



THE DIVERSITY OF SPHINGIDAE (INSECTA: LEPIDOPTERA) IN KORITNIKU MOUNTAIN, THE REPUBLIC OF KOSOVA

*Pajtim Bytyçi¹, Ferdije Zhushi-Etemi²,
Edona Kabashi-Kastrati³, Toni Koren⁴*

¹ ORCID 0000-0002-1521-3370

² ORCID 0000-0002-1627-2479

³ ORCID 0000-0001-5582-9471

⁴ ORCID 0000-0002-4776-6287

¹⁻³ Department of Biology, Faculty of Mathematics and Natural Sciences
University of Prishtina, Prishtina, Kosovo

¹Department of Agriculture and Environmental Engeneering,
UBT – Higher Education Institution, Kalabria, Kosovo

⁴ Association Hyla, Lipovac I no. 7, HR-10000 Zagreb, Croatia

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Abstract

Moths of the family Sphingidae are large and usually easily recognizable moths, that remain not sufficiently surveyed in some parts of Europe, including the Republic of Kosovo. From 2020 to 2022, Sphingidae diversity was surveyed in Kosovo's part of mountain Koritniku, near the border with Albania. The moths were collected with light traps in the period April-October in each year of the survey. In total 12 Sphingidae species were recorded, which compose about 30% of European fauna. Of those, 7 have been recorded in Kosovo for the first time: *Daphnis nerii* (Linnaeus, 1758), *Deilephila elpenor* (Linnaeus, 1758), *Hyles livornica* (Esper, 1780), *Acherontia atropos* (Linnaeus, 1758), *Laothoe populi* (Linnaeus, 1758), *Mimas tiliae* (Linnaeus, 1758) and *Smerinthus ocellata* (Linnaeus, 1758). The recorded number of Sphingidae species in our research is only a modest contribution to a better knowledge of the moth fauna of Kosovo, but still represents an update in comparison with historical records. Considering the number of species of this family in neighbouring countries, we can suppose that the number of recorded species is not a final one and further research is needed.

Introduction

Family Sphingidae Latreille, 1802 (hawk moths) is a moth family, represented by more than 1450 species in all continents, except Antarctica (VAN NIEUKERKEN et al. 2011). The number of species in Europe registered so far is 40 (KRPAČ et al. 2019, DE JONG et al. 2014).

Address: Ferdije Zhushi-Etemi, University of Prishtina, 10000 Prishtina, Kosovo, e-mail: ferdijezhushi2010@gmail.com

They are among the largest Lepidoptera, with a strong robust bodies, fast fliers, and with a long proboscis. A lot of species of hawk moths are very important pollinators. Long proboscis in many species enables them to feed with nectar in plants with long flowers, whereas the moths with shorter proboscises can't access the flowers' nectar (CALDAS and ROBINS 2003).

Most hawk moth species fly at night, with exception of a few species, like the genus *Hemaris*, that fly during the day (POWEL 2009).

The caterpillars of hawk moths are usually easily recognizable due to their large size and the curved horn on the eighth abdominal segment (LERAUT 2006). Many Sphingidae species are migratory and may occur far from their habitats, and can fly distances between the continents (LERAUT 2006).

This family has never been systematically studied in the Republic of Kosovo, and the existing records are mostly historical and few (REBEL and ZERNY 1931, VASIĆ et al. 1978, DOROVIĆ 1979, JAKŠIĆ 1986). Even some of the most common species have not been recorded in the country, indicating the need for additional surveys. Therefore, this research aimed to gain insight into the diversity of Sphingidae of Koritnik Mountain and Kosovo itself.

Material and Methods

Koritniku Mt. is located in the south of the Republic of Kosovo and stretches along the state border with Albania. The highest part of the mountain, above 1470 m, with an area of 818 ha, is designated as a strict nature-protected area. The reserve represents the area of high limestone mountains, characterized by special geomorphological and biodiversity values. The special feature of this mountain is the presence of the largest area (nearly 2000 ha) of Heldreich's pine forest (*Pinus heldreichii*) in the Balkans (REXHEPI 1994).

Moths were collected with a 6 W 12 V Portable Heath Moth Trap and a portable trap consisting of a single 20 W black light bulb, in the period April-October in each year of the survey 2020 and 2022. All the collected specimens were transported to the Laboratory of Zoology at the Department of Biology, FMNS, University of Prishtina. In the lab, specimens were fixed in entomological pins, labelled, and preserved. The taxonomy is based on PITTAWAY (1993).

This survey was done on two main localities. The given habitat types according to EUNIS, with geographic coordinates and altitude:

– Koritniku: Koritniku Mt., 835 m, Agriculturally improved, re-seeded, and heavily fertilized grassland, in an area of oak forest (*Quercus frainetto* woods 9280), 42°09'24" N, 20°39'21" E, light trap, obs. PB, Figure 1 and Figure 2;

– Koritniku: Koritniku Mt., 1245 m, Fagu's woodland (41.1 Beech forests), 42°04'52" N, 20°36'20" E, light trap, obs. PB, Figure 1 and Figure 3.

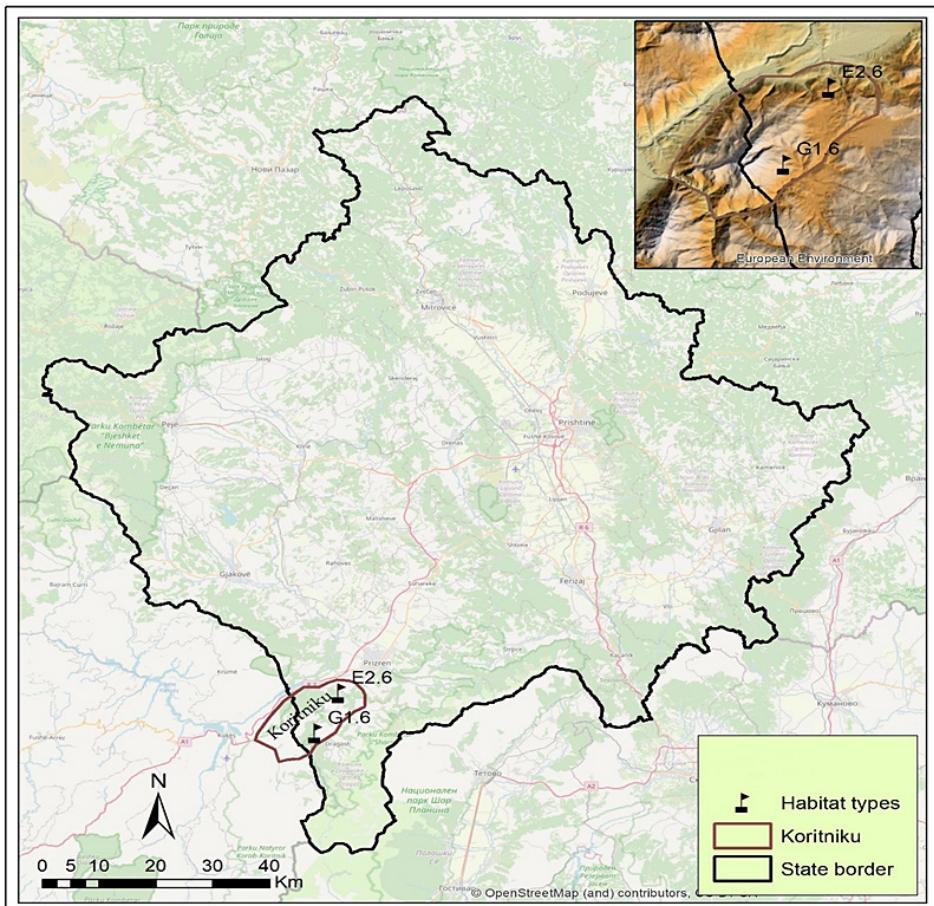


Fig. 1. The Map of Kosovo with the two surveyed localities on Mt. Koritniku



Fig. 2. The first habitat of the hawk-moths survey in Koritniku Mt.
Source: photo by Pajtim Bytyçi in Zhur, 10. June 2022



Fig. 3. The second habitat of the hawk-moths survey in Koritniku Mt.
Source: photo by Pajtim Bytyçi in Rapçë, 10. May 2022

Results and Discussion

Family Sphingidae

During this survey, a total of 76 Sphingidae specimens were collected at Mt. Koritniku. From them, 12 species were identified, six belonging to the subfamily Macroglossinae, four to the subfamily Smerinthinae and two species to Sphinginae. For each species, all the available literature records for Kosovo are presented, as well as their global distribution and comments.

The subfamily Macroglossinae

1. *Macroglossum stellatarum* (Linnaeus, 1758).

Global distribution. *Macroglossum stellatarum* (Linnaeus, 1758) is a common moth species found across the Holarctic region (CUADRADO 2017).

Distribution in the region. It is known from Albania (REBEL and ZERNY 1931), North Macedonia (REBEL and ZERNY 1931, DANIEL 1964, KRPAČ et al. 2019), Montenegro (REBEL and ZERNY 1931), Serbia (VASIĆ et al. 1978, HABIPROT 2022), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Croatia (KOREN 2018), Slovenia (CARNELUTTI 1992), Greece (FRITSCH et al. 2014), Romania (SZÉKELY 2010).

Literature records: Zhleb (Rebel & Zerny 1931).

New records: Koritnik, 26. July 2021.

2. *Daphnis nerii* (Linnaeus, 1758).

Global distribution. *Daphnis nerii* is a large hawk-moth found in wide areas of Africa and eastwards as far as Middle-East, and southern Europe where it ventures north, sometimes as far as Scandinavia and Finland, and also Ireland and England (GOATER 1974, LERAUT 2006). Extra-limital range – to south-east Asia and the Philippines; Hawaii, the islands of Saipan and Guam as well as Chichijima, Japan (*Daphnis nerii*. 2023).

Distribution in the region. It is known from Albania (REBEL and ZERNY 1931, BESHKOV and NAHIRNIĆ-BESKOVA 2021), North Macedonia (DANIEL 1964, KRPAČ et al. 2019), Serbia (VASIĆ et al. 1978, HABIPROT 2022), Croatia (KOREN 2020), Montenegro (REBEL and ZERNY 1931), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Slovenia (CARNELUTTI 1992), Greece (FRITSCH et al. 2014), Romania (SZÉKELY 2010).

New records. Koritnik, 19. June. 2021. No published records of this species in Kosovo were found, but some of the records from KRPAČ et al. (2019) may refer also to Kosovo.

3. *Hyles euphorbiae* (Linnaeus, 1758).

Global distribution. it is distributed from Europe to China, in Europe it is distributed from Spain to the Balkans (LERAUT 2006).

Distribution in the region. It is reported from Albania (REBEL and ZERNY 1931, BESHKOV and ABADJIEV 1996), Montenegro (REBEL and ZERNY 1931), North Macedonia (DANIEL 1964, KRPAČ et al. 2019), Serbia (VASIĆ et al. 1978, HABIPROT 2022), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Croatia (KOREN and LADAVAC 2013), Slovenia (CARNELUTTI 1992), Greece (WEÍDLICH 2016), Romania (SZÉKELY 2010).

New records: Koritnik, 27. May 2021.

Literature records: Novosellë (REBEL and ZERNY 1931).

4. *Hyles livornica* (Esper, 1780).

Global distribution. This species is found in Africa, and from Europe to India and Japan (LERAUT 2006).

Distribution in the region. It is reported from Albania (BESHKOV and ABADJIEV 1996), North Macedonia (DANIEL 1964, KRPAČ et al. 2019), Bulgaria HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Croatia (KOREN 2020), Greece (HASSELER et al. 1988, FRITSCH et al. 2014), Romania (SZÉKELY 2010).

New records: Koritnik, 05. August 2022.

Comments. New species for Kosovo. No published records of this species in Kosovo were found, but some of the data in research by KRPAČ et al. (2019) may refer also to Kosovo.

5. *Deilephila elpenor* (Linnaeus, 1758).

Global distribution. It is a species distributed throughout the Euro-asiatic distribution, not presented in N Africa, from Europe to Japan (BESTMANN et al. 1992, LERAUT 2006), it has also been found in Canada and the USA (northern Washington State (WARING 2017).

Distribution in the region. It is reported from Albania (BESHKOV et al. 1996), North Macedonia (DANIEL 1964, KRPAČ et al. 2019), Serbia (VASIĆ et al. 1978, HABIPROT 2022), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Croatia (KOREN 2018), Slovenia (CARNELUTTI 1992), Romania (SZÉKELY 2010).

New records: Koritnik, 26. April 2022, 18. May 2021.

Comments. New species for Kosovo. No published records of this species in Kosovo were found, but some of the data in research by KRPAČ et al. (2019) may refer also to Kosovo.

6. *Deilephila porcellus* (Linnaeus, 1758):

Global distribution. It is distributed from Europe to Central and Eastern Asia (Amurland) as well as North Africa (LERAUT 2006).

Distribution in the region. It is reported from Albania (EICHLER and FRIESE 1965, BESHKOV et al. 2020b), Serbia (VASIĆ et al. 1978, HABIPROT 2022), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Croatia (VIGNJEVIĆ et al. 2010, KOREN 2018), Slovenia (CARNELUTTI 1992), Romania (SZÉKELY 2010).

Literature records: Pejë (REBEL and ZERNY 1931).

New records: Koritniku, 20. May 2021.

The subfamily Sphinginae

1. *Agrius convolvuli* (Linnaeus, 1758).

Global distribution. It is distributed throughout Europe, Asia, Africa, Australi, Indonezia and New Zealand (LERAUT 2006, BUTLER 1879).

Distribution in the region. It is reported from Albania (REBEL and ZERNY 1931), North Macedonia (DANIEL 1964, KRPAČ et al. 2019), Serbia (VASIĆ et al. 1978, HABIPROT 2022), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Croatia (VIGNJEVIĆ et al. 2010), Slovenia (CARNELUTTI 1992), Greece (HASSLER et al. 1988), Romania (SZÉKELY 2010).

Literature records: Novosellë (REBEL and ZERNY 1931).

New records: Koritnik, 20. June 2020, Koritnik, 23. August 2021.

2. *Acherontia atropos* (Linnaeus, 1758).

Global distribution. This is an Afrotropical species distributed from Northern Africa, the Mediterranean regions of Europe (with migrating specimens found all across Europe) to the Middle East (to Iran, Turkmenistan and Kazakhstan) (PITTAWAY 1993).

Distribution in the region. It is reported from Albania (BESHKOV et al. 2020), North Macedonia (DANIEL 1964, KRPAČ et al. 2019), Serbia (VASIĆ et al. 1978, HABIPROT 2022), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Croatia (KOREN and LADAVAC 2013), Slovenia (CARNELUTTI 1992), Greece (HASSLER et al. 1988), Romania (SZÉKELY 2010).

New records: Koritnik, 28. May 2021.

Comments. New species for Kosovo. No published records of this species in Kosovo were found, but some of the data in research by KRPAČ et al. (2019) may refer also to Kosovo.

The subfamily Smerinthinae

1. *Marumba quercus* (Denis & Schiffermüller, 1775).

Global distribution. It is widespread and is found in southern Europe, the Middle East, North Africa, and Mesopotamia (PITTAWAY 2018).

Distribution in the region. It is reported from Albania (REBEL and ZERNY 1931), Montenegro (REBEL and ZERNY 1931), North Macedonia (DANIEL 1964, KRPAČ et al. 2019), Serbia (VASIĆ et al. 1978, HABIPROT 2022), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Croatia (KOREN 2020), Slovenia (CARNELUTTI 1992), Greece (HASSLER et al. 1988), Romania (SZÉKELY 2010).

New records: Koritnik, 10. May 2021.

Literature records: Biraç (DOROVIĆ 1979).

2. *Mimas tiliae* (Linnaeus, 1758).

Global distribution. This is a Euroasiatic species, distributed from Spain to Finland, Asia Minor, Iran and Mongolia and China to the East (DANNER et al. 1998, PÉREZ et al. 2009).

Distribution in the region. It is reported from Albania (BESHKOV et al. 2020), North Macedonia (DANIEL 1964, KRPAČ et al. 2019), Serbia (VASIĆ et al. 1978, HABIPROT 2022), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Croatia (VIGNJEVIĆ et al. 2010, KOREN 2018), Slovenia (CARNELUTTI 1992), Greece (KOUTSAFTIKIS 1970), Romania (SZÉKELY 2010).

New records: Koritnik, 26. June 2022.

Comments. New species for Kosovo. No published records of this species in Kosovo were found, but some of the data in research by KRPAČ et al. (2019) may refer also to Kosovo.

3. *Smerinthus ocellata* (Linnaeus, 1758).

Global distribution. Has spread throughout Europe (with the exception of much of Scandinavia and the Baltic Republics) (LERAUT 2006), it is also found in the east through Russia, and to eastern Kazakhstan and the Altai (DANNER et al. 1998), North Africa and Middle-East (LERAUT 2006).

Distribution in the region. Albania (BESHKOV et al. 2020a), North Macedonia (DANIEL 1964, KRPAČ et al. 2019), Serbia (VASIĆ et al. 1978,

HABIPROT 2022), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Slovenia (CARNELUTTI 1992), Croatia (VIGNJEVIĆ et al. 2010, KOREN 2018), Greece (HASSLER et al. 1988), Romania (SZEKELY 2010).

New records: Koritnik, 26. June 2022.

Comments. New species for Kosovo. No published records of this species in Kosovo were found, but some of the data in research by KRPAČ et al. (2019) may refer also to Kosovo.

4. *Laothoe populi* (Linnaeus, 1758):

Global distribution. It occurs throughout Europe to Central Asia (PITTAWAY 1993).

Distribution in the region. It is reported from Albania (EICHLER and FRIESE 1965), North Macedonia (DANIEL 1964, KRPAČ et al. 2019), Serbia (VASIĆ et al. 1978, HABIPROT 2022), Bulgaria (HRISTOVA and BESHKOV 2017), Bosnia and Herzegovina (LELO 2004), Croatia (VIGNJEVIĆ et al. 2010, KOREN 2018), Slovenia (CARNELUTTI 1992), Greece (FRITSCH et al. 2014), Romania (SZÉKELY 2010).

New records: Koritnik, 26. June 2022.

Comments. New species for Kosovo. No published records of this species in Kosovo were found, but some of the data in research by KRPAČ et al. (2019) may refer also to Kosovo.

During our survey, 12 Sphingidae species have been recorded on Mt. Koritnik, and of those seven have been recorded in Kosovo for the first time. Before our survey, only seventh species were reported: *Macroglossum stellatarum* (Linnaeus, 1758), *Hyles euphorbiae* (Linnaeus, 1758), *Deilephila porcellus* (Linnaeus, 1758), *Agrius convolvuli* (Linnaeus, 1758), *Marumba quercus* (Denis & Schiffermüller, 1775), *Hemaris tityus* (Linnaeus, 1758), and *Hyles vespertilio* (Esper, 1780) (REBEL 1913, REBEL and ZERNY 1931, DOROVIĆ 1979, JAKŠIĆ 1986). Based on our results and literature data, 14 species of Sphingidae moths are recorded in Kosovo so far, however considering the data from the neighbouring countries, this number will for sure increase with additional surveys in the region.

Regarding the number of Sphingidae species in other countries in the Balkans and region, 20 species are known from Albania (REBEL 1913, REBEL and ZERNY 1931, BESHKOV and ABADJIEV 1996, BESHKOV et al. 1996, BESHKOV 1998, BESHKOV and NAHIRNIĆ 2019a, 2019b, BESHKOV et al. 2020a, 2020b), 25 species are registered in North Macedonia (KRPAČ et al. 2019), 20 species in Serbia (VASIĆ 1978, KOREN 2022), 20 in Bosnia and Herzegovina (LELO 2004, KOREN 2022), 21 species are

recorded in Slovenia (CARNELUTTI 1992), 22 in Croatia (KOREN 2018, 2020, KOREN et al. 2022), and 26 species in Bulgaria (HRISTOVA and BESHKOV 2017).

With additional surveys, 9 species can be expected in Kosovo: *Sphinx ligustri* (L.), *Hyloicus pinastri* (Linnaeus, 1758), *Hemaris fuciformis* (Linnaeus, 1758), *Hemaris croatica* (Esper, 1800), *Proserpinus proserpina* (Pallas, 1772), *Rethera komarovi* (Christoph, 1885), *Hyles nicea* (de Prunner 1798), *Hyles gallii* (Rottemburg, 1780), *Hippotion celerio* (Linnaeus, 1758).

We can conclude that our research contributed to the expansion of the list of moth species in Kosovo with additional seven species from this research. It should be noted that though most of these species are common in the Balkans, due to the lack of surveys they were not recorded earlier.

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