One worn female and four final instar caterpillars were collected. Only one imago emerged in November 2019. The study of the morphology of obtained adults confirmed the determination of these specimens as *C. berezowskii*. Larvae were collected from *Spiraea* shrubs using a turned umbrella and an entomological net handle. After collecting, they were placed in individual plastic boxes with twigs of the host plant under humidity control. In a laboratory in Moscow, the larvae were transferred to *Spiraea douglasii* which was utilized by them up to pupation, because the native host plant was inaccessible. The host plant of *C. berezowskii* under natural conditions was determined as *Spiraea lasiocarpa* after Lu & Crinan (1993) with emendations by Businský (2011).

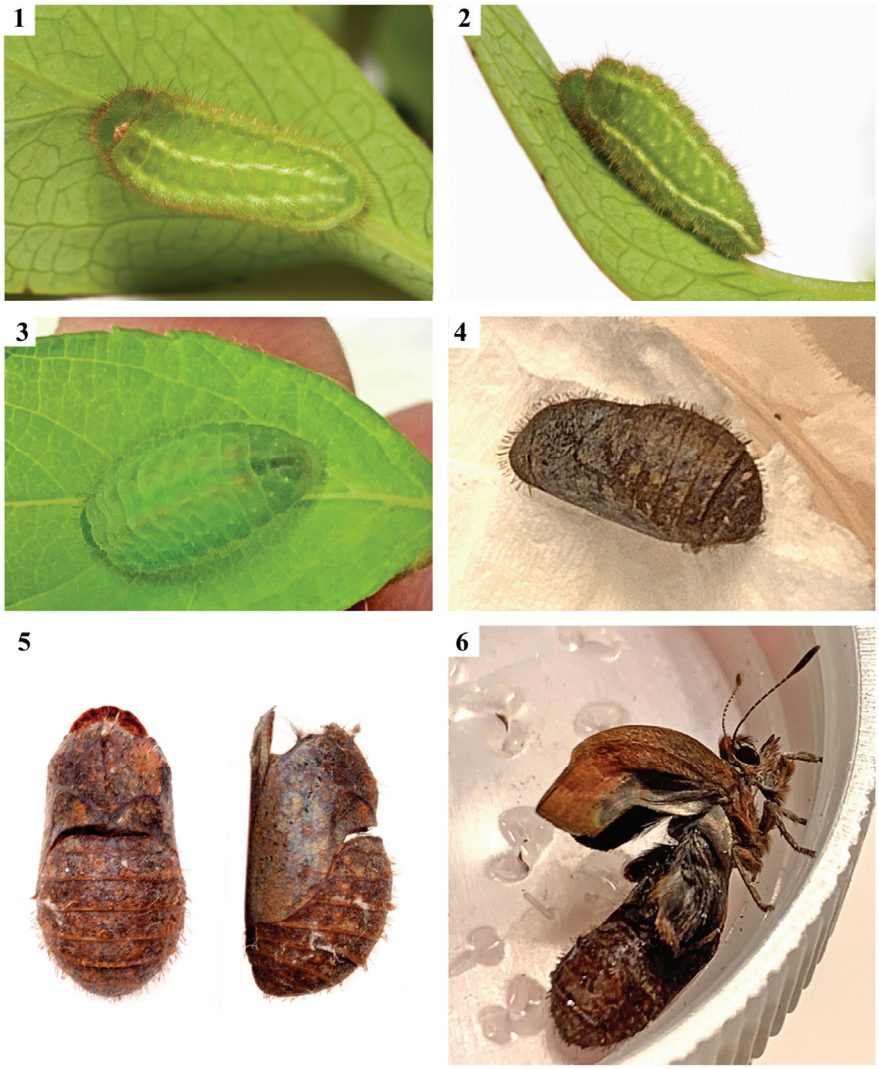
The methods of morphological analyses and photography techniques were described earlier (Krupitsky *et al.*, 2015). The terminology of the general morphology of immature stages follows Huang & Zhou (2014). Dead caterpillars were preserved in 96% ethanol. The photos were edited in Adobe Photoshop CS6. Geographic coordinates of the collecting sites were obtained with Garmin 64s handheld GPS receiver. The map was generated with Google Maps (https://www.google.com/maps). Immature and adult specimens are deposited in the collection of the first author (AKM) and the collection of the Zoological Institute of Russian Academy of Science, St. Petersburg, Russia (ZISP).

