

Butterfly diversity (Lepidoptera: Papilionoidea) of Mt. Blegoš and Mt. Koprivnik (Škofjeloško hribovje, Slovenia)

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Abstract. An overview of the surveys of butterfly fauna of Mt. Blegoš, Mt. Koprivnik and their surroundings is provided. In 2018, 14 surveys were performed and 80 butterfly species on eight transects recorded in the process. Additional surveys in 2019 and 2020 yielded 5 additional butterfly species. Among the butterflies observed, *Parnassius mnemosyne*, *Lycaena hippothoe*, *Euphydryas maturna*, *Euphydryas aurinia*, *Melitaea britomartis*, *Melitaea diamina*, and *Pyrgus alveus* are identified as vulnerable species, while both *Phengaris arion* and *Phengaris alcon* are classified as endangered species in Slovenia. The latter was found on two occasions in July 2018 and July 2020 on a single locality. Eggs of *P. alcon* were found on the host plant *Gentiana cruciata* at the same locality. Despite the fact that many species characteristic of higher altitudes were observed, like *Aricia artaxerxes*, *Pyrgus alveus*, *Erebia stiria* and *Lasiommata petropolitana*, other, which had still been present a few decades ago, were not found (*Parnassius apollo* and *Boloria pales*). In this article, the problem of loss of important butterfly habitats in the region due to overgrowing, and the negative impacts of overgrazing is also highlighted.

Key words: transect surveys, grazing, overgrowing, *Phengaris alcon*, *Phengaris arion*, Slovenia

Izvleček. Raznolikost dnevnih metuljev (Lepidoptera: Papilionoidea) Blegoša in Koprivnika (Škofjeloško hribovje, Slovenija) – V članku predstavljamo popise favne dnevnih metuljev Blegoša in Koprivnika z njuno okolico. V letu 2018 smo opravili 14 popisov, med katerimi smo zabeležili 80 vrst metuljev na 8 transektih. Med dodatnimi popisi v letih 2019 in 2020 pa smo opazili še 5 dodatnih vrst. Izmed zabeleženih metuljev spadajo *Parnassius mnemosyne*, *Lycaena hippothoe*, *Euphydryas maturna*, *Euphydryas aurinia*, *Melitaea britomartis*, *Melitaea diamina* in *Pyrgus alveus* med ranljive vrste, medtem ko sta *Phengaris arion* in *Phengaris alcon* klasificirana kot ogroženi vrsti za Slovenijo. Slednji je bil najden zgolj med dvema popisoma v juliju 2018 in 2020 na eni sami lokaciji, prav tako pa smo na rastlini *Gentiana cruciata* našli njegova jajčeca. Kljub dejstvu, da smo opazili določene vrste značilne višje nadmorske višine, kot so *Aricia artaxerxes*, *Pyrgus alveus*, *Erebia stiria* in *Lasiommata petropolitana*, pa dveh, ki smo ju lahko opazovali še pred nekaj desetletji, nismo našli (*Parnassius apollo* in *Boloria pales*). V članku poudarjamo tudi problem izgube pomembnih habitatov v regiji zaradi zaraščanja in negativnega vpliva prekomerne paše.

Key words: transektni popisi, pašništvo, zaraščanje, *Phengaris alcon*, *Phengaris arion*, Slovenija

Introduction

Škofjeloško hribovje, a roughly 25 km long mountain chain, is one of the highest in Slovenia outside the Alps (Perko & Orožen-Adamič 2001). It is positioned in the southwestern part of the country in the Gorenjska region. Due to its location it forms a barrier between three different climates – continental to the east and south, alpine to the north and sub-Mediterranean to the southwest. Due to its specific geological structure and climate it has a very diverse morphology, with a plethora of different habitats, which is reflected in a diverse fauna and flora found in the region (Ilešič 1938, Šifrer 1974). Due to the rich diversity and unique habitats, Mt. Blegoš is also a part of the Natura 2000 network (Blegoš; SI3000260; Ur. l. RS 2004a).

The two highest points of the mountain chain are Mt. Blegoš (1,562 m) and Mt. Koprivnik (1,393 m), which have been surveyed for butterflies since the first half of the 20th century (Carnelutti 1980, Withrington 2003). However, apart from those general overviews, with only the most interesting species mentioned, there has been no extensive account of the butterfly fauna of the two mountains published. Nevertheless, Carnelutti (1980) provides some interesting observations, which can be used for the comparison with the current situation. He mentions several subalpine or alpine species for Mt. Blegoš, specifically *Boloria pales*, *Parnassius apollo* (already extinct at that time), *Erebia euryale*, *E. medusa*, and *Pieris bryoniae*. The only other faunistic survey, which only partially overlaps with our studied area, was done by Verovnik (2000), however, the aforementioned highest peaks were not visited at the time.

