DIVERSITY OF BURNET MOTHS
(LEPIDOPTERA: ZYGAENIDAE) ON
MOUNTAIN KORITNIK, KOSOVO

Pajtim Bytyçi1,2, Ferdije Zhushi-Etemi1*, Edona Kabashi-Kastrati1,
Hazir Çadraku2 & Toni Koren3

1Department of Biology, Faculty of Mathematics and Natural Sciences, University of Prishtina,
George Bush, nr.5, Prishtina10000, Kosovo (e-mail: pajtim.bytyqi@hotmail.com, ferdije.zhushi@uni-pr.edu, edona_edona@hotmail.com)
2UBT - Higher Education Institution, Kalabria, street Rexhep Krasniqi Nr. 56, Prishtina, 10000, Kosovo (e-mail: hazir.cadraku@ubt-uni.net)
3Association Hyla, I. Lipovac 7, HR-10000 Zagreb, Croatia (e-mail: koren.toni1@gmail.com)


The aim of this paper is to present the first data on the diversity of the moth family Zygaenidae, on Koritnik Mountain in Kosovo. Although this mountain is a biodiversity hotspot, no study of Zygaenidae has ever been conducted. During our survey in 2021 and 2022, in ten localities, 11 Zygaenid species were recorded. Among them Jordanita notata (Zeller, 1847) is reported for the first time for Kosovo.

Key words: burnet moths, forester moths, distribution, Jordanita notata

INTRODUCTION

Representatives of the family Zygaenidae Latreille, 1809, are day-flying moths, which are known as burnets (subfamily Zygaeninae) and foresters (subfamily Procridinae). In most of the Balkan countries, the general distribution of the zygaenid moths is well studied: Albania (Nahirnić & Beshkov, 2018; Vrenoz et al., 2019; 2020), North Macedonia (Micevski et al., 2018; Nahirnić & Beshkov, 2018; Nahirnić-Beshkova et al., 2021); Montenegro (Jakšić et al., 2019; Jakšić & Nahirnić-Beshkova, 2020); Serbia (Jakšić, 2016); Croatia (Razov et al., 2017; Koren, 2021). As for the Republic of Kosovo, the data are
still incomplete and most records date from the beginning of the 20th century (Rebel, 1917; Rebel & Zerny, 1931); more recent data are very scarce (Jakšić, 1986; 2006).

Zygaenidae are excellent indicators of environmental changes (Nahirnić et al., 2019) and show biological similarities with butterflies which are also good indicators of biodiversity in Europe (van Swaay et al., 2013; Nahirnić et al., 2019). Zygaenidae react very quickly to the presence of chemical substances (pesticides) and soon disappear from contaminated habitats (Tarmann, 2009; Nahirnić et al., 2019). Accordingly, they can be used as a good model organism to establish a biodiversity baseline for an area that can be compared to future states.

The aim of this study is to present the first results on Zygaenidae studies on Mt Koritnik and to contribute to a better knowledge of moth diversity in Kosovo.

Mt Koritnik is located in the south of 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 a strict nature protection area. The reserve is a high limestone mountain area, 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.

MATERIAL AND METHODS

The material for this study was collected during June, July and August in 2021 and 2022, in different habitats on Mt Koritnik (Tab. 1). The collected and preserved specimens were identified at the National Museum of Natural History in Sophia in Bulgaria and at the Department of Biology of the Faculty of Natural Science, University of Pristina.

For each specimen, the genitals were isolated by being boiled in 10% KOH solution, after which the excess organic material was removed and stored in genital micro vials that were pinned to the specimen they originated from. The identification of the specimens was based on Naumann et al. (1999).

Tab. 1. Studied localities, habitat types, geographic coordinates and altitudes.

