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The description of *Leptochilus quintus* GUSENLEITNER, 1991, female, with further notes on its distribution and life cycle (Hymenoptera, Vespidae)

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A b s t r a c t : A female of *Leptochilus quintus* GUSENLEITNER, 1991 is described for the first time. The distribution areal is supplemented by new findings from Mosor and Dinara mountains in Southern Croatia, suggesting fragmented local populations, restricted to lower altitude mountainous environments, from 400-1000 m above sea level.

K e y w o r d s : *Leptochilus*, Eumeninae, Croatia.

Introduction

Leptochilus DE SAUSSURE, 1853 is a large Eumeninae genus with 215 known species, split into six subgenera (GBIF 2022). The European fauna is less diverse, with 33 known species (GUSENLEITNER 1993, 2003; SANZA et al. 2003; GBIF 2022), and representation of five out of six subgenera (GUSENLEITNER 1993). The European species can broadly be classified into four large groups based on their distribution; 3 species are distributed in nearly the entire Europe (except Scandinavian countries and the UK), 13 in Western and South-Western Europe, 8 in Eastern and South-Eastern, while additional nine species are endemic to various European islands (GUSENLEITNER 1993, 2003, SANZA et al. 2003, GBIF 2022).

A recent re-discovery of *L. quintus* GUSENLEITNER, 1991 male in Mosor mountain in Croatia (POLAŠEK 2022) is another example of diverse distribution patterns in this genus. The species was reported after 136 years of presumed extinction, previously known only by the holotype specimen collected in the Kvarner region in North-Western Croatia (GUSENLEITNER 1991, 1993). The examination of six males collected in 2021 suggested a substantial diversity in colour patterns and the pubescence length, which would have caused taxonomical problems and possible misclassification of a few specimens as a different species (POLAŠEK 2022). In addition, two males were genotyped, exhibiting a dissimilar sequence of the COI gene and suggesting the existence of a larger population in the region. Interestingly, despite the collection of multiple males, the study did not report the discovery of a female; therefore, the female of that species remained undescribed. Therefore, the aim of this study was to perform a systematic collection effort in the same and adjacent locations in an attempt to collect and describe a female of this species.

Material and methods

Following the discovery of males of this species in Mosor mountain of Southern Croatia, systematic fieldwork was undertaken the following season. The fieldwork was initiated in the same location where the species was rediscovered the year before. In addition, it encompassed several other locations in the same mountain, an area in the neighbouring Kozjak mountain and an area in the remote Dinara mountain, with the highest peak in Croatia. These three locations were planned to broadly correspond to the initial location regarding climate and vegetation, with a comprehensive collection coverage plan ranging from 200 to 1800 m above sea level. All specimens were collected by the hand net, and stored in collection Polašek, except three male-female pairs, which were subsequently deposited in the Biologiezentrum of the OÖ Landes-Kultur in Linz, Austria, the Natural History Museum, London, UK and the Hungarian Natural History Museum in Budapest, Hungary. Visualisations were made using the Leica s9i stereomicroscope, and photographs were made by the integrated digital camera. Photograph stacking was performed using Helicon Focus 6.8.0 (Kharkiv, Ukraine).

Results

Leptochilus (*Lionotulus*) *quintus* GUSENLEITNER, 1991

Material examined: CROATIA: Mosor mountain, Gornje Sitno, mountain path [43.516418, 16.617555; 623 m above sea level], 29.5.2022, leg. O. Polašek, 1♂, 2♀♀; Mosor mountain, Gornje Sitno, mountain path to the observatory [43.504880, 16.609562; 623 m asl], 6.6.2022, leg. O. Polašek, 1♂; Mosor mountain, Zagrade, the path near dried stream [43.525685, 16.597307; 616 m asl], 5.6.2022, leg. O. Polašek, 1♀; Kozjak mountain, Blaca, dirt road [43.525685, 16.597307; 418 m asl], 2.6.2022, leg. O. Polašek, 3♂♂, 3♀♀; Dinara mountain, mountain path [44.027356, 16.406618; 995m asl], 3.6.2022, leg. O. Polašek, 1♀.

Description:

Diagnosis: This species is characterized by the following combination of features: basally black body with whitish or yellow markings on tegula, T1 and T2, strong punctation of T2 and S2, T2 lamina with shorter interdigitations, evenly curved occipital carina and dark-brown tarsi in combination with brownish tibia that have yellow outer surface. Wing length: 4.1-4.3 mm (head+thorax+T1+T2 ~5.6-5.9 mm).

