



**DAHLICA GOLTELLA SP. N., A NEW BAGWORM SPECIES
FROM SLOVENIA
(LEPIDOPTERA: PSYCHIDAE)**

Jurij REKELJ¹ and Željko PREDOVNIK²

¹ Struževo 35, 4000 Kranj, Slovenia, e-mail: jurij.rekelj@gmail.com

² Ob železnici 82, 3313 Polzela, Slovenia, e-mail: predovnik1@gmail.com

Abstract – The description and illustrations of a new species *Dahlia goltella* sp. n. from Slovenia are provided. Morphological differences between related species of Dahlicini are presented and figured. Results of DNA barcoding analysis are shown. Data on the diagnosis, distribution and biology of the new species are given.

KEY WORDS: Lepidoptera, Psychidae, Slovenia, COI, DNA Barcoding, new species.

Izveček – *DAHLICA GOLTELLA* SP. N., NOVA VRSTA VREČKARJA IZ SLOVENIJE (LEPIDOPTERA: PSYCHIDAE)

Prispevek vsebuje opis in prikaze nove vrste *Dahlia goltella* sp. n. iz Slovenije. Predstavljene in upodobljene so morfološke razlike s sorodnimi vrstami plemena Dahlicini. Prikazani so rezultati molekularne analize DNK. Podani so podatki o prepoznavi, razširjenosti in biologiji nove vrste.

KLJUČNE BESEDE: Lepidoptera, Psychidae, Slovenija, COI, DNA molekularna analiza, nova vrsta.

Introduction

Psychidae are interesting and increasingly researched group of moths. Many new species have been found recently and more of them still waiting to be described. Currently, this family comprises 250 species in Europe, of which 60 belong to the tribe Dahlicini (http://www.lepiforum.de/lepiwiki.pl?Psychidae_Europa, last update 2.3.2014). There is not much literature about bagworms in Slovenia. Old records and

fragmented literature data were collected and published in the works of Mann (1854), Rebel (1905-1910), Hafner (1909-1912), Meier (1955, 1958), Sieder (1972), Carnelutti & Michieli (1955, 1969), Carnelutti (1971, 1975, 1992a, 1992b), Gomboc (1999) and Lesar & Habeler (2005). Intensive studies of the bagworms in Slovenia in the last years have led to many interesting findings and contributed a lot to the knowledge of the recent Psychidae fauna in the country. Many additional species as *Acanthopsyche ecksteini* (Lederer, 1855), *Ptilocephala muscella* ([Denis & Schiffermüller], 1775), *Phalacropteryx graslinella* (Boisduval, 1852), *Brevantennia adriatica* (Rebel, 1919) and *Luffia lapidella* (Goeze, 1783) were reported in recent publications (Štanta, 2008, Predovnik 2009, 2010, Weidlich, 2012, Rekelj, 2013).

The basic reference list of Slovenian bagworms was published by Lesar & Govedič (2010) with 50-51 species, which is currently the only official list. Due to many new interesting finds recently, a revision of this list is being prepared. According to the latest data, the number of known bagworms in Slovenia is approximately 50, of which 11 belong to the tribe Dahlicini, and another 6 species remain unidentified (author's data).

During one excursion in November 2010 in landscape park of Golte at eastern edge of the Kamnik-Savinja Alps, the second author found a small number of old larval cases of unidentified Dahlicini species. In April 2012 and 2013, large numbers of larval cases of this species were collected and reared to adult stage. The first observations, especially the habitat, liveliness of hatched males and nicely colored specimens, showed great affiliation to the genus *Postsolenobia* Meier, 1958. But detailed studies of morphological characters (lack of epiphysis on foretibia, absence of medial cells on fore and hindwing, accessory cell present, six veins from the discoidal cell of



Fig 1. *Dahlica goltella* sp. n., holotype, male, Golte, Slovenia.

the hindwing, ante- and postvaginal plate not merged), have shown that this new species (according to current terminology) ranks to the genus *Dahlica* Enderlein, 1912. Here we use a combination of morphology and DNA barcodes to test the hypothesis that this *Dahlica* is a new species of this genus.

Methods

Morphology. We followed the current terminology of morphological structures (class of cloaking scales, dorsal field thorns, pupal skin etc.) for the tribus Dahlicini by Sauter (1956), Hättenschwiler (1977, 1997), and taxonomic key of the family by Sauter & Hättenschwiler (1991, 1999). The nomenclature is taken from Sobczyk (2011).

All drawings and photographs are works of the senior author.

Abbreviations of venation and cells: an – Analis; cu – Cubitus; pcu – Postcubitus; m – Media. All structures on wings are explained in Fig. 2.

DNA barcodes. DNA was extracted and barcodes were sequenced at the Canadian Centre for DNA Barcoding (CCDB, Guelph) using standard high-throughput protocols described in Ivanova et al. (2006). A total of four specimens were sequenced. Barcode data were analysed using the analytical tools of the Barcode of Life Data Systems.

(BOLD;www.boldsystems.org; (Ratnasingham & Hebert, 2007).

Dahlica goltella Rekelj and Predovnik, sp. n.

Description. *Male* (Figs 1, 11). Forewing length: 5 to 6 mm (n=23). Head (Fig. 3,a) covered with grey hairlike scales. Labial palpi small, covered with creamy yellow

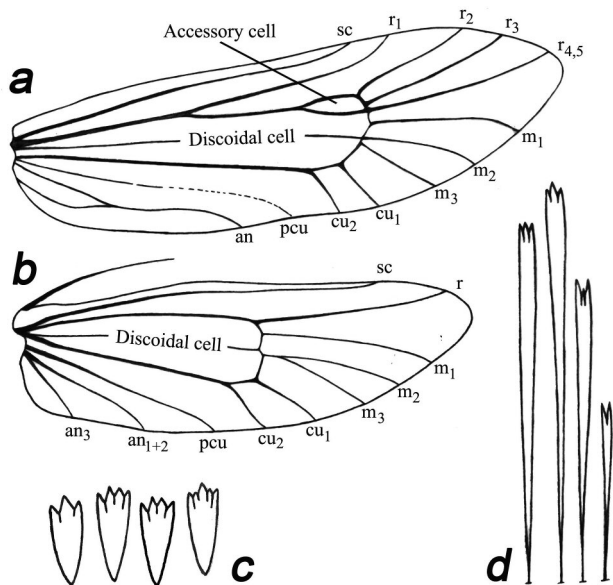


Fig 2. *Dahlica goltella* sp. n., paratype, male, Golte, Slovenia: a – forewing venation; b – hindwing venation; c – cloaking scales; d – external margin fringe scales.

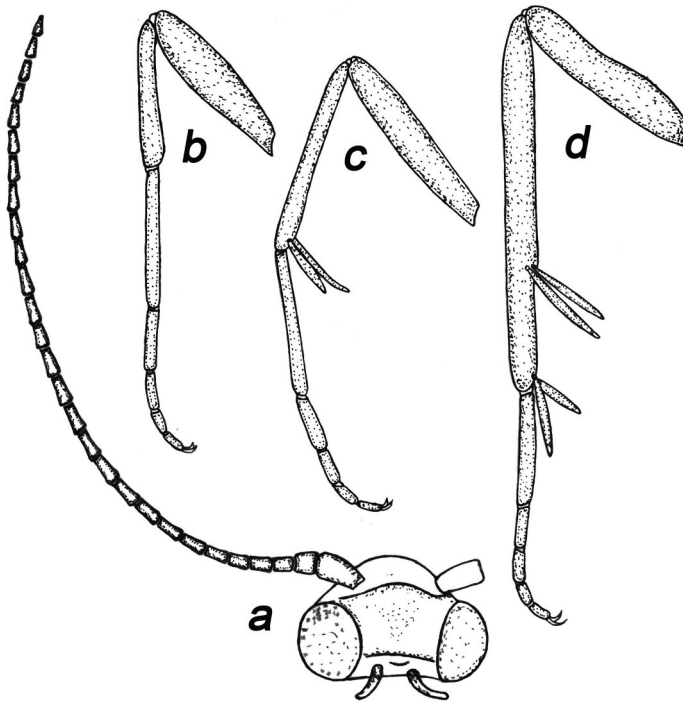
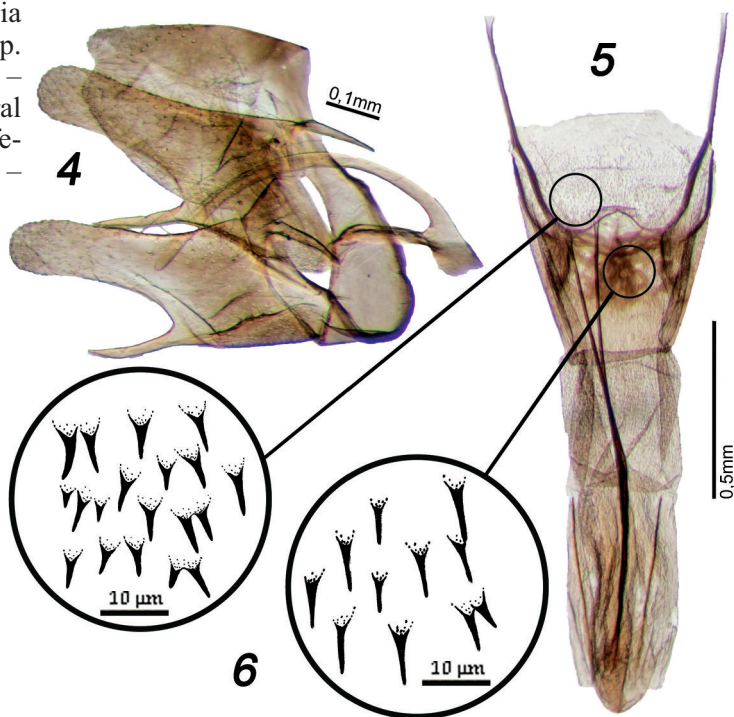


Fig 3. *Dahlica goltella* sp. n., paratype, male, Golte, Slovenia: a – head structures with antenna; b – fore leg; c – middle leg; d – hind leg.

hairs. Eyes small, widely separated. Distance between eyes 2.1 times the diameter of an eye. Antenna with 27-30 segments (including scape and pedicel), about 0.47 of forewing length. Ocelli lacking. Thorax and tegulae covered with grey and white hairlike scales. Wings (Fig. 2) narrow: forewing length 3.6 times exceeding its width. Fringes (Fig. 2,d) coloured creamy yellow, very intensive in fresh specimens. The ground colour of forewings is greyish white. On radial margin the ground colour of scales changes to creamy yellow, usually more intensive than the colour of fringes. Pattern strong, dark grey colored, on several places fused to larger areas. The most visible expanded area is on anal angle between veins an and cu_2 . Cloaking scales (Fig. 2,c) classified into class IV (method after Sauter, 1956). Most of the specimens have four tines on cloaking scales, but there are also specimens with the reduced number. At 15% of population we found specimens with just three tines ($n=50$). Forewing venation (Fig. 2,a) with nine veins, originates from the discoidal cell. Vein pcu less well expressed, accessory cell present ($n=5$). Hindwing covered with grey scales. Colour of hindwing fringes is creamy. Venation (Fig. 2,b) with six veins, from the discoidal cell, m_2 and m_3 approximated at the base or fused for a short distance. Legs grey white, foretibia (Fig. 3,b) without epiphysis. Midtibia (Fig. 3,c) with one pair of spurs, hindtibia (Fig. 3,d) with two pairs. Number of tarsal segments of all legs five. Abdomen dark grey. Males show great variability in size, as well as in coloration of specimens, which is typical for Dahlicini.

Figs 4-6. Genitalia of *Dahlica goltella* sp. n., Golte, Slovenia: 4 – paratype, male, lateral view; 5 – paratype, female, ventral view; 6 – dorsal field thorns.



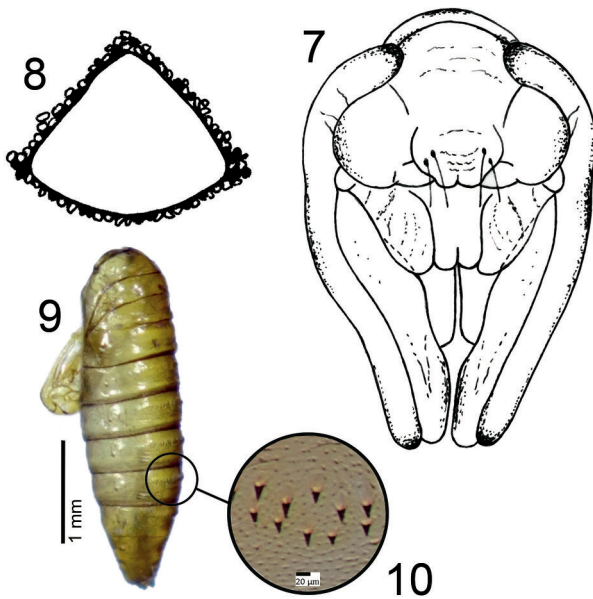
Female (Fig. 12). Yellowish with broad, light brown plates dorsally on each segment, body length about four mm. Antenna with 15-17 segments (including scapus and pedicellus). Tibiae of forelegs without epiphysis, all legs with four-segmented tarsi. Hairs of 7th segment cream-gray coloured, apex normal - simple, without expanded process at the end.

Male genitalia (Fig. 4). Typical for Dahlicini, Genital index (after Sauter, 1956) 0.98-1.15, middle 1.06 (n=10). Cucullus length 3.1 times its width.

Female genitalia (Fig. 5). Typical for Dahlicini, dorsal field thorns (Fig. 6) single, long and narrow, sometimes combined in groups of two, rarely three.

Female pupa (Fig. 9). Length of antennae covers slightly exceeding length of forelegs covers (n=10). Pupal skin (after Hättenschwiler, 1977) is illustrated on Fig. 7 and thorns on surface of pupal exuvia of 7th tergite on Fig. 10.

Larval cases. Typical for the tribus Dahlicini, in shape and size most similar to the genus *Postsolenobia*. On type locality, the larval cases of both sexes are 4.9 to 5.8 mm long and 1.4 to 1.6 mm wide. They are indistinct triangular (Fig. 8) in cross section. The cases are composed of fine light-gray limestone sand, and dark brown-black particles of soil. In other localities (Košuta, Olševa gora and Raduha) there has been a slight deviation in colour of larval cases as a result of different colour of limestone.



Figs 7-10. *Dahlica goltella* sp. n., Golte, Slovenia: 7 – female, pupal skin; 8 – larval case, cross section; 9 – female exuvia, lateral view; 10 – thorns on surface of pupal exuvia of 7th tergite.

Type material. *Holotype:* ♂ with larval case, Bela Peč - Požganije, Golte, Slovenia, 1250-1320 m, 15.4.2012 (e.p. 26.4.2012), leg. Ž. Predovnik. *Paratypes:* 3 ♂♂, 3 ♀♀, Bela Peč - Požganije, Golte, Slovenia, 1250-1320 m, 25.4.2011 (e.l. 1.-8.5.2011), leg. Ž. Predovnik; 4 ♂♂, 2 ♀♀, 15.4.2012 (e.l. 26.4.-5.5.2012), leg. Ž. Predovnik; 7 ♂♂, 11 ♀♀, with larval cases, 15.4.2012 (e.p. 25.-30.4.2012), leg. J. Rekelj; 10 ♂♂, 13 ♀♀, with larval cases, 1.5.2013 (e.l. 15.-17.5.2013), leg. J. Rekelj; 60 ♂♂, 87 ♀♀, with larval cases, 18.5.2013 (e.p. 20.-29.5.2013), leg. J. Rekelj; 34 ♂♂, 29 ♀♀,



Fig 11. *Dahlica goltella* sp. n., Golte, Slovenia: fresh adult male, resting on rock.

Fig 12. *Dahlica goltella* sp. n., Golte, Slovenia: fresh adult female, transmitting pheromones.



with larval cases, 1.5. and 9.5.2013 (e.l. 8.-29.5.2013), leg. Ž. Predovnik. 16 ♂♂, 16 ♀♀, with larval cases (e.p. 12.-14.5.2012), Rjava peč, Košuta, Slovenia, 1400 m, 5.5.2012 leg. J. Rekelj; 14 ♂♂, 58 ♀♀, with larval cases, 12.5.2013 (e.p. 19.-23.5.2013), leg. J. Rekelj. 1 adult larva, with larval case, Potočka zijalka, Olševa gora, Slovenia, 1700 m, 26.10.2013, leg. J. Rekelj & M. Česanek. The holotype and a female paratype are deposited in the Slovenian Museum of Natural History Ljubljana (Prirodoslovni muzej Slovenije); other paratypes are in coll. J. Rekelj and Ž. Predovnik.

Further material: 1 ♀, with larval case, Rjava peč, Košuta, Slovenia, 1400 m, 15.5.2008 (e.p. 25.5.2008), leg. et. coll. M. Lasan (Ljubljana); 5 ♂♂, with larval



Fig 13. *Dahlica goltella* sp. n., Golte, Slovenia: full grown larva.



Fig 14. Habitat of the type locality of *Dahlica goltella* sp. n., Bela Peč-Požganije, Golte, Slovenia.

cases, 7.5.2009 (e.p. 15.5.2009), leg. et. coll. M. Lasan; 20♂♂, 16♀♀, 11.5.2011 (e.l. 15.-20.5.2011), leg. et. coll. M. Lasan. Empty larval cases, Akelj – Slemenca, Raduha, Slovenia, 1500 m, 1.11.2013, leg. et coll. Ž. Predovnik.

Distribution. At present *Dahlica goltella* sp. n. is known from the Northern-mountain part of Slovenia, from four localities. Three of them are in the eastern part of the Kamnik - Savinja Alps and one in the Karavanke at the border zone with Austria (Fig 16). On locality Košuta – Rjava skala, we found numerous larval cases on the border with Austria, which indicates the prevalence of species in the neighbouring country. Similar habitats can be found also in neighbouring mountains and therefore wider distribution is expected.

Ecology. Larval cases were collected on south and southwest facing cliffs consisting of limestone. The vegetation on type locality around the cliffs is xerothermic and

consists of mainly: *Ostrya carpinifolia*, *Pinus sylvestris*, *Salix* spp., *Larix decidua*, *Amelanchier ovalis*, *Erica carnea*, *Rosa* sp. etc. Cases with larvae were found on partly shaded places with low light intensity, but also on the most warm and sunny places on southwest sides of the cliffs. Altitude of lowest locality in Golte is 1250 and the highest 1700 m on Olševa mountain. Intensive searching of cases on lower an upper altitude was unsuccessful. All observations indicates that species is univoltine. Larvae prefer to feed on lichens, algae and mosses, growing on rocks. They pupate in the second half of April and the first half of May. Flying period of adults begins in late April and lasts to the end of May, depending of altitude of the locality. Hatching period of males in captivity was in the afternoon with a peak in the evening between 18:00-20:00. They become active in the first dawn, after the occurrence of females. Females were always hatched only at the first morning light between 6:00-7:30, unlike males, which have more extensible time, especially on cloudy days. Copula lasts for about two and a half minutes. Females begin to lay eggs immediately after copulation in collar (exit hole) of their larval cases. We also noticed that males are very lively and are easily disturbed. This way of behaviour was also observed when rearing both Slovenian species of *Postsolenobia* - *juliella* and *nanosella*.