<table>
<thead>
<tr>
<th>Nr</th>
<th>Locality- EU NATURA 2000</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Altitude (m a.s.l.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Zhur 1. Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia)</td>
<td>N 42°10’05” E 20°38’49”</td>
<td>585</td>
<td></td>
</tr>
<tr>
<td>S2</td>
<td>Zhur 2. Agriculturally improved, re-seeded and heavily fertilized grassland, in area of oak forest (Quercus frainetto woods)</td>
<td>N 42°09’24” E 20°39’21”</td>
<td>835</td>
<td></td>
</tr>
<tr>
<td>S3</td>
<td>Brezne 1. Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia)</td>
<td>N 42°08’08” E 20°38’54”</td>
<td>949</td>
<td></td>
</tr>
<tr>
<td>S4</td>
<td>Brezne 2. Quercus frainetto woods</td>
<td>N 42°08’19” E 20°37’41”</td>
<td>1167</td>
<td></td>
</tr>
<tr>
<td>S5</td>
<td>Brezne 3. Dry grasslands</td>
<td>N 42°07’41” E 20°36’49”</td>
<td>1395</td>
<td></td>
</tr>
<tr>
<td>S6</td>
<td>Rapče. Temperate thickets and scrub (Juniperus communis formations on heaths or calcareous grasslands)</td>
<td>N 42°04’52” E 20°36’20”</td>
<td>1245</td>
<td></td>
</tr>
<tr>
<td>S7</td>
<td>Fagus woodland and Beech forests near the water springs</td>
<td>N 42°04’52” E 20°36’20”</td>
<td>1245</td>
<td></td>
</tr>
<tr>
<td>Nr</td>
<td>Locality- EU NATURA 2000</td>
<td>Latitude</td>
<td>Longitude</td>
<td>Altitude (m a.s.l.)</td>
</tr>
<tr>
<td>----</td>
<td>----------------------------------------------------------------------------------------</td>
<td>------------</td>
<td>-------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>S8</td>
<td>Subalpine Mediterranean Pinus woodland and High oro-Mediterranean pine forests)</td>
<td>N 42°5’8”</td>
<td>E 20°35’36”</td>
<td>1624</td>
</tr>
<tr>
<td>S9</td>
<td>Recently felled areas (Epilobium angustifolium (L.) Scop) &amp; Salix caprea L.)</td>
<td>N 42°4’52”</td>
<td>E 20°35’24”</td>
<td>1720</td>
</tr>
<tr>
<td>S10</td>
<td>Recently felled areas (Epilobium angustifolium (L.) Scop) &amp; Salix caprea L.)</td>
<td>N 42°4’55”</td>
<td>E 20°35’3”</td>
<td>1866</td>
</tr>
</tbody>
</table>

Fig. 1. Records of Zygaenidae in Kosovo from literature (black dots) and records from our study (red dots).

RESULTS

During our research 11 Zygaenidae species were recorded, among them five Procridinae and six Zygaeninae. Procridinae were represented by 2 species of the genus *Adscita* and three species of the genus *Jordanita*, whereas Zygaeninae were represented with 6 species of the genus *Zygaena*. For each species, the locality number and dates of observations are given.

The systematics of Zygaenidae in this publication follows the last revisions of the group (Efetov, 2001; Efetov et al., 2022; Hofmann & Tremewan, 2017):

**Subfamily Procridinae**

**Genus Adscita** Retzius, 1783

**Subgenus Adscita** Retzius, 1783

*Adscita (Adscita) geryon* (Hübner, 1813)
Fig. 2. Surveyed localities on Mt. Koritnik. S1) Zhur 1. Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia), 28.08.2022 (Photo by F. Millaku); S2) Zhur 2. Agriculturally improved, re-seeded and heavily fertilized grassland, in area of oak forest (Quercus frainetto woods, 28.06.2022 (Photo by F. Millaku); S3) Brezne 1. Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia), 30.06.2022 (Photo by F. Millaku); S4) Brezne 2. Quercus frainetto woods, 30.06.2022 (Photo by F. Millaku); S6) Rapçe, Temperate thickets and scrub (Juniperus communis formations on heaths or calcareous grasslands), 30.06.2022 (Photo by F. Millaku); S7) Fagus woodland and Beech forests near the water spring, 30.06.2022 (Photo by F. Millaku); S9) and S10) Recently felled areas (Epilobium angustifolium (L.) Scop) & Salix caprea L.), 30.06.2022 (Photo by F. Millaku).
Subgenus *Tarmannita* Efetov, 2000
*Adscita* (*Tarmannita*) *mannii* (Lederer, 1853)

Genus *Jordanita* Verity, 1946
Subgenus *Roccia* Alberti, 1954
*Jordanita* (*Roccia*) *budensis* (Speyer & Speyer, 1858)
Subgenus *Tremewania* Efetov & Tarmann, 1999
*Jordanita* (*Tremewania*) *notata* (Zeller, 1847)
Subgenus *Solaniterna* Efetov, 2004
*Jordanita* (*Solaniterna*) *subsolana* (Staudinger, 1862)

