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Perigrapha heidi Hreblay, 1996, a little-known species new to the faunas of Kyrgyzstan and Kazakhstan, with molecular-genetic evidence of its species status (Lepidoptera: Noctuidae)

Perigrapha heidi Hreblay, 1996, малоизвестный вид совок, новый для фаун Казахстана и Киргизии, с молекулярно-генетическим доказательством его видового статуса (Lepidoptera: Noctuidae)

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КЛЮЧЕВЫЕ СЛОВА. Совки, новые находки, малоизвестный вид, молекулярно-генетические данные.

ABSTRACT. A little-known owlet moth species, *Perigrapha heidi* Hreblay, 1996, recorded for the first time from Kyrgyzstan (Bishkek environs) and Kazakhstan (Altyn-Emel Nature reserve); it was known till now from only its type locality and by only its type series. Photographs of imagines, male and female genitalia are provided, differences from the closely related *P. centralasiae* Bartel, 1906 are listed both in external features and genital armatures. The COI sequences of *P. heidi* Hreblay, 1996 and *P. centralasiae* Bartel, 1906 from both localities are studied; it is shown that the differences in COI sequences of *P. heidi* Hreblay, 1996, *P. centralasiae* Bartel, 1906 and *P. i-cinctum* (Denis et Schiffermüller, 1775) are enough to separate them as good species.

РЕЗЮМЕ. Впервые для Киргизии (окр. г. Бишкека) и Казахстана (природный парк «Алтын-Эмель») указывается малоизвестный вид совок *Perigrapha heidi* Hreblay, 1996; до настоящего времени он был известен только из типового местонахождения исключительно по типовым экземплярам. Приводятся изображения имаго, гениталий самцов и самок, описываются генитальные и внешние отличия от близкого *P. centralasiae* Bartel, 1906. Исследованы последовательности COI экземпляров *P. heidi* Hreblay, 1996 и *P. centralasiae* Bartel, 1906 из обоих местонахождений. Показано, что уровень различий по этой последовательности между *P. heidi* Hreblay, 1996, *P. centralasiae* Bartel, 1906 и *P. i-cinctum* (Denis et Schiffermüller, 1775) достаточен для придания им видового статуса.

Introduction

Perigrapha heidi Hreblay, 1996, belonging to *P. i-cinctum* (Denis et Schiffermüller, 1775) group, described from "USSR, Tadzhikistan, 39°N, 68°40′E, Hissarskij mts., Romit, 1100 m" by 3 males [Hreblay, 1996], and long time it was only known by these type specimens from only its type locality. All type specimens have been collected in the 3rd decade of April — a time, which is too early for regular lepidopterological expeditions (normally they held in June and July, the best time for Lepidoptera species richness in Middle Asia).

In 2015 I received a good series of *Perigrapha* Lederer, 1857 moths from South-East Kazakhstan. In this series two closely related species were presented: widely distributed in Middle Asia *P. centralasiae* Bartel, 1906, and little-known *P. heidi* (known so far from only its type locality). Both species have been sampled for mtDNA analysis and sequenced. In April 2021 same both species have been collected in Kyrgyzstan; they were also sampled for mtDNA study and sequenced.

Materials and methods

The sequencing was processed within the BOLD project in the University of Guelf (Canada) [Ratnasingham, Hebert, 2007]. Primers used: LepF1 (ATTCAACCAATCATAAAGATATTGG) and LepR1 (TAAACTTCTGGATGTCCAAAAAATCA) [Hebert et al., 2004]. The sequences were aligned in BioEdit ver. 7.0.9.0. For

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the calculations of tree, I used Maximum Likelihood with 10000 bootstrap replications by Tamura 3-parameter model [Tamura, 1992], transition and transversion substitutions included and with Gamma distributed heterogeneous rates in MEGA X [Kumar et al., 2018]. Some calculations were made in Microsoft Excel 2016. Processing of final illustrations was made by Corel Draw X8 and Adobe Photoshop CC.

Dissection processed by standard "cold" method: abdomens placed into 5% KOH for 48 — 52 hours, then

Figs 1–10. *Perigrapha* spp., imagines: 1–4 — *P. heidi* (1–2 — Kyrgyzstan, near Bishkek, Ala-Too environs; 3–4 — Kazakhstan, Altyn-Emel Nature Reserve) 5–10 — *P. centralasiae* (5–8 — Kyrgyzstan, near Bishkek, Ala-Too environs; 9–10 — Kazakhstan, Altyn-Emel Nature Reserve); 1, 3, 10 — females, 2, 4–9 — males.