Given the lack of systematic research, our main objective was to survey the butterfly fauna of the region and check for potential habitats and presence of the interesting species mentioned in the previous studies. We also provide an evaluation of the conservation status and threats to the butterflies in the region.

Geographical characteristics of the region

Škofjeloško hribovje is a mountainous region between the Poljanska Sora River to the south and the Selška Sora River to the north. It is a diverse mountainous landscape which merges to the west, just north of Cerkno, with Cerkljansko hribovje and its highest mountain Porezen (1,630 m), and with Mt. Lubnik (1,025 m), just above Škofja Loka, reaches its easternmost point. Mt. Blegoš and its neighbour, Mt. Koprivnik, are located north of the villages of Volaka and Gorenja Žetina, respectively, and are the highest peaks of the region (Šifrer 1974).

The two mountains are surrounded with an old Paleozoic, presumably Silurian, shale and chives, while their peaks are predominantly composed of younger dolomites and shell limestone, which lie atop the Carboniferous layers. The limestone and dolomites are especially predominant at the top of Mt. Blegoš (Ilešič 1938, Šifrer 1974, Marinček & Wraber 1980). Due to the very complex geological structure composed of mainly impermeable rocks, which represents a transition point between the Alps and the Karst, the surrounding area of Mt. Blegoš is densely intersected with smaller gorges and ravines created by strong temporary torrents (Šifrer 1974).

Mt. Blegoš and Mt. Koprivnik have, like the major part of Škofjeloško hribovje, a typical continental climate characteristic of the Ljubljana basin, with alpine climate influences at higher altitudes, especially above 1,300 m. On warmer southern slopes, the influence of the neighbouring sub-Mediterranean climate is evident (Ilešič 1938, Marinček & Wraber 1980). The wider area of Škofjeloško hribovje has high annual rainfall of around 1,800–2,000 mm on average (Nadbath 2010, Vertačnik & Bertalančič 2017), while the highest parts of Mt. Blegoš and Mt. Koprivnik receive on average between 2,000–2,600 mm annually (Vertačnik & Bertalančič 2017). The annual mean temperatures for the highest parts of Mt. Blegoš are between 4–6 °C, and 6–8 °C for lower parts (including Koprivnik) while the average temperature in July is between 12–14 °C for Mt. Blegoš and 14–16 °C for Mt. Koprivnik (Marinček & Wraber 1980, Vertačnik & Bertalančič 2017).

Given the amount of precipitation and specific geology, the region is characterised by lush vegetation, especially dense mixed woods, consisting predominantly of *Fagus sylvatica*, *Abies alba* and *Picea abies*. *F. sylvatica* is especially common on the limestone and dolomite near the top of Mt. Koprivnik and in particular Mt. Blegoš, while the surrounding area is mostly covered by mixed woods (49 %) with a predominance of conifers. Those woods have the characteristics of sub-alpine mixed forest of *Luzulo-Abieti-Fagetum praealpinum* or *Luzulo-Fagetum montanum praealpinum*, depending on the altitude. Above 1,450 m they are considered as part of *Fagetum subalpinum* forests (Ilešič 1938, Marinček & Weber 1980). Ash, an important larval host plant of *Euphydryas maturna*, is also found in the area, especially around »Likar's hayfield« locality.

The highest parts of Mt. Blegoš are covered with extensive grasslands and pastures, which are present also on the southern slopes. These, despite showing the characteristics of a true alpine grasslands and pastures in some places, are of anthropogenic origin, which can be seen in an advanced overgrowing of uncut and un-grazed areas, as well as in a very high upper tree line limit, which nowadays reaches up to 1,500 m. Also typical of Paleozoic shales are low woodland shrubs and vegetation, like *Vaccinium myrtillus*, *Calluna vulgaris* and different species of ferns, which are especially common in the overgrown grasslands of Mt. Koprivnik (Ilešič 1938, Marinček & Weber 1980).

