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Further notes on Zygaenidae (Lepidoptera) from Montenegro

Original Article

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Abstract:

Faunistic data on 11 species of Zygaenidae from seven pre-selected research areas in Montenegro obtained during several trips in the year 2017 are presented. Photographs of adults of *Jordanita notata, Zygaena punctum, Z. viciae, Z. ephialtes* and *Z. filipendulae* are shown. Interspecific mating attempts by males of *Z. filipendulae* with females of *Z. ephialtes* and *Z. viciae* are discussed.

Key words:

Zygaenidae, interspecific mating, Montenegro

Apstract:

Novi podaci o ziganidama (Insecta, Zygaenidae) Crne Gore

Predstavljeni su faunistički podaci o 11 vrsta Zygaenidae iz sedam prethodno odabranih i istraženih područja u Crnoj Gori, dobijeni tokom više obilazaka terena 2017. godine. Prikazane su fotografije adulta vrsta *Jordanita notate, Zygaena punctum, Z. viciae, Z. ephialtes* i *Z. filipendulae*. Diskutovani su pokušaji interspecijskog parenja mužjaka *Z. filipendulae* sa ženkama *Z. ephialtes* i *Z. viciae*.

Ključne reči:

Zygaenidae, interspecijsko parenje, Crna Gora

Introduction

As Montenegro intends to become a member of the EU, data about regional species distributions are of great importance, specifically as regards Annex II species of the Habitats Directive. On the other hand, species of the lepidopterous family Zygaenidae are excellent indicators of environmental conditions. During the last decades more than 300 papers were published dealing with the moths and butterflies of Montenegro (Jakšić & Nahirnić, 2017). According to Nahirnić & Tarmann (2014) there are about 30 publications known which contain data about Zygaenidae for Montenegro.

In 2017 & 2018 the first author had the opportunity to participate in the IPA Project 'Establishment of Natura 2000 network, Montenegro'. Some of the results are presented in this paper.

Materials and methods

Specimens were collected with a butterfly net. Research was done in preselected areas (Key Biodiversity Areas - KBAs) some of which should be proposed as potential NATURA 2000 sites. The coordinates of the localities where Zygaenidae were collected were determined by using Garmin e-Trex Vista GPS device (**Tab. 1**). The photos in situ of specimens were taken using Nikon Camera with AF-S Micro Nikkor Lens.

After preparation, we determined the specimens on the base of habitus and male genitalia. The preparations were carried out following the well-known standard procedure: maceration by boiling in potash, dissecting and cleaning, clearing in xylolum and mounting in Canada balsam. Abdomen and genitalia of *Zygaena purpuralis* were mounted in Euparal on glass slide or were after cleaning placed in glycerol

Table 1. List of Annex I habitat types according to the "Catalogue of habitat types of EU importance of Montenegro" (Petrović et al., 2012) and collecting localities in Montenegro 2017

HABITATS and LOCALITIES	ELEVATION (m)	COORDINATE	
		Latitudeφ (N)	Longitude λ (E)
4070 Bushes with *Pinus mugo* and *Rhododendron hirsutum* (*Mugo-Rhododendretum hirsuti*)			
Prutaš, Durmitor Mt.	2262	43° 07' 47,3"	19° 00' 04,9"
Veliki Štuoc, Durmitor Mt.	1880	43° 11' 28"	19° 03' 25"
6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)			
Meždo, Žabljak, Durmitor Mt.	1376	43° 09' 54,8"	19° 09' 02,0"
6520 Mountain hay meadows			
Tepca village, Tara River Canyon	880-920	43° 12' 19"	19° 04' 37"
8210 Calcareous rocky slopes with chasmophytic vegetation			
Todorov Do, Durmitor Mt.	1820 – 1900	43° 07' 40"	18° 59' 15"
9110 *Luzulo-Fagetum* beech forests (meadow on forest edge)			
Monastery St. Nikola, Bistrica, Đalovića klisura	780	43° 04' 14"	19° 54' 12"
Vrelo Bukovice, Durmitor Mt.	1350	43° 03' 28,8"	19° 06' 37,4"
Bukovica, in the vicinity of Tušina Village	999	42° 57' 07"	19° 10' 19,7"
Sušičko jezero Lake Sušica River Canyon	1180	43° 11' 46"	19° 00' 18"
Komarnica River, before Nevidio Canyon	981	42° 59' 17"	19° 04' 02"
9280 *Quercus frainetto* woods			
Cijevna River, Podgorica (restaurant "Niagara")	38	42° 22' 50"	19° 16' 28"
9530 (Sub-) Mediterranean pine forests with endemic black pines			
Sušičko jezero, Sušica River Canyon, Mala Crna Gora	1554	43° 11' 45,8"	19° 00' 18,5"
6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)			
Veliko Pošćensko Jezero, Pošćenska jezera Lakes	1010	42° 59' 03"	19° 04' 04"

filled microvials. All the material is deposited in the collection of P. Jakšić.