RESULTS AND DISCUSSION

Cissatsuma berezowskii **Krupitsky, 2018**
Figs 1–6, 10

MATERIAL. **China:** Sichuan Prov., Songpan County, Chuanzhusi env., 32°46'16.32" N, 103°37'02.17" E, 3000 m, 27.VI 2019, 1 larva, A.V. Krupitsky leg. (AKM); 2 km W Chuanzhusi, 32°46'59.92" N, 103°35'30.99" E, 3100 m, 28.VI 2019, 1 larva, A.V. Krupitsky leg. (AKM); same locality, larva 28.VI.2019, pupa 05.VII.2019, A.V. Krupitsky leg. (AKM); same locality, larva 28.VI 2019, pupa 07.VII 2019, imago ♂ 06.XI 2019, A.V. Krupitsky leg. (AKM). **China:** Sichuan Prov., Songpan County, Chuanzhusi env., Limpo, 32°46'10.58" N, 103°38'29.46" E, 3200 m, 19.VI 2019, 1♀, A.A. Marusov leg. (AKM); 1♂ with original label "Сы-ч., Сунпань. / 9500 ф. и выше. / Березовск. 24.IV.94" [=China, Sichuan Prov., Songpan county / 9500 ft. [2900 m] [above sea level] and higher / M.M. Berezovsky leg. 24.IV.1894] (ZISP).

IMMATURE STAGES. Last-instar larva (Figs 1, 2) onisciform, length about 10.0–12.0 mm, pale green with two whitish longitudinal bands on dorsal surface and whitish longitudinal lateral line on each side, bearing two rows of protuberances with whitish apices. Spiracles whitish. Larva densely covered with two kinds of setae: short light, covering entire body, and longer brownish setae situated on head and along dorsal and lateral longitudinal bands. Prepupa (Fig. 3) uniformly emerald green, flattened. Pupa (Figs 4, 5) about 8.0 mm long, dark brown with mottled pattern, tegument densely covered with short brown setae.



Figs 1–6. Development of *Cissatsuma berezowskii* Krupitsky, 2018. 1, 2 – last-instar larva; 3 – prepupa; 4 – pupa; 5 – pupal exuvium; 6 – adult emerging from pupa.

The only *Cissatsuma* species with described preimaginal stages is *C. zhoujingshuae*. Last-instar larva of *C. berezowskii* differs from the latter in smoother body with less developed protuberances, while the colouration of larva, as well as the shape and colouration of the pupa, are similar in both species.

Figs 7–9. Host plant and habitat of *Cissatsuma berezowskii* Krupitsky, 2018. 7, 8 – *Spiraea lasiocarpa*, host plant; 9 – a valley east Chuanzhusi town (Songpan County, Sichuan Province).

NATURAL HISTORY. A worn female of *C. berezowskii* was spotted on a twig of *Spiraea lasiocarpa* (Figs 7, 8) on 19 June, and further search for larvae was carried out on this plant. We inspected about 200 plants of *S. lasiocarpa*, and only four last-instar larvae were collected from three plants. Three of them were collected during a two kilometer route in a valley east Chuanzhusi town (Fig. 9). It is noteworthy that two larvae were collected from the same plant.

Larvae seem to hide deep in the inflorescens of the host plant. Soon after transferring to another host plant in a laboratory, one larva died. One caterpillar was parasitized with a hymenopteran larva, one pupa did not reach adulthood, and one was reared to the adult stage without overwintering but failed to spread its wings (Fig 6). In both cases, pupation took place on the bottom of individual boxes. The duration of the final instars after capturing was 8 and 10 days (both caterpillars were collected on 28 June), the prepupa lasted 2 days in both cases. The duration of the pupal stage was 22 weeks.