One of the main agricultural activities in the region and especially Mt. Blegoš is grazing. Before 1900, it was very widespread, also extending to other parts of the mountain chain (e.g. Mt. Koprivnik). After 1900, however, with the newly formed border between Italy and Slovenia, the grazing activity started to decline (Ilešič 1938). This has been even more prominent in recent decades when there was also a shift from sheep to now predominant cattle grazing (own observations).

Materials and Methods

Description of the surveys

Despite a few observations of butterflies around Mt. Blegoš, Mt. Koprivnik and their surroundings, no thorough research has ever been undertaken in this region. Thus, a more extensive survey was performed in order to determine the most important species and habitats

from the conservation perspective. We established surveys on 8 transects/localities and, weather permitting, visited them at least once every second week from 27. 5. to 8. 9. 2018, counting the number of butterflies (species and individuals) in the process.

Table 1. The list of transects surveyed during the study. Coordinates are given in a WGS 84 projection. In the case of a broader locality, the observations were made near the transect location, but are sometimes not restricted to the indicated habitat type of the transect. Start/End refer to start and end points of each transect.

Tabela 1. Seznam transektov, ki smo jih vzorčili med študijo. Koordinate so podane v WGS 84 projekciji. V primeru širše lokacije so bili popisi opravljeni v bližini transektta, a niso bili vedno omejeni le na habitatni tip, značilen za tisti transekt. Start/End se nanašata na začetno in končno točko transektta.

No.	Name (ENG/SLO)	Description	Habitat type	Start	End	Length [m]
1	Meadow under Mt. Koprivnik/Travnik pod Koprivnikom	Mt. Koprivnik, meadow 500 m S of the top	Intensive grassland	X: 46.171691, Y: 14.140815; Alt.: 1112 m	X: 46.171944, Y: 14.142006; Alt.: 1116 m	120 m
2	Potok/Potok	Potok, meadow 500 m SE of the village entre	Intensive grassland	X: 46.180063, Y: 14.110464; Alt.: 970 m	X: 46.179911, Y: 14.109219; Alt.: 921 m	150 m
3	Mt. Koprivnik/Koprivnik	Mt. Koprivnik, meadow 200 m SE of the top	Extensive grassland	X: 46.174310, Y: 14.143750; Alt.: 1268 m	X: 46.175569, Y: 14.141969; Alt.: 1368 m	300 m
4	Likar's hayfield/Likarjeva senožet	Mt. Blegoš, 1900 m S of the top	Extensive grassland	X: 46.146215, Y: 14.119547; Alt.: 1051 m	X: 46.148255, Y: 14.118667; Alt.: 1137 m	300 m
5	Forest clearing/Gozdna poseka	Mt. Blegoš, 650 m SE of the top	Forest clearing	X: 46.159735, Y: 14.118791; Alt.: 1333 m	X: 46.161318, Y: 14.118619; Alt.: 1376 m	170 m
6	Forest by the macadam/Gozd ob kolovozu	Mt. Blegoš, 850 m S of the top	Forest clearing	X: 46.156421, Y: 14.113011; Alt.: 1296 m	X: 46.154801, Y: 14.107443; Alt.: 1229 m	570 m
7	Mt. Blegoš: meadow under the hilltop/Blegoš: travnik pod vrhom	Mt. Blegoš, 300 m S of the top	Pasture meadow	X: 46.161210, Y: 14.112718; Alt.: 1473 m	X: 46.162834, Y: 14.110422; Alt.: 1441 m	270 m
8	Mt. Blegoš: hilltop/Blegoš: vrh	Mt. Blegoš, 150 m S of the top	Pasture meadow	X: 46.163187, Y: 14.112729; Alt.: 1509 m	X: 46.163685, Y: 14.115937; Alt.: 1498 m	330 m

The transect surveys were performed according to the Pollard walk method (Pollard 1977). In total, 14 surveys were conducted on all transects on the given dates: 27.5., 3.6., 10.6., 17.6., 26.6., 1.7., 7.7., 22.7., 30.7., 4.8., 13.8., 19.8., 28.8. and 8.9., all in 2018. The only exception is the transect No. 2 – Potok, where only 13 surveys were performed – the survey wasn't performed on 22.7.2018 due to bad weather conditions. After extensive surveys in 2018, additional visits were made on some of the localities near the transects in 2019 and 2020, to check for additional expected species. In 2019, one additional survey was performed on localities near transects Nos. 1, 3, 6 (all on 2.6.) and 4 (14.7.), while in 2020, one additional survey was performed on localities near transects Nos. 1, 2, 6 (all 13.4.) and 8 (20.7.), two additional surveys on localities near transects No. 5 and 7 (4.7. and 20.7.), and three additional surveys on locality near transect No. 4 (11.4., 4.7. and 20.7.). Unlike in 2018, the Pollard walks were not carried out in 2019 and 2020. During this research, no major floristic surveys were performed and only certain larval host plants are pointed out in this article.