The taxonomic order follows Nieukerken et al. (2011).

Results

ZYGAENOIDEA Latreille, 1809

ZYGAENIDAE Latreille, 1809

Subfam. Procridinae Boisduval, 1828

Jordanita notata (Zeller, 1847)

Podgorica, Cijevna (restaurant "Niagara"), 38 m, 9. May 2017, 1♂, Jakšić P. leg. et coll. Genitalia checked, slide: CG-2871. (**Fig. 1**); Ćemovsko polje, 40 m, 2. June, 2017, 2♀, Jakšić P. leg et coll.

Third record for Montengro! So far, this species was only mentioned once by Jakšić (1990) on Durmitor (Crno Jezero, Čeline). It has been recollected on Durmitor in 2015 (Tepca, Tara river, 6. June 2015; leg. P. Jakšić, 1♂, genitalia checked, slide: CG 2684).

An early flying green "forester moth" (= Procridinae). The preferred habitats are semidry and dry grassy places with *Centaurea*-species, the larval host-plants. This species is not common but widespread throughout southern Europe and can be found from the sea shore up to lower mountain meadows.

Adscita geryon (Hübner, 1813)

Durmitor Mt., Žabljak, Meždo, 1376 m, 21 July, 2017, 1♂, Jakšić P. leg et col., Genitalia checked: slide CG-2912.

A widespread species that is most common in higher elevations. The preferred habitats are open mountain grassland, grassy ravines, often on steep, rocky ground and semidry and dry meadows. The larvae feed on *Helianthemum* spp. (Cistaceae).

Adscita mannii (Lederer, 1853)

Bukovica, in the vicinity of Tušina, 999 m, 21 July 2017, 1♂, Jakšić P. leg. et coll. Genitalia checked, slide: CG-2906; Bistrica, Đalovića Klisura Gorge, 780 m, 20 July, 2017, 1♀, Jakšić P. leg et col. Gen-

Fig. 1. *Jordanita notata* (Zeller, 1847), male, Podgorica, Cijevna (restaurant "Niagara"), 38 m, 9. May 2017, Photo P. Jakšić

italia checked, slide: CG-2913.

This Adriato-Mediterranean species is widespread along the Adriatic coast inhabiting various types of biotopes like Mediterranean bushland near the sea, semidry and dry meadows, forest clearings and rocky ground with grassy spots between the rocks. In Montenegro this species occurs at the coast and in the mountains. The larvae feed on *Helianthemum*- and *Cistus*-species (Cistaceae). Only a few records are known for this species in Montenegro but it is expected to be more widespread.

Subfam. Zygaeninae Latreille, 1809

Zygaena punctum Ochsenheimer, 1808

Podgorica, Cijevna (restaurant "Niagara"), 38 m, 9. May 2017, 4♂, 2♀, Jakšić P. leg. et coll. (**Fig. 2**).

All populations of *Zygaena punctum* in Montenegro belong to ssp. *dalmatina* Boisduval, 1834. This population group is distributed from southern Croatia and western Bosnia and Herzegovina southwards as far as Greece. One of the main characters of this subspecies is its small size (compared with the nominotypical *Z. punctum punctum* from eastern central Europe) and the tendency to confluence of the red pattern on the forewing upperside. The larva of *Z. punctum* feeds on *Eryngium* species, mainly on *E. campestre* (Apiaceae). The preferred habitats are dry, undisturbed meadows, rocky slopes with grassy spots and abandoned cultures with low or medium high vegetation.

Zygaena purpuralis (Brünnich, 1763)

Bukovica near Tušina village, 900 m, 6. June, 2017, 2♀, Jakšić P. leg et col.; Meždo, Žabljak, 1376 m, 21-24. July 2017, 2♂, 1♀, Jakšić P. leg. et coll.; Veliki Štuoc, 1880 m, 22. July 2017, 1♂, 1♀, Jakšić P. leg et col.; Mala Crna Gora, right bank of Sušica River Canyon, 1554 m, 22. July, 2017, 2♂, 5♀, Jakšić P. leg et coll., genitalia checked: glycerin and slide ANZ573♀; Sušičko jezero (Sušica Lake), 1180 m, 22. July 2017, 3♂, 2♀, Jakšić P. leg. et coll.; Todorov Do, 1900 m, 23. July, 2017, 2♂, 2♀, Jakšić P. leg et coll., genitalia checked: glycerin and slide ANZ574♂; Prutaš, 2262 m, 22. July 2017, 1♂, 1♀, Jakšić P. leg et coll.