Colour: The ground colour is black with whitish markings (all markings become yellowish after drying; Figure 1a). Head frontally completely black (Figure 1b). Three examined specimens have smaller yellow bilateral spot on the pronotum (Figure 1a, 1c), while two specimens have an entirely black pronotum. Whitish markings include the lateral part of the tegula, a posterior band on T1 and T2, with an occasional spot or a short triangular remnant of a posterior band on S2 (Figure 1a; notably, all of these markings can also be yellowish in some specimens). Femora basally black, distally brown, and terminally yellow (Figure 1a). Tibia and tarsi brownish-red, but the external tibia surface is yellow (Figure 1a; in contrast to *L. crassipunctatus* (MAIDL, 1922), with orange-brown tibia and tarsi or *L. hermon* GUSENLEITNER, 1971 females, with blackish or black markings on all three tibia pairs). Wings dark-grey, nervature and stigma dark brown to black (Figure 1a), as opposed to brownish nervature and overall brownish wing colour in *L. crassipunctatus* (MAIDL, 1922). The antenna entirely black (Figure 1d), but a few terminal flagellomeres ventrally reddish in two specimens (in contrast to *L. hermon* GUSENLEITNER,

1971 females, which have most of the distal flagellomeres reddish ventrally).

Head: Head about 1.1x wider than long (Figure 1b). The interantennal distance about 2.4x of the socket-eye distance (Figure 1b). Clypeus 1.3x wider than long, with rounded basal margin and moderately projecting apex (Figure 1b). The apical excavation of the clypeus comparatively deeper and circular (Figure 1b). The central surface of the clypeus with intermediate-sized and coarse punctation, smaller and less coarse than in *L. crassipunctatus* (MAIDL, 1922). The lateral and basal margin of the clypeus covered by silvery pubescence, which is much sparser in the centre and the apex. The inner orbit and inter-antennal area covered by short and dense silvery pubescence, while the frons is covered by somewhat longer yellowish setae; those on the frons are about 0.7x of the anterior ocellus diameter (Figure 1a). The antennal scape is coarsely punctated, and covered by silvery pubescence, which is at most 0.5x of its basal width (Figure 1b). The frons and vertex, as well as gena and tempora densely and coarsely punctated. The occipital carina is evenly curved along the entire length, as opposed to an angular contour in *L. tarsatus* (DE SAUSSURE, 1855), *L. hermon* GUSENLEITNER, 1971 and *L. alpestris* (DE SAUSSURE, 1855).

Mesosoma The entire mesosoma is coarsely and densely punctated; punctation on the pronotum is larger than the inter-punctum surface, with occasional weak reticulation. The pronotal carina moderately developed, interrupted medially in some specimens, but laterally creates an almost the right angle in all examined specimens. Mesonotum about 1.1-1.2x wider than long, equally punctated, with somewhat denser punctation close to the scutellum. The mesonotal pubescence is slightly shorter (0.7-0.8x) than that on the frons. Mesopleura covered by a similar punctation, which becomes somewhat less dense towards the ventral part of the body. Scutellum covered by large and dense punctation, stronger and denser than in *L. tarsatus* (DE SAUSSURE, 1855). Metapleura horizontally striated, with punctation in the lateral half. Metanotum with the irregular apical margin, with nearly the entire surface punctated. The propodeal excavation without the superior carina, in contrast to *L. alpestris* (DE SAUSSURE, 1855), which has developed carina. In addition, the propodeal excavation is covered with weakly developed oblique striae and coarse and sparse punctation, which diminishes in size towards the valvula. The femora and tibia covered by the short silvery pubescence, the tarsal segments parallel-sided.

Metasoma: T1 comparatively wider, covered by the coarse punctation. T2 covered by large and coarse punctation, which becomes less coarse dorsally, but it remains visible even in the posterior whitish band of T2. The T2 lamella about as long as the T2 posterior whitish band width, yellow and translucent, with punctation interdigitations that do not reach the half of the lamella length, as opposed to *L. crassipunctatus* (MAIDL, 1922), which has longer interdigitations. S2 covered by a similar punctation to that on T2, which gradually becomes smaller, but equally spaced towards the S2 lamella. The S2 contour is similar to *L. hermon* GUSENLEITNER, 1971 and *L. crassipunctatus* (MAIDL, 1922) (Figure 1a); it is uneven, with a stronger convex beginning and a more flattened remaining surface, in contrast, the S2 contour is similarly convex during its entire length in *L. tarsatus* (DE SAUSSURE, 1855) and *L. alpestris* (DE SAUSSURE, 1855). The remaining metasomal segments with a cuticular surface and weakly defined punctation.