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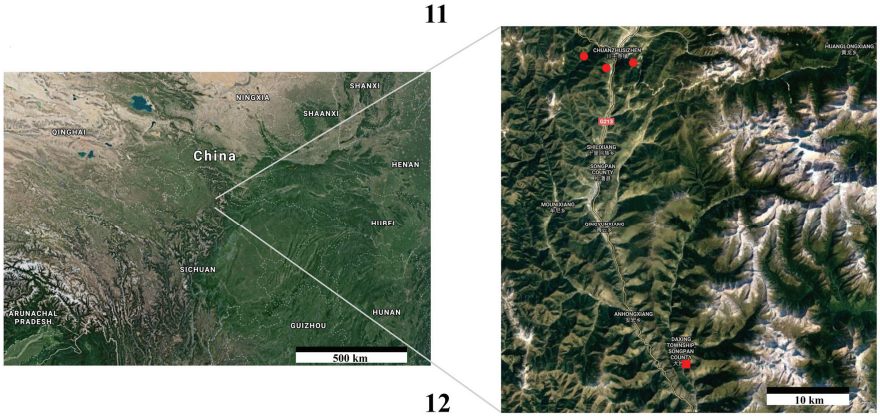

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Figs 10–12. Adult, label and type locality. 10 – male of *Cissatsuma berezowskii* Krupitsky, 2018 labeled as "Guihuagou vill. env., ca. 32°27'28.4" N, 103°42'12.5" E, M.M. Berezovsky leg. 24.IV.1894" (ZISP); 11 – example of supplementary label of the elfin butterflies collected by Berezowsky at the same locality but 06.V.1894; 12 – type locality of *C. berezowskii* (red square) and collecting sites of pupae and imago near Chuanzhusi (red circles).

Among the species of the genus *Cissatsuma*, host plants of only one species, namely *C. zhoujingshuae*, are known. According to the surveys by Huang & Zhou (2014), larvae of this species utilize two Rosaceae shrubs, *Spiraea fritschiana* and *Aruncus sylvester*. It is noteworthy that caterpillars feeding on different plants slightly differ in colouration (Huang & Zhou, 2014). Our search for elfin butterflies larvae on *Aruncus* shrubs in the examined localities were unsuccessful.

TYPE LOCALITY AND DISTRIBUTION. One more specimen of *C. berezowskii* bearing the same label as the type specimens was found in the collection of ZISP (Fig. 10). Additionally, a series of an elfin butterfly species tentatively determined by us as *Ahlbergia oppocoenosa* (Johnson, 1992), comprising six males and a female, was found in the same drawer. These specimens are supplied with the same printed labels as *C. berezowskii* from ZISP collection ("Сы-ч., Сунпань. / 9500 ф. и выше. / Березовск.", (China, Sichuan Prov., Songpan County / 9500 ft. [2900 m] [above sea level] and higher / M.M. Berezovsky leg.) differing in collection dates. Moreover, some of these specimens also bear hand-written specifying labels "Сунпань, Гуйхуа" (Songpan [County], Guihua) (Fig. 11). The only locality in Songpan County containing this toponym is Guihuagou (归化沟), a village situated at 32°27'28.4" N, 103°42'12.5" E exactly at 2900 m (Fig. 12). There are no accessible travel diaries of Berezovsky confirming the exact localities of the specimens from his expeditions, so we assume the environs of the abovementioned village as the type locality of *C. berezowskii.* Our finding also clarifies Berezovsky's route during his expedition to China in 1891–1894 and can help in further geographical attribution of materials from his zoological collection. Guihuagou is the most possible type locality of lycaenid species *Grumiana berezowskii* (Grum-Grshimailo, 1902) and *Patricius lucina* (Grum-Grshimailo, 1902). Both species were collected by Berezovsky and supplied with the above-mentioned printed labels differing in collection dates.

Currently, the known distribution range of *C. berezowskii* covers a small area in the Min River upper reaches at 2900–3200 m. Taking into account all the known findings, *C. berezowskii* can be treated as an endemic of the western Min Mountains. In the Yangdong River valley, 2 km northwest Chuanzhusi, *C. berezowskii* cohabits with recently described epicopeiid moth *Deuveia panda* Krupitsky et Shapoval, 2020, which is also known from the western Min Mountains so far (Krupitsky & Shapoval, 2020).

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