In Montenegro only *Z. purpuralis lathyri* Boisduval, 1828 can be found. It inhabits various biotopes in hilly and mountainous areas. *Zygaena minos* ([Denis & Schiffermüller], 1775), a species which is indistinguishable from *Z. purpuralis* by habitus of imago, occurs in Montenegro as well (Nahirnić et al., 2013). Correct determination of these species must be based on genitalia or larvae (Nahirnić & Tarmann, 2016).

Fig. 2. *Zygaena punctum* Ochsenheimer, 1808, female, Podgorica, Cijevna, 38 m, 9. May 2017, Photo P. Jakšić

Zygaena carniolica (Scopoli, 1763)

Meždo, Žabljak, 1376 m, 21-24. July 2017, 3♂, 2♀, Jakšić P. leg. et coll.; Tepca village, 1260 m, Mt., 22. July 2017, 6♂, 2♀, Jakšić P. leg. et coll.; Komarnica: Nevidio and Pošćenska jezera, 1010 m, 24. July 2017, 3♂, 2♀, Jakšić P. leg. et coll.; Vrelo Bukovice, 1350 m, 24. July 2017, 3♂, 1♀, Jakšić P. leg. et coll.

The populations of *Z. carniolica* of Montenegro belong to the nominotypical subspecies *Z. carniolica carniolica*. This population group is distributed in the Balkans from the south-eastern Alps and the karst areas in Slovenia throughout the Dinaric Arc to northern Albania. The larva feeds mainly on *Onobrychis* spp. (Fabaceae). The preferred habitats are undisturbed and unfertilized semidry and dry meadows. This species is known as a perfect indicator for air pollution by pesticides. It has disappeared in many agricultural and industrial areas in Europe where it was still common half a century ago (Tarmann, 2009).

Zygaena viciae ([Denis & Schiffermüller], 1775)

Bukovica, in the vicinity of Tušina, 999 m, 21. July 2017, 1♀ in copula with ♂ of *Z. filipendulae*, Jakšić P. leg. et coll. (**Fig. 5**); Veliki Štuoc Mt., 1880 m, 22. July 2017, 3♂, Jakšić P. leg. et coll.

All populations of *Z. viciae* in Montenegro belong to ssp. *bosniensis* Reiss, 1922. This subspecies differs from the nominotypical *Z. viciae viciae* from central Europe by its much darker appearance and the broad dark margin on the hindwing. *Zygaena viciae* has so far only been found in the mountains of Montenegro around Durmitor. Its preferred habitats are humid meadows. The larval host-plants in Europe are Fabaceae (preferably *Vicia* and *Lathyrus* species) but nothing is known on the life history of the populations of Montenegro up to this date.

Zygaena ephialtes (Linnaeus, 1767)

Monastery St. Nikola, Bistrica, Đalovića klisura, 780 m, 20. July 2017, 12. ♂, 7♀, Jakšić P. leg. et coll.; Bukovica, in the vicinity of Tušina, 999 m, 21. July 2017, 12♂, 4♀, Jakšić P. leg. et coll.; 1554 m, 22. July 2017, 9♂, 2♀, Jakšić P. leg. et coll.; Komarnica: Nevidio, Pošćenska jezera, 1010 m, 24. July 2017, 4♂, 3♀, Jakšić P. leg.

The specimens of *Zygaena ephialtes* collected during this project belong to ssp. *istoki* Silbernagel, 1944. This subspecies, consisting of black ephialtoid morphs only, with a mixture of red and yellow individuals that can be 5- or 6-spotted, is distributed throughout large parts of the southern Balkans from Bosnia and Herzegovina and southern Serbia to Greece and eastwards to the Black Sea. There is another subspecies of *Z. ephialtes* known from Montenegro, viz. *Z. ephialtes rauchi* Hofmann, 2003. This population group is restricted to the surroundings of the Bay of Kotor and the coastal areas of Montenegro. It is significantly different from ssp. *istoki* (see Hofmann, 2003). *Zygaena ephialtes* prefers bushy habitats with presence of the larval host-plant *Securigera varia* L. (Lassen) (Fabaceae) and good nectar resources for the adults. It is often found on clearings, near forest roads and in river valleys with flowering *Rubus* bushes where the adults obtain nectar.