Subfamily Zygaeninae
Genus *Zygaena* Fabricius, 1775
Subgenus *Mesembrynus* Hübner, 1819
*Zygaena* (*Mesembrynus*) *purpuralis* (Brünnich, 1763)
Subgenus *Agrumenia* Hübner, 1819
*Zygaena* (*Agrumenia*) *carniolica* (Scopoli, 1763)
*Zygaena* (*Agrumenia*) *loti* ([Denis & Schiffermüller], 1775)
Subgenus *Zygaena* Fabricius, 1775
*Zygaena* (*Zygaena*) *ephialtes* (Linnaeus, 1767)
*Zygaena* (*Zygaena*) *filipendulae* (Linnaeus, 1758)
*Zygaena* (*Zygaena*) *lionicerae* (Scheven, 1777)

Procridinae


Zygaeninae

This work significantly contributes to knowledge of the Zygaenidae diversity of Mt Koritnik and represents the first recent study of this family in Kosovo. From the 11 recorded species, several of them can be considered rare or interesting records for Kosovo.

*Adscita geryon* (Hübner, 1813) is a species distributed from southern and central Europe, the Iberian Peninsula to southern Russia, Crimea and north-western Turkey and England (*Naumann et al.*, 1999). According to historical data, it was recorded on Mt Koritnik and Mt Pashtrik (*Rebel & Zerny*, 1931). The present record is the first in Kosovo in the last 90 years. It is also present in the other countries in the region: Albania (*Rebel & Zerny*, 1931), North Macedonia (*Rebel & Zerny*, 1931), Montenegro (*Rebel & Zerny*, 1931), Serbia (*Nahirnić et al.*, 2012) and Croatia (*Šašić et al.*, 2016; *Koren*, 2021).
Adscita mannii (Lederer, 1853) is a species distributed from Spain, France across southern parts of central Europe, Italy, to the Balkans, Greece and Turkey (Naumann et al., 1999). So far in Kosovo it was recorded in Pashtrik, Zhleb (Rebel & Zerny, 1931), and in Brezovica in Sharr Mountain (Jakšić, 2006). It is a rather common species, present in all the surrounding countries: Albania (Rebel & Zerny, 1931), North Macedonia (Rebel & Zerny, 1931), Montenegro (Rebel & Zerny, 1931), Serbia (Nahirnić et al., 2012), Croatia (Koren, 2021).

Fig. 4. Male genitalia of Adscita mannii, recorded on Koritnik on 10.vi.2021; 28.V.2021, 16.vi.2022

Jordanita budensis (Speyer & Speyer, 1858) has a very fragmented distribution, with isolated populations occurring in central Spain, southern France, Italy, Balkans, eastern Austria, Slovakia, Hungary, southern Russia, Caucasus, Transcaucasia and further East to eastern Asia (Amur, Mongolia) (Naumann et al., 1999). This species was earlier recorded only at two localities in Kosovo, Mt Pashtrik (Rebel & Zerny, 1931), and in Sharri (Jakšić, 2006). It is considered a rare species. In the region it is present in North Macedonia (Rebel & Zerny, 1931), Bulgaria (Nahirnić et al., 2021). The historical record from Croatia (Mladinov, 1958) has not been confirmed in recent studies (Koren, 2021).

Jordanita notata (Zeller, 1847) this species is distributed across western and central Europe, through the northern part of the Mediterranean region, up to Turkey and Transcaucasia (Naumann et al., 1999). In the region it has somewhat limited distributions in Croatia (Koren, 2021), Montenegro (Jakšić & Nahirnić-Beshkova, 2020), Albania (Vrenozi et al., 2020), and Serbia (Nahirnić et al., 2012). This is the first record of
Jordanita notata in Kosovo. It prefers semi-dry habitats and habitats with dry grass (Jakšić et al., 2019) which are common in Kosovo, so further records are to be expected.

Jordanita subsolana (Staudinger, 1862), is distributed from southern Spain through the southern part of central Europe, Italy, the Balkan Peninsula and Greece to southern Russia and Ukraine, Turkey and Transcaucasia up to the Altai (Naumann et al., 1999). Earlier this species was recorded at several localities in Kosovo: Mt Pashtrik (Rebel & Zerny, 1931), Rugova George, Milishevc, Bistricë e Deçanit, Prishtinë-Gërmi (Jakšić, 2006). In Kosovo this species inhabits grasslands and dry pastures, as recorded, as recorded in other research papers (Koren, 2021; Naumann et al., 1999). This species is also distributed in the other countries in the region: Albania (Rebel & Zerny, 1931), North Macedonia (Rebel & Zerny, 1931), Serbia (Jakšić, 2003; 2006; Nahirnić et al., 2012), Croatia (Šašić et al., 2016; Koren, 2021).