Many larvae were infested with at least two unidentified species of parasitoid wasps (Hymenoptera). In type locality Golte the number of parasitism was 40% of total larval population. In natural habitat *Dahlica goltella* sp. n. cohabits with the following species of bagworms: *Dahlica triquetrella* parth. (Hübner [1813]); *Taleporia tubulosa* (Retzius, 1783); *Anaproutia comitella* (Bruand, 1853); *Psyche casta* (Pallas, 1767) and *Psyche crassiorella* (Bruand, 1850). On the localities Košuta, Podolševa and Raduha additionally *Siederia meierella* (Sieder, 1956) is present next to other species.

Diagnosis: The new species is similar to the following species in the genus *Dahlica* (regards to gen. index): *Dahlica achajensis* (Sieder, 1966); *Dahlica karatyshica* Rutjan, 2000; *Dahlica larella* (Chrétien, 1906); *Dahlica marmorella* Herrmann, 1988 and *Dahlica sauteri* (Hättenschwiler, 1977). From all these species *Dahlica goltella* sp.n. is easily distinguished in external view: the new species has in discal and anal area of the forewing pattern merged into larger areas, which is not noted in other compared *Dahlica* species. New species has also noticeable creamy yellow coloured fringes on fore wings, and the area around the labial palpi unlike other compared *Dahlica* species where those parts are greyish. *D. achajensis* can be separated by absence of marked spots on forewing, by bigger class of cloaking scales (IV-V) and larger number (5) of tarsal segments in female. *D. karatyshica* is distinguished by smaller size (forewing length: 3.5 to 4.5 mm), absence of marked spots on forewing, by bigger class of cloaking scales (IV-V), presence of only five veins on hindwing originating from the discoidal cell and different shape of dorsal field thorns in female. *D. larella* differs by absence of marked spots on forewing, different hairs of 7th segment in female (apex with expanded, button-like process at the end) and characteristic, broader shape of larval cases composed of sand and particles of chitin. *D. marmorella* is distinguished by absence of marked spots on forewing, bigger class of cloaking scales (V), and different - narrow and pointed shape of dorsal field thorns in females.

D. sauteri is distinguished by absence of marked spots on forewing, smaller class of cloaking scales (II-IV) and very bright dorsal field thorns in females.

Morphological analysis and habitat show close relation of the new species to the genus *Postsolenobia* with the following species known: *P. banatica* (Hering, 1922), *P. juliella* (Rebel, 1919), *P. nanosella* Petru & Liška, 2003 and *P. thomanni* (Rebel, 1936). From all four species *Dahlica goltella* sp.n. is distinguished by larger size, smaller size of cloaking scales and presence of accessory cell on forewing. Differences between patterns of forewings are shown in Fig. 15.

Etymology: The name of the new species is derived from Golte, diverse alpine plateau at the eastern edge of the Kamnik-Savinja Alps.

DNA barcoding: All four specimens formed a monophyletic clade with Barcode index number (BIN): BOLD:ABU8294.