Zygaena angelicae Ochsenheimer, 1808

Bistrica, Đalovića Klisura Gorge, 780 m, 20. July, 2017, 1♀, Jakšić P. leg et coll., Durmitor Mt., Todorov Do, 1900 m, 23. July 2017, 1♀, Jakšić P. leg et col.

A widespread species on the whole Balkans from lowland to elevations above 2000 meters. Larvae on Fabaceae, mainly on *Hippocrepis comosa* L. This species is represented in Montenegro by its subspecies *Z. angelicae herzegowinensis* Reiss, 1922 that inhabits the whole mountainous part of the Balkans from Slovenia to Greece and the Black Sea.

Zygaena filipendulae (Linnaeus, 1758)

Bukovica, in the vicinity of Tušina, 999 m, 21. July 2017, 4♂, 3♀ , Jakšić P. leg.; Meždo, Žabljak, 1376 m, 21-24. July 2017, 6♂, 3♀, Jakšić P. leg. et coll.; 1554 m, 22. July 2017, 8♂, 4♀., Jakšić P. leg. et coll.; Vrelo Bukovice, 1350 m, 24. July 2017, 1♂, 1♀, Jakšić P. leg. et coll.

Zygaena filipendulae is common on the whole Balkans and occurs here in a number of different subspecies. Montenegro is inhabited by *Z. filipendulae illyrica* Holik, 1943. This species has a wider ecological tolerance than most other *Zygaena* species and can inhabit various biotopes from wetlands to dry environment, open meadows to forest clearings and roadside habitats. It can be observed in the lowlands but also in the mountains up to more than 2000 meters. The larvae live on various Fabaceae, mainly on *Lotus* species.

Zygaena lonicerae (Scheven, 1777)

Monastery St. Nikola, Bistrica, Đalovića klisura, 780 m, 20. July 2017, 4♂, 1♀, Jakšić P. leg. et coll.; Mala Crna Gora, right edge of Sušica River Canyon, 1554 m, 21. July, 2017, 1♂, Jakšić P. leg et coll.

Zygaena lonicerae is widespread and common in the Balkans and in Montenegro. Its preferred habitats are meadows near forest or forest clearings. The larvae feed on *Lotus* and *Trifolium* (Fabaceae).

Fig. 3. *Zygaena filipendulae* male x *Z. viciae* female, found in copula on Durmitor Mt., Veliki Štuoc, 1930 m, 22. July, 2017. Jakšić P. leg.

Discussion and conclusion

In all seven pre-selected research areas Zygaenidae species could be found. This is an important proof that these biotopes are in a good environmental condition. As stated by Šašić, Nahirnić & Tarmann (2016), Zygaenidae are extremely stenoecious insects and are therefore good indicator species for environmental changes. They can show us perfectly whether a biotope is in a good, natural condition or somehow disturbed or even contaminated. Special studies on this topic have been undertaken in northern Italy in Val Venosta (Vinschgau) (Huemer & Tarmann, 2001; Tarmann, 2000, 2009, 2016). It has been shown that destructive poisons from apple plantations (some of them commonly used plant protection substances) were transported by wind into the environment over kilometres into earlier habitats and that Zygaenidae were amongst the first insects that disappeared from seemingly completely intact habitats. Several of such habitats are Annex I habitat types according to the Habitats Directive.

More intensive studies on Montenegrin Zygae-

Fig. 4. Interspecific mating attempt by male of *Zygaena filipendulae* and female of *Z. ephialtes* in the wild. Bukovica River, near Tušina village, 1006 m, 21. July 2017. Photo P. Jakšić

Fig. 5. Interspecific mating attempt by male of *Zygaena filipendulae* and female of *Z. ephialtes* in the wild. Mala Crna Gora village, right bank of Sušica River Canyon, 1554 m, 22. July 2017. Photo P. Jakšić.

nidae and especially their ecology and biology are needed as there is little known about their exact distribution in the country, local larval food plants, their nectar resources, preferred habitat requirements, parasites and predators.

During this study three interspecific copulae could be observed. This is a well-known phenomenon in Zygaenidae and has been studied by various authors. The reason is a somehow unspecific pheromone system that leads to the attraction of males of various species by females. However, hybrids can only be produced between extremely closely related species. Such hybrids are known only for a few species. They can not only be produced by artificial rearing experiments but are also found in nature. The species combinations found in copula in Montenegro in 2017 (**Figs. 3-5**) cannot produce fertilized eggs as they are not very closely related species. In his monographic study, Tremewan (2006) provided data for 200 literature sources that provide examples of this phenomenon. In these data 73 different combinations of species are listed.

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