Zygaena purpuralis (Brünnich, 1763) inhabits a wide range of habitats at an altitude up to 2000 m. It is distributed from the Pyrenees, the British Isles, through central and
southern Europe to Asia Minor, the Caucasus and southern Russia (Naumann et al., 1999). In Kosovo it was previously recorded in a few localities in Zhleb (Rebel & Zerny, 1931), while in the publications from Jakšić (Jakšić, 2006), it is stated that this species was recorded in Sharr and in Kopaonik.

This species is also distributed in other countries in the region: Albania (Rebel & Zerny, 1931; Vrenozi et al., 2020), North Macedonia (Rebel & Zerny, 1931), Montenegro (Rebel & Zerny, 1931; Jakšić & Nahirnić, 2020), Serbia (Nahirnić et al., 2012), Croatia (Šašić et al., 2016), and Bulgaria (Nahirnić et al., 2021).

*Zygaena carniolica* (Scopoli, 1763), is a common species in the Balkan Peninsula (Nahirnić et al., 2012), and inhabits limestone habitats (Naumann et al., 1999). It is distributed in Europe, in north, south and central Spain, in Asia Minor and in Transcaucasia (Naumann et al., 1999). In Kosovo this species was previously registered on Pashtrik (Rebel & Zerny, 1931), as well as in Mokna, Rugova George, Gërmi, Brezovicë and in Bistrica e Prizrenit (Jakšić, 2006).

This species is also distributed in other countries in the region: Albania (1931), North Macedonia (Rebel & Zerny, 1931), Montenegro (Rebel & Zerny, 1931; Jakšić & Nahirnić, 2020), Serbia (Nahirnić et al., 2012) and Croatia (Šašić et al., 2016).

*Zygaena loti* (Denis & Schiffermüller, 1775) is a common species in the Balkan Peninsula (Nahirnić et al., 2012). The distribution ranges from Spain in the Iberian Peninsula (locally and only in the north) across central and southern Europe to Siberia (Naumann et al., 1999). In Kosovo this species is recorded on Pashtrik, Zhleb and Çakor (Rebel & Zerny, 1931) as well as in Rugova Gorge, on Milishevc, in Brezovicë and Gërmi (Jakšić, 2006). In the region it is known from Albania (Rebel & Zerny, 1931; Vrenozi et al., 2020), North Macedonia (Rebel & Zerny, 1931), Montenegro (Jakšić & Nahirnić, 2022), Serbia (Nahirnić et al., 2012), Croatia (Šašić et al., 2016), Bulgaria (Nahirnić et al., 2021).

*Zygaena ephialtes* (Linnaeus, 1767) is distributed from the western and northern Spain to central and southern Europe to the Urals and to Anatolia (Naumann et al., 1999). According to the data from literature, this species is earlier recorded from Rugova...
Gorge, Milishev, Bistrica e Prizrenit Gorge, in several localities on Sharr Mountain as well as in Gërmi (Jakšić, 2006).

This species is also distributed in the other countries in the region: Albania (Rebel & Zerny, 1931), North Macedonia (Rebel & Zerny, 1931), Montenegro (Rebel & Zerny, 1931), Serbia (Nahirnić et al., 2012), and Croatia (Šašić et al., 2016).

**Zygaena filipendulae** is a common species throughout Europe, excluding the Atlantic coast of the Iberian Peninsula, northern Scandinavia and the Great Russian North (Naumann et al., 1999). It is also present in Turkey, the Caucasus to Syria and Lebanon (Naumann et al., 1999). This species is recorded for the first time in Kosovo from Pashtrik and Zhleb (Rebel & Zerny, 1931), whereas later on it was recorded by Jakšić (2006) in Bjeshket e Nemuna at the localities Milishev and Rugova Gorge (Jakšić, 2006). This species is also distributed in the other countries in the region: Albania (Rebel & Zerny, 1931; Vrenozi et al., 2020), North Macedonia (Rebel & Zerny, 1931), Montenegro (Rebel & Zerny, 1931), Serbia (Nahirnić et al., 2012), Croatia (Šašić et al., 2016), and Bulgaria (Nahirnić et al., 2021).