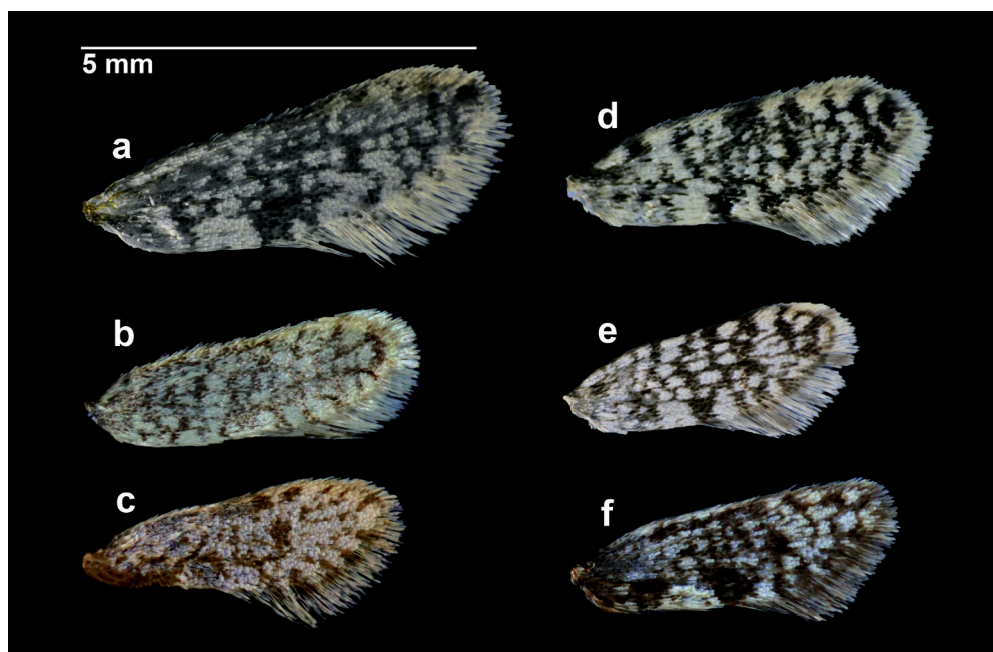


Fig 15. Comparison of patterns of male forewings in tribus Dahlicini: a – *Dahlica goltella* sp. n., paratype, Golte, Slovenia; b – *Dahlica karatyshica* Rutjan 2000, Kamennye mogily, Ukraina, 21.4.2001, Rutjan leg., coll. M. Petru; c – *Postsolenobia banatica* (M. Hering, 1922), Băile Herculane, Romania, 22.5.1965, Căpușe leg., coll. MNHV – Museum of Natural History of Vienna; d – *Postsolenobia juliella* (Rebel, 1919), Sabotin, Slovenia, 1.5.2011, Rekelj leg. et coll.; e – *Postsolenobia nanosella* Petru & Liška, 2003, Nanos, Slovenia, 25.4.2009, Rekelj leg. et coll.; f – *Postsolenobia thomanni* (Rebel, 1936), paratype, Campocologno, Schweiz, 10.5.1935, Rebel leg., coll. MNHV - Museum of Natural History of Vienna.