Рис. 1–10. *Perigrapha* spp., имаго: 1–4 — *P. heidi* (1–2 — Киргизия, близ Бишкека, окрестности Ала-Тоо; 3–4 — Казахстан, Алтын-Эмельский заповедник) 5–10 — *P. centralasiae* (5–8 — Киргизия, близ Бишкека, окрестности Ала-Тоо; 9–10 — Казахстан, Алтын-Эмельский заповедник); 1, 3, 10 — самки, 2, 4–9 — самцы.

genital armatures cleaned from soft tissues and fixed in 96% alcohol for photography.

MATERIAL EXAMINED. *P. heidi*. **Kazakhstan**. 15 ♂, 5 ♀, 21–22.03.2015, Sholak Mts., western limits of the Altyn-Emel Nature Reserve, 1000 m, leg. P. Egorov (sequence MZ274400). **Kyrgyzstan**. 1 ♂, 1 ♀, 20.04.2021, Bishkek environs near Ala-Too village, 1000 m, leg. S.K. Korb (sequence MZ274403). Both Kyrgyzstanian and 6 Kazakhstanian specimens dissected.

P. centralasiae. **Kazakhstan**. 39 ♂, 4 ♀, 21–22.03.2015, Sholak Mts., western limits of the Altyn-Emel Nature Reserve, 1000 m, leg. P. Egorov (sequence MZ274402). **Kyrgyzstan**. 1 ♂, 2.05.2014 Kyrghyzsky Mts., near Bishkek, village Ala-Too environs, 1000 m, leg. S.K. Korb; 2 ♂, 10.05.2014, same locality, leg. S.K. Korb; 11 ♂, 1 ♀, 20.04.2021, same locality, leg. S.K. Korb (sequence MZ274401). 6 Kyrgyzstanian and 6 Kazakhstanian specimens dissected.

All specimens deposited in the author collection. Sequenced specimens I will deposit in the Zoological Institute of the Russian Academy of Sciences (St.-Petersburg, Russia).

Figs 11–16. *Perigrapha* spp., genitalia: 11, 14, 16 — *P. heidei*, Kyrgyzstan, near Bishkek, Ala-Too environs; 12–13, 15 — *P. centralasiae*, Kyrgyzstan, near Bishkek, Ala-Too environs; 11–12 — female genitalia; 13–16 — male genitalia (13–14 — aedoeagus, vesica everted; 15–16 — male genitalia, frontal view, aedoeagus removed).

Рис. 11–16. *Perigrapha* spp., гениталии: 11, 14, 16 — *P. heidei*, Киргизия, близ Бишкека, окрестности Ала-Тоо; 12–13, 15 — *P. centralasiae*, Киргизия, близ Бишкека, окрестности Ала-Тоо; 11–12 — гениталии самок; 13–16 — гениталии самца (13–14 — эдеагус, везика вывернута; 15–16 — гениталии самца, вид спереди, эдеагус удален).

Results and discussion

P.heidi found in Kazakhstan and Kyrgyzstan for the first time. *P. heidi* and *P. centralasiae* are closely related by their habitus and genitalia, but can be distinguished by the following characters. External features (Figs 1–10): *P. heidi* is slightly less (wingspan 2–3 mm less in average than in *P. centralasiae*, it is better visible in series), light external band in the forewing upperside of *P. heidi* wide and is not separated from the same color external border (in. *P. centralasiae* it is not so wide and even can be not present, always separated from external border by a darker belt); *P. heidi* in general is lighter than *P. centralasiae*. Female genitalia of *P. heidi* with 2 signa on the bursa copulatrix (in *P. centralasiae* with 4 signa); ostium in *P. heidi* long-oval, in *P. centralasiae* rectangular (Figs 11–12). Within the male genitalia (Figs 13–16) the differences are in the harpae structure: in *P. centralasiae* its distal and proximal parts are almost equal in size, in *P. heidi* distal part is 2 times shorter than proximal.

Cladogram of the closely related taxa from *P. i-cinctum* group (Fig. 17) show their good separation. p-distance between *P. centralasiae* and *P. heidi* (Table) is 0.027; the 'standard' species separation p-distance is 0.020 or more [Hebert et al., 2004]. It clearly proves the specific status of *P. heidi*. As we can see from the Table, sequences from Kazakhstan and Kyrgyzstan for both *P. centralasiae* and *P. heidi* have no differences. Perhaps the reason is that we use a single sequence from each location from each species; in European sequences of *P. i-cinctum*, however, we can see the same picture from the populations located not far away (see Table, Austrian and Slovenian sequences).

Both species inhabit similar biotopes in Kazakhstan and Kyrgyzstan: dry foothill steppes with *Artemisia* sp.

The early spring fauna of the Middle Asiatic Lepidoptera remain very poorly studied. This is evidenced by our recent records (including current), made with a relatively weak coverage of the territory in Kazakhstan and Kyrgyzstan in early spring period. For example, the presence of the largest Middle Asian species of snout moths, *Evergestis kopetdagensis* Kuznetsov, 1958 (described from Kopet-Dagh in Turkmenistan) in the vicinity of the capital city of Kyrgyzstan found only in 2018 [Korb, 2018]; etc. The reason for this is quite obvious: the volume of expeditionary work in this vast region in early spring is too small and fragmentary.

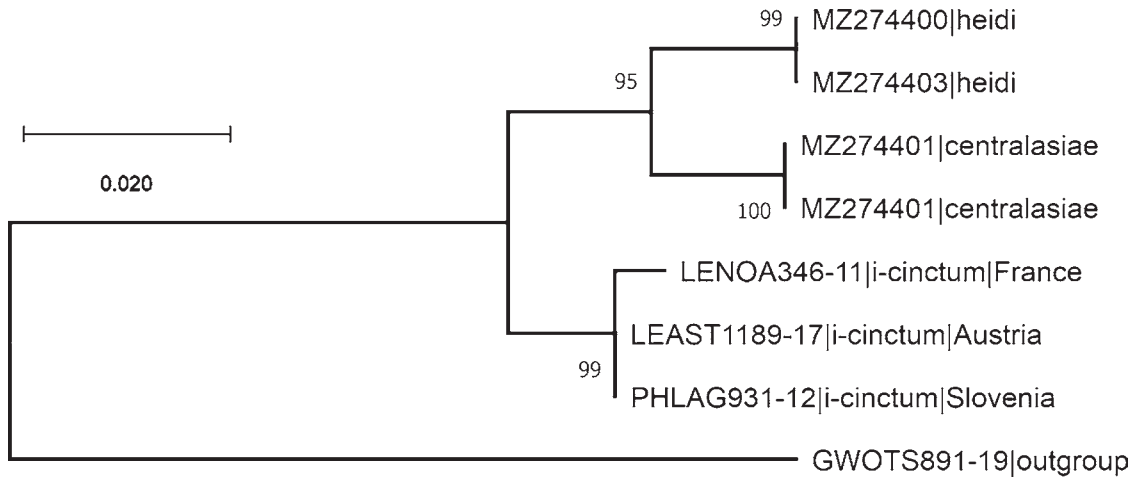

Fig. 17. Cladogram of *Perigrapha i-cinctum* group. ML tree, Tamura-3 parameter model, 10000 bootstrap replications.
Рис. 17. Кладограмма группы *Perigrapha i-cinctum*. ML-дендрограмма, модель параметров Tamura-3, 10000 бутстреп-репликаций.

Table. p-distances of COI sequences used in current paper.
Таблица. p-расстояния последовательностей COI, обсуждаемых в данной статье.

Sequence ID	1	2	3	4	5	6
LEAST1189-17|i-cinctum|Austria						
LENOA346-11|i-cinctum|France	0.005					
PHLAG931-12|i-cinctum|Slovenia	0.000	0.005				
MZ274400|heidi	0.038	0.042	0.038			
MZ274402|centralasiae	0.036	0.038	0.036	0.027		
MZ274401|centralasiae	0.036	0.038	0.036	0.027	0.000	
MZ274403|heidi	0.038	0.042	0.038	0.000	0.027	0.027

Thus we can predict findings of currently little-known species of early spring Noctuoid moths as far as other Macroheterocera and Microlepidoptera in good series within Middle Asia when the lepidopterological expeditions will visit this area in right time.

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