**Zygaena lonicerae** (Scheven, 1777) is distributed across Ireland and Fennoscandia, to western China up to central and northern Spain through southern Europe to Turkey and the Caucasus (Naumann et al., 1999). It is a common species that was earlier recorded at several localities in Kosovo; Vermosh Pejë (Rebel & Zerny, 1931), as well as Milishev, Rugova Gorge, Zhleb, Prishtinë and on Mt Sharri (Jakšić, 2006). This species is also distributed in the other countries in the region: Montenegro (Jakšić & Nahirnić, 2020), Albania (Rebel & Zerny, 1931; Nahirnić & Beshkov, 2018), North Macedonia (Rebel & Zerny, 1931; Nahirnić & Beshkov, 2018), Serbia (Nahirnić et al., 2012), Croatia (Mladinov, 1976; Šašić et al., 2016).

In respect to the Zygaenidae diversity of Kosovo, 17 species were known prior to this survey (Rebel, 1917; Rebel & Zerny, 1931; Jakšić, 2006) and now, with the first record of Jordanita notata, the number has increased to 18. From those, eight species were not recorded during this survey: Jordanita chloros (Hübner, 1813), J. globulariae (Hübner, 1793), Adscita albana (Naufock, 1926), A. statices (Linnaeus, 1758), Zygaena transalpina (Esper, 1780), Z. osterodensis (Reiss, 1921), and Z. exulans (Reiner & Hohenwarth, 1792). Some of them could also be expected on Mt. Koritnik with additional surveys in the parts of the mountain that were not included in this research.

If we compare the Zygaenidae diversity of Kosovo with that of other states in the region, 17 species are known in Albania and North Macedonia (Nahirnić & Beshkov, 2018), 23 in Serbia (Nahirnić et al., 2012) and 24 in Croatia (Šašić et al., 2016). Accordingly, we can expect the number of species in Kosovo to increase with additional surveys.

**ACKNOWLEDGEMENT**

We would like to express our gratitude to the Associate Professor Dr. Stoyan Beshkov from the National Museum of Natural History in Sofia, Bulgaria for his help with expertise and literature during the species identification.

We are also grateful to Professor Dr. Fadil Millaku, University of Prishtina, for his help during the identification of the plant associations in the surveyed area, as well as for taking the pictures of the habitats.

Received October 14, 2022
REFERENCES


Vrenojić, B., Toshova, T. B., Efetov, K.A., Kucherenko, E.E., Reddi, A. & Tarmann, G.M., 2019: The first well-documented record of the vine bud moth Theresimima ampellophaga (Bayle-Barelle, 1808) in Al-
bynia established by field screening of sex pheromone and sex attractant traps (Lepidoptera: Zygaenidae, Procridinae). SHILAP Revista de lepidopterologia, 47(187), P. 567-576.


SUMMARY

Diversity of burnet moths (Lepidoptera: Zygaenidae) on Mountain Koritnik, Kosovo


Representatives of the family Zygaenidae Latreille, 1809, are day-flying moths, which are known as burnets and foresters. The data for the diversity of this moth family for Republic of Kosovo are still scarce and incomplete. Most records of Zygaenidae in Kosovo date from the beginning of the 20th century (Rebel, 1917; Rebel & Zerny, 1931), whereas the latest data are these from Jakšić (1986; 2006).

In this paper we presented the first data on diversity of the moth family Zygaenidae in the Koritnik Mountain in Kosovo. The survey was conducted during the period June–August in 2021 and 2022, in ten localities. Moths were collected during the day, with entomological net. Collected and preserved specimens were identified at the National Museum of Natural History in Sophia in Bulgaria and at the Department of Biology at the Faculty of Natural Science, University of Prishtina. Identifications were based on Naumann et al. (1999).

During our research 11 Zygaenid species were recorded, among them five Procridinae and six Zygaeninae.

The Procridinae species: Adscita geryon (Hübner, 1813); A. mannii (Lederer, 1853); Jordanita budensis (Speyer & Speyer, 1858); J. notata (Zeller, 1847) – new record for Republic of Kosovo; J. subsolana (Staudinger, 1862).

Zygaeninae species: Zygaena purpuralis (Brünnich, 1763); Z. carniolica (Scopoli, 1763); Z. loti (Denis & Schiffermüller, 1775); Z. ephialtes (Linnaeus, 1767); Z. filipendulae (Linnaeus, 1758); and Z. loniceræ (Scheven, 1777).

Together with Jordanita notata (Zeller, 1847), the new species recorded in our research, and 17 species known prior to this survey (Rebel, 1917; Rebel & Zerny, 1931; Jakšić, 2006) the number of burnet moths in Kosovo came to 18. Seven species that were recorded earlier in other areas in Kosovo were missing in our survey. Some of them could also be expected in Mt. Koritnik with additional surveys in the parts of the mountain that were not included in this research.