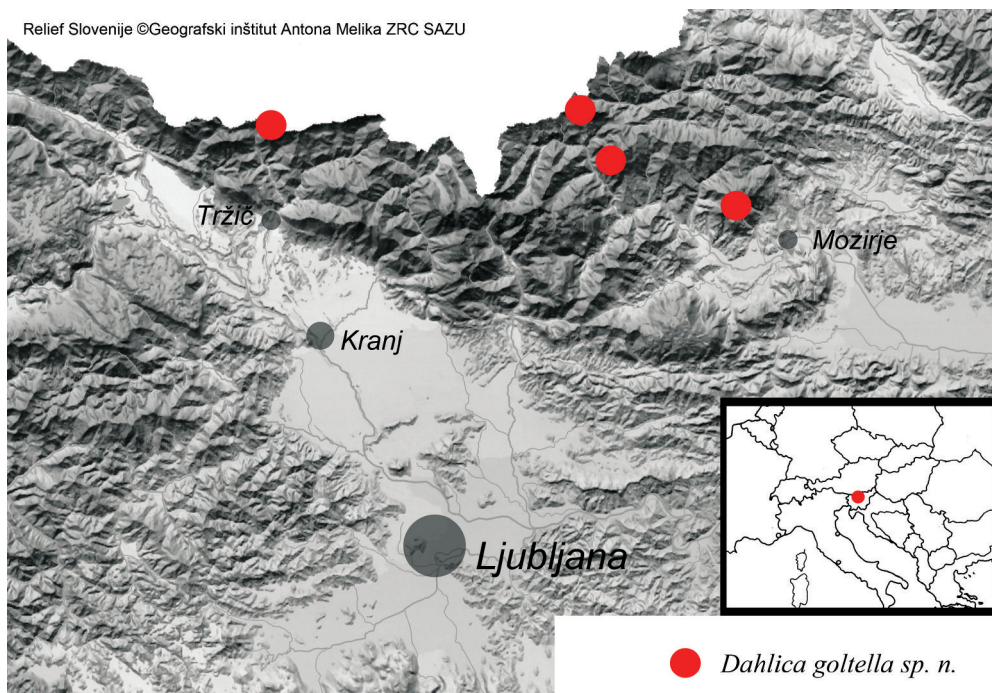


Fig 16. Distribution map of *Dahlica goltella* sp. n. in the northern part of Slovenia.

http://v3.boldsystems.org/index.php/Public_BarcodeCluster?clusteruri=BOLD:ABU8294

The distance to the nearest neighbour *Dahlica charlottae* (BOLD:AAI5841) is 4.33%. The average intraspecific distance is 0.06%. DNA barcodes show unequivocal support to the distinction of *Dahlica goltella* as a new species, with as much as 4.33% p-distance between this newly described species and its nearest neighbour.

Discussion

Recently many authors devoted a lot of time to research of the Psychidae. Especially in the tribe Dahlicini we got quite a number of new species in recent years, the vast majority in the genus *Dahlica*. This group is studied quite well in Central Europe and supported by many publications, including the most recent ones, but nevertheless some species remain whose status are unclear and need a revision.

In our case, the new species shows great affiliation with the group *Postsolenobia*, in several respects. The history of this group offers us a partial solution, because the status of this genus has not been recognized throughout the whole period. A group of two species - *thomanni* and *friulana* (*friulana* was later recognized as synonym for *S. juliella* by Arnscheid, 1988) was separated by Meier in 1958 from the original genus as a subgenus *Postsolenobia*. Meier defined *P. thomanni* as the type species of this

subgenus, for which the cited features are correct with the exception of the last point, about hatching females throughout the day (Meier, 1958). Later authors state reduced veins of the hindwing as unclear taxonomic character of this subgenus because the same features were also found in small *Solenobia* species (Sauter, 1956). These states and published article about *S. banatica* (Căpușe, 1964), revolved a synonymization of *Postsolenobia* with the genus *Dahlica* by Arnscheid (1988), where overview of all facts was given. Just a few years later a work about systematics of the palaeartic Psychid species was published (Sauter & Hättenschwiler 1991, 1999), where the genus *Postsolenobia* became valid again. The authors specify the following characteristics of the genus *Postsolenobia*:

1. Small size of the male, wingspan 7-10 mm,
2. Cloaking scales very bright - class V-VI,
3. Accessory cell on forewing not present,
4. Hindwing with 5 veins arising from the discoidal cell,
5. Female with long antennae, with 12-16 segments.

To these morphological characters some other characteristics can be added:

6. Xerothermic habitat, warm slopes with large stones, boulders or cliffs,
7. Males are very lively and are easily disturbed.

Dahlica goltella sp.n. shares the same habitat preferences and behaviour of the males, while morphological characteristics are different with the exception of the number of antennal segments of females. From this aspect, we decided to rank *D. goltella* sp.n. to the genus *Dahlica* which is numerically the largest group of the tribe Dahlicini.

Acknowledgements

The authors kindly thank Carlos Lopez-Vaamonde (INRA, Orléans, France) for help with analysis and interpretation of genetic data and Stanislav Gomboc (Ljubljana, Slovenia) for his advices and assistance during the preparation of this work. They are grateful also to Thomas Sobczyk (Hoyerswerda, Germany) for reviewing the early version of this manuscript and to Mojmir Lasan (Ljubljana, Slovenia), who kindly allowed the study of his collection.

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Received / Prejeto: 20. 4. 2014