Further notes on males: The single examined male specimen from Dinara mountain does not show any structural difference from other examined specimens. It has a wide black margin of clypeus, with only a central part remaining yellow. However, this

specimen has a large bilateral yellow spot on the pronotum that occupies nearly the entire pronotum width. The absence of the translucent pronotal carina and short T2 lamella interdigitations suggests that this is not a misclassified *L. membranaceus* (MORAWITZ, 1867), while the leg colour and clypeus shape disagree with four examined *L. hermon* GUSENLEITNER, 1971 specimens from Greece. The remaining six examined male specimens from Mosor and Kozjak mountains have either black pronotum or only a small yellow round spot. Wing length: 3.6-3.8 mm (head+thorax+T1+T2 ~4.5-5.6 mm).

D i s t r i b u t i o n : Croatia. The species was originally described from the Kvarner region (GUSENLEITNER 1991), and later reported from Mosor mountain near Split (POLAŠEK 2022).

Discussion

The female of *L. quintus* GUSENLEITNER, 1991 is described for the first time and compared to a few similar species. Males can easily be separated from other *Leptochilus* species in Croatia by the entirely black clypeus, or at least a black border on yellow clypeus (POLAŠEK 2022).

The genus *Leptochilus* is one of the most speciose European Eumeninae genera. The life cycle is a possible explanation for such species diversity, compared to other similar body-sized genera, like *Stenodynerus* DE SAUSSURE, 1853. While specimens of *Stenodnerus* can commonly be collected on flowering plants at the height of 1.5 to 2 m , all of the freshly collected specimens of *L. quintus* were collected at very low elevations from the ground, either in resting on small stones or flying in the nearby vegetation, always within the 15 cm from the ground. All specimens were collected in only five micro-locations during the seasonal collection, which encompassed a careful examination of nearly 130 km of the mountain paths in the Mosor, Kozjak and Dinara mountains over two weeks. In addition, each location where the specimens were collected was at least 1.5 km away from the second, suggesting that this species exists in a metapopulation, consisting of multiple small and relatively isolated local populations. The main driver of such population structuring is the combination of geographical barriers between these sites and low mobility, reflected in both weak flying capacities and frequent collection of males and females in the same location (which, in conjunction with the lek type of behaviour in males suggest a territorial pattern of occurrence; POLAŠEK 2022). Furthermore, a similar pattern was also seen for several other species of the same genus, of patchy occurrence and a complete lack of any collected specimens in the long stretches of the examined mountain paths. All this suggests that the species of this genus experience substantial barriers and consequently have lower gene flow than other similarly-sized genera, which contributes to their speciation process.

There are further issues regarding the taxonomy of this genus in Europe. These include the need for a better understanding of relationships and morphological features among several Eastern and South European species, most notably the relationship in the *L. hermon* - *L. crassipunctatus* pair along their entire distribution range, or further understanding of the apparently allopatric relationship of *L. tarsatus* (DE SAUSSURE, 1855) and *L. mimulus* GUSENLEITNER, 1970 (ARENS 2012).

The biogeography of this genus is another focus for future studies. The most interesting regions in this regard are undoubtedly less accessible parts of the Balkans, where systematic Eumeninae research has been almost systematically neglected. The same may

be true for some of the Croatian Adriatic islands, although the degree of their isolation is probably insufficient for the existence of endemic species, such as those that were described in the Canary Islands, Crete or Sicily (GUSENLEITNER 1993). Therefore, a revision of the species occurring in South and Eastern Europe is needed to resolve these issues. Such a revision will require re-examining the types, including genetic analysis, and the provision of fresh specimens from hardly accessible areas, which might host additional small and restricted populations, retaining their isolation and experiencing ongoing speciation processes.

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Zusammenfassung

Ein Weibchen von *Leptochilus quintus* GUSENLEITNER, 1991 wird erstmals beschrieben. Das bekannte Verbreitungsgebiet wird durch neue Funde aus den Bergen Mosor und Dinara in Südkroatien erweitert, die auf fragmentierte lokale Populationen hindeuten, die auf bergige Umgebungen in niedrigeren Höhen zwischen 400 m und 1000 m beschränkt sind.

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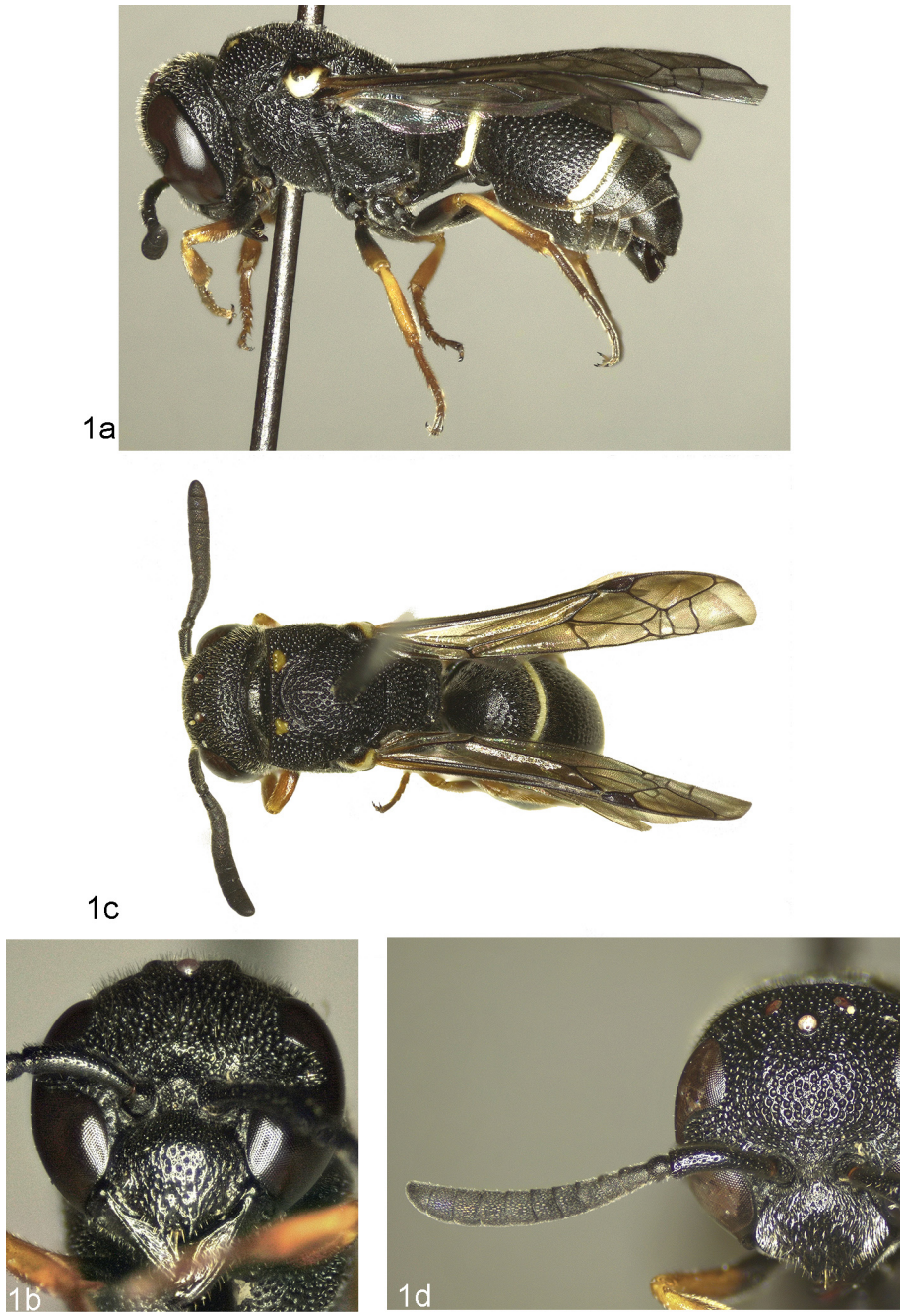

Fig. 1. *L. quintus* GUSENLEITNER, 1991 female, **a)** habitus, lateral, **b)** head, **c**) habitus, dorsal, **d**) antenna, dorsal.