The selected transects included four main different habitat types (pastures, intensive grasslands, extensive grasslands and forest clearings) at different altitudes, in order to cover as many different ecotypes as possible. Two transects/localities were selected for each habitat type. The individual butterflies were caught (if necessary) with a butterfly net and determined using Tolman & Lewington's (2008) butterfly guide.

Data analysis

We calculated a population density of each species for each transect separately. The population density of species is expressed as number of individuals per survey per 100 m of transect, and was adapted from Čelik & Verovnik (2020) with slight alterations:

$$\text{Population density of species} = (X * 100 \text{ m}) / (Y * Z) \quad (1)$$

Where X is the sum of all imagines of species observed in 2018 on a transects during all surveys, Y is the number of surveys performed on a transect (13 for locality »Potok«, and 14 for all other localities) and Z is the length of the transect in metres.

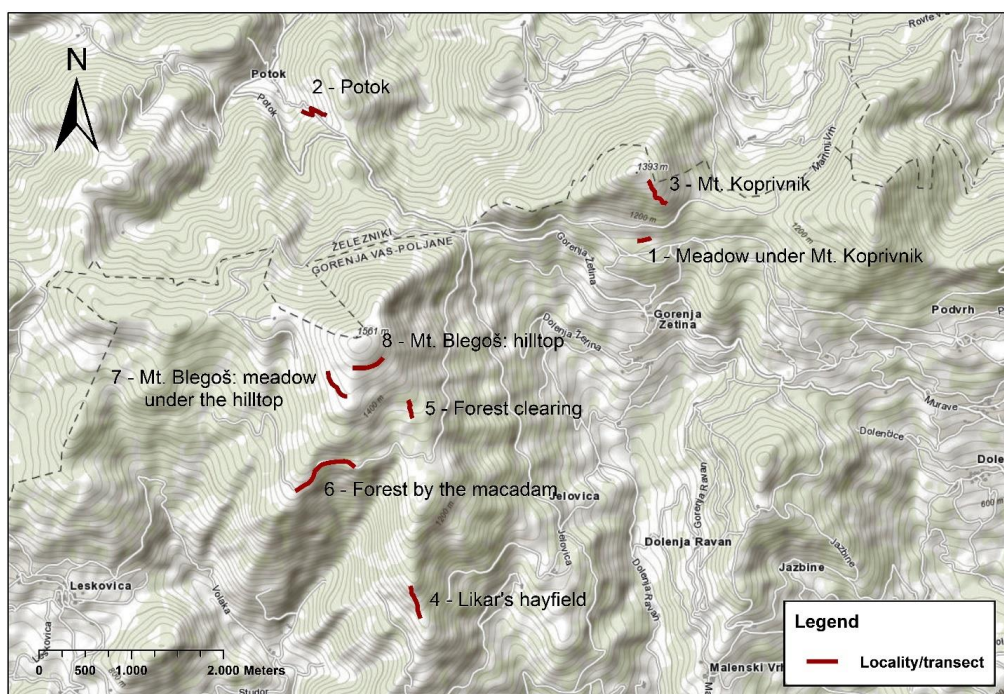


Figure 1. Position of transects for butterfly surveys on Mt. Blegoš and Mt. Koprivnik in Škofjeloško hribovje.
Slika 1. Mesta transektov za popise dnevnih metuljev na območju Blegoša in Koprivnika v Škofjeloškem hribovju.



Figure 2. Habitats of selected transects/localities on Mt. Blegoš, Mt. Koprivnik and their vicinity: A) Potok; B) Meadow under Mt. Koprivnik; C) Mt. Koprivnik; D) Mt. Blegoš: meadow under the hilltop; E) Mt. Blegoš: hilltop; F) Likar's hayfield; G) Forest clearing; H) Forest by the macadam (main part); I) Forest by the macadam (the part with rocky cliffs).

Slika 2. Življenjski prostori izbranih transektov/lokacij na Blegošu, Koprivniku in njuni okolici: A) Potok; B) Travnik pod Koprivnikom; C) Likarjeva senožet; D) Blegoš: travnik pod vrhom; E) Blegoš: vrh; F) Likarