



## A golden shadow in the mountains: A new *Stygioides* Bruand, 1853 (Lepidoptera: Cossidae) from Turkey

LASHA-GIORGI JAPARIDZE<sup>1\*</sup>, JARI JUNNILAINEN<sup>2</sup> & PASI SIHVONEN<sup>3</sup>

<sup>1</sup>Agricultural University of Georgia, Tbilisi, Georgia.

<sup>2</sup>Mahlapolku 3, 01730, Vantaa, Finland.

[junnilainen.jari@googlemail.com](mailto:junnilainen.jari@googlemail.com); <https://orcid.org/0009-0004-5000-4170>

<sup>3</sup>Finnish Museum of Natural History, University of Helsinki, Helsinki, Finland.

[pasi.sihvonen@helsinki.fi](mailto:pasi.sihvonen@helsinki.fi); <https://orcid.org/0000-0003-2237-9325>

\*Corresponding author: [lgjaparidze@gmail.com](mailto:lgjaparidze@gmail.com); <https://orcid.org/0000-0001-7171-5589>

### Abstract

A new species of the genus *Stygioides* Bruand, 1853 (Lepidoptera: Cossidae) is described from central Turkey. *Stygioides hecate* Japaridze & Junnilainen **sp. nov.** is based on material collected in the Sultan Dağları Mountains (Konya Province). The new species is characterised by its distinct wing coloration in females. Adults are diurnal, as in other members of the genus, and were collected by daytime netting. DNA barcode data (COI) are provided and compared with available sequences in the Barcode of Life Data Systems (BOLD Systems), supporting the distinctiveness of the new taxon. The discovery of this species increases the number of *Stygioides* species to 10 and those from Turkey to three, thus contributing to a better understanding of the diversity and distribution of the genus in the Palearctic realm.

**Key words:** carpenter moths, DNA barcoding, Heteroneura, Middle East

### Introduction

The genus *Stygioides* Bruand, 1853 comprises a rather small and poorly known group of diurnal moths within the family Cossidae Leach, 1815. To date, the genus includes only nine described species distributed across the Palearctic region (Mazzei & Yakovlev 2016; Japaridze *et al.* 2025a,b). Species are primarily found on xerothermic and open habitats of the Mediterranean basin, Western Asia, South Caucasus, and the western parts of Central Asia. However, despite this relatively wide geographic range, species of the genus are rarely represented in entomological collections (Mazzei & Yakovlev 2016).

The apparent scarcity of *Stygioides* specimens is largely attributable to their diurnal activity, small body size, and cryptic coloration, which together make adults difficult to detect during daylight hours. In contrast to mostly nocturnal carpenter moths (Cossidae), *Stygioides* species are not attracted to artificial light, further limiting their detectability using conventional collecting methods. However, recent studies have demonstrated that males of several species, *S. colchica* (Herrich-Schäffer, 1851), *S. ivinski* Saldaitis & Yakovlev, 2007, *S. nupponenorum* Yakovlev & Saldaitis, 2011, *S. persephone* (Reisser, 1962), and *S. jarii* Japaridze, Makharadze & Seropian, 2025, respond to synthetic sex pheromones, suggesting that pheromone trapping represents an effective approach for studying these elusive diurnal moths (Yakovlev 2011; Lingenhölle *et al.* 2017; Gorbunov & Efetov 2024; Japaridze *et al.* 2025b).

Despite the Cossidae fauna of Turkey being relatively well studied (Japaridze 2024) only two species of *Stygioides* are known from the country, *S. colchica* and *S. nupponenorum*, both of which were originally described from Turkish material.

The aim of the present study is to describe a hitherto unknown species, *Stygioides hecate* Japaridze & Junnilainen **sp. nov.**, and to provide a synthesis of the available taxonomic, distributional, and molecular data for this species. This contribution further improves our understanding of the diversity and distribution of *Stygioides* within the Palearctic realm.

## Material and methods

### *Sampling and specimen preparation*

All specimens were collected with a net sweep during daytime. Adult specimens, genitalia, and abdomens were prepared and photographed according to the methods summarized in Sihvonen *et al.* (2020). Uneverted vesica were photographed *in situ* during dissection to allow an optimal angle for observation and illustration. Photographs were edited in Adobe Photoshop v. CS6, and figures were compiled in CorelDRAW v. 24.

The following external characters were measured: wingspan (widest distance between forewing margins in spread specimens); forewing length (length of the costa from the base to the wing).

### *DNA processing*

Barcoding was performed within the Biodiversity Genomics Europe (BGE) project and sequencing was carried out in Naturalis Biodiversity Center (Leiden, Netherlands). The resulting sequences have been submitted to the Barcode of Life Data Systems (BOLD Systems) database (Ratnasingham & Hebert 2013). Newly obtained COI barcodes were compared against existing publicly available entries in the BOLD Systems database. Barcode Index Numbers (BINs) are provided for the sequenced taxa, along with their nearest neighbours in BOLD Systems (where available). Sequence differentiation was calculated using *p*-distance, as implemented in the BOLD Systems platform.

### *Stygioides hecate* Japaridze & Junnilainen sp. nov.

urn:lsid:zoobank.org:act:3B41E504-8AC8-4731-AC27-AE1B8E110D30

(Figs 1–3)

### Material examined

Type material. Holotype ♀ (1C–1D, 2F–2H, 3B): ‘TURKEY 7.5.1996 | Aksehir 30 km SW | Sultan Daglari | 1200–1500 m ♀ | K. Nupponen & | J. Junnilainen leg.’, <red label> ‘**HOLOTYPE** ♀ | *Stygioides hecate* | Japaridze & Junnilainen 2026. Paratype ♂ (1A–1B, 2A–2E, 3A): ‘TURKEY 20.5.1997 | Aksehir 30 km SW | Sultan Daglari 1200 m | K. Nupponen & | J. Junnilainen leg.’, <red label> ‘**PARATYPE** ♂ | *Stygioides hecate* | Japaridze & Junnilainen 2026’. Both specimens are in the collection of Jari Junnilainen (Vantaa, Finland), to be deposited in the Finnish Museum of Natural History (Helsinki, Finland).

### *Barcoding*

Two specimens, one holotype and one paratype, submitted to the barcoding (ProcessIDs BGE-MZH-LEP.1981, BGE-MZH-LEP.1991) yielded nearly identical sequences (BOLD:AHC7746, *p*-distance 0.91%). The closest taxon in the BOLD Systems is *S. italica* from Italy, Monte Pollino (BOLD:AEZ6676; mean *p*-distance 6.93%). The mean *p*-distance with *S. nupponenorum* (BOLD:AHC7747) is 8.62%.

### *Description*

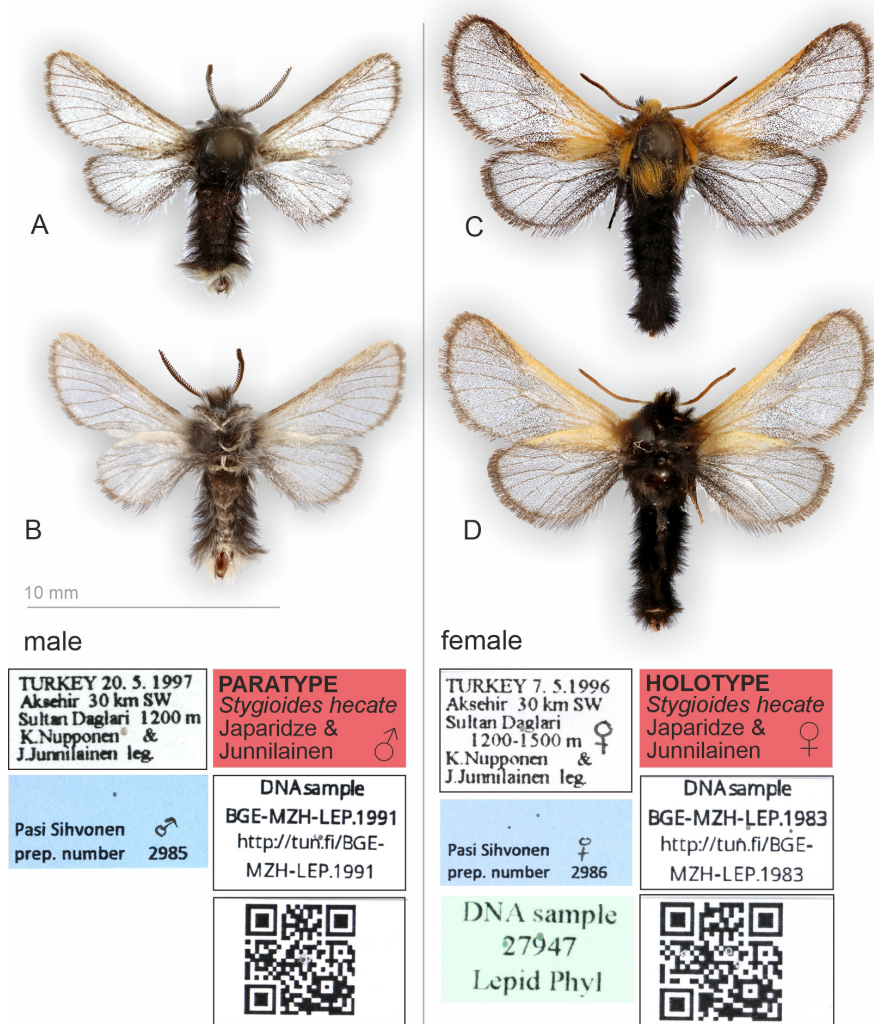
Male (Fig. 1A–1B). Wingspan 14 mm. Antennae half-length of forewing, covered with white scales, bipectinate; rami short and blackish brown. Head, tegula, thorax, and abdomen densely hirsute, pale grayish dorsally, black ventrally, last abdominal segment fully covered with white piliform scales. Forewing length 6 mm long, relatively short with rounded apex; semitranslucent; sparsely covered with grayish scales; costal margin denser covered with gray scales, semitranslucent, fringe brownish-black. Ivory-coloured spots pronounced on submedian and apical area of forewings and submedian area and anal margin of hindwings.

Female (Fig. 1C–1D). Wingspan 17 mm. Antennae slightly serrate, weakly ringed, orange-brown, lighter colour at base, gets darker towards tips, half-length of forewing. Head, tegula, and thorax densely hirsute golden-yellow

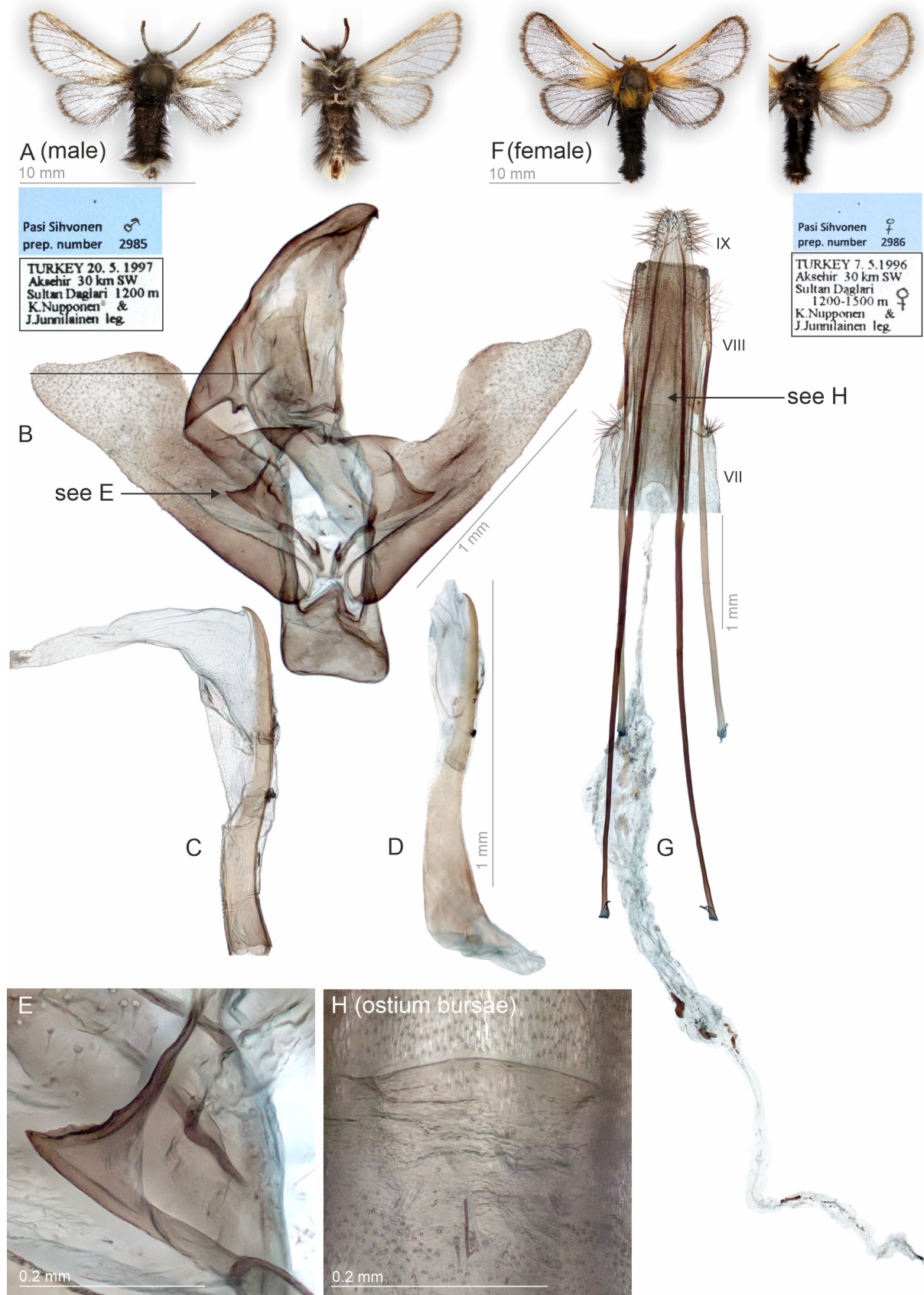
dorsally, black ventrally. Abdomen hirsute, black. Forewing length 7.5 mm long, relatively short with rounded apex; semitranslucent, sparsely covered with grayish-black scales; basal half golden-yellow. Fringes golden-yellow. Hindwings brownish black, semitranslucent. Fringes brownish black.

Male genitalia (Figs 2B–2E). Tegumen wide. Uncus triangular, sclerotized, with claw-like tip. Socii rounded, loosely covered with short setae. Gnathos weakly sclerotized, arms relatively short, fused medially. Valvae lanceolate, apex rounded, basal half of costal margin convex, dorsal margin 2/3 from base slightly concave. Ventral margin of valva tubular basally; basal sclerotisation of valva triangular, inner margin concave. Lateral juxta lobes sharp. Saccus well developed, rectangular, anterior margin strongly sclerotized, slightly concave. Aedeagus curved in basal 2/3, same length as valvae, vesica wide basally, opens to 90 degree angle, membranous, without cornutus.

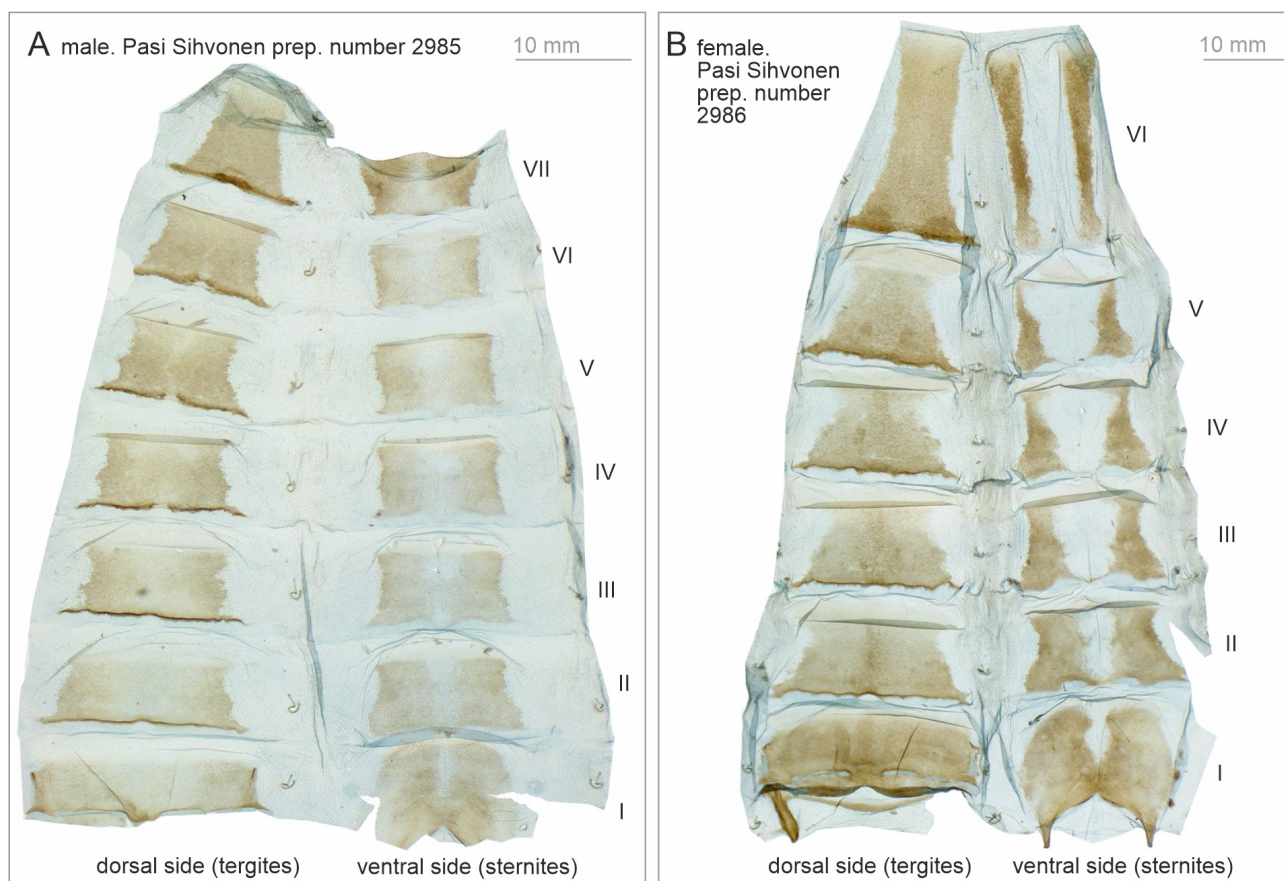
Female genitalia (Figs 2G–2H). Segments 6–9 elongated, telescopic. Papillae anales elongated, ellipsoid, setose. Both apophyses very long, apophyses posteriores 1.5 longer than apophyses anteriores. Lamella antevaginalis weakly sclerotized, margin evenly curved. Ostium bursae small, dorsal of lamella antevaginalis. Ductus bursae and corpus bursae membranous. Posterior part thin, middle part slightly expanded, anterior part thin. Point of origin of ductus seminalis not found.



**FIGURE 1.** Adults of *Stygioides hecate* Japaridze & Junnilainen **sp. nov.** A–B. Paratype male, dorsal and ventral view and associated labels. C–D. Holotype female, dorsal and ventral view and associated labels. Scale bar: 10 mm



**FIGURE 2.** Male and female genitalia of *Stygioides hecate* Japaridze & Junnilainen *sp. nov.* **A–E.** Paratype male. **A.** Adult. Scale bar: 10 mm. **B.** Male genitalia. Scale bar: 1 mm. **C.** Aedeagus with vesica everted. **D.** Aedeagus. Scale bar: 1 mm. **E.** basal sclerotisation of valva enlarged. Scale bar: 0.2 mm. **F–H.** Holotype female. **F.** Adult. Scale bar: 10 mm. **G.** Female genitalia. Scale bar: 1 mm. **H.** Ostium bursae enlarged. Scale bar: 0.2 mm.



**FIGURE 3.** Descaled abdominal skins of *Stygioides hecate* Japaridze & Junnilainen **sp. nov.** **A.** Paratype male. **B.** Holotype female. Scale bars: 10 mm.

## Diagnosis

Males of *S. hecate* Japaridze & Junnilainen **sp. nov.** differ from *S. nupponenorum* by the presence of a distinct white tip of the male abdomen and white scales on the antennae, the absence of brown piliform scales on the abdomen, a narrower apex of the valvae, and a shorter saccus (Figs 1A–1B, 2 C; cf. Lingenh le *et al.* 2016: fig. 6; Yakovlev 2011: fig. 35). Females are readily distinguished from all congeners by the presence of golden-yellow scales on the antennae, head, thorax and wings (Figs 1C–1D; cf. Lingenh le *et al.* 2017: figs 1–3, 9; Japaridze *et al.* 2025b: fig. 22).

## Distribution

The holotype and paratype of *S. hecate* Japaridze & Junnilainen **sp. nov.** originate from Aksehir, Turkey.

## Biology

Like its congeners, the imago of *S. hecate* Japaridze & Junnilainen **sp. nov.** is diurnal. All specimens were collected around midday using a net while resting on vegetation. The habitat was a xerothermic south-facing slope with calcareous soil, characterised by sparse low vegetation and scattered shrubs. No host plants or immature stages are known.

## Etymology

The species name is derived from Hecate, the ancient Greek goddess associated with the night and commonly depicted carrying yellow or golden torches. This name alludes to the coloration of the holotype female, which is predominantly black with yellow-golden scales on the wings, thorax, head, and antennae.

## Discussion

Species of *Stygioides* are frequently associated with mountain systems, which likely function as effective barriers to dispersal. When combined with short, diurnal flight periods and apparently limited dispersal capacity, particularly in females, because of their inability to fly long distances, these conditions are expected to promote population isolation and allopatric differentiation (Japaridze *et al.* 2025b). As a result, geographically localised distributions and regional endemism appear to be common within the genus, although broader ranges cannot be excluded without more intensive, targeted sampling.

The description of *Stygioides hecate* Japaridze & Junnilainen **sp. nov.** increases the number of recognised species in the genus to 10, and it represents the third species recorded from Turkey. Despite the recent extensive Cossidae studies in Turkey and adjacent territory (Yakovlev & Ströhle 2016; Japaridze & Hulsbosch 2023; Japaridze 2024; Japaridze *et al.* 2025a, b; Yakovlev *et al.* 2025; Saldaitis *et al.* 2025a,b), the discovery of a new species highlights the continued incompleteness of our knowledge of diurnal Cossidae, particularly those taxa that are inconspicuous and poorly represented in museum collections.

The molecular data obtained from COI barcodes provide additional support for the distinctiveness of *S. hecate* Japaridze & Junnilainen **sp. nov.** Comparisons with publicly available sequences in the BOLD Systems database reveal clear genetic separation from other sequenced *Stygioides* species, corroborating the morphological evidence. Although barcode coverage within the genus remains incomplete, the integration of molecular data represents an important step towards resolving species boundaries in this taxonomically challenging group.

At present, *S. hecate* Japaridze & Junnilainen **sp. nov.** is known only from the Sultan Dađlarý Mountains in central Turkey. This area forms part of a biogeographically complex region characterised by a mixture of Mediterranean, Anatolian, and Irano-Turanian zoogeographic elements, which has been shown to harbour a high level of endemism (Noroozi *et al.* 2019). The apparent localised occurrence of the new species may reflect genuine range restriction, but it is equally likely to result from insufficient targeted sampling. As demonstrated for other *Stygioides* species (Yakovlev 2010; Lingenh le *et al.* 2017; Gorbunov *et al.* 2024; Japaridze *et al.* 2025b), the use of synthetic sex pheromones may prove particularly effective for detecting additional populations and clarifying the true distribution of *S. hecate* Japaridze & Junnilainen **sp. nov.**

Information on the natural history of the new species remains limited. As with other congeners, adults are diurnal, but no data are currently available on larval host plants or early developmental stages. Focused field studies addressing larval ecology, phenology, and habitat specificity will be necessary to better understand the ecological requirements and conservation status of this and other *Stygioides* species.

In summary, the discovery of *S. hecate* Japaridze & Junnilainen **sp. nov.** emphasises the hidden diversity within *Stygioides* and underlines the importance of combining targeted collecting methods, detailed morphological study, and molecular data in the investigation of diurnal Cossidae. Continued research in Anatolia and adjacent regions is likely to reveal additional undescribed taxa and contribute to a more comprehensive understanding of the evolutionary history and biogeography of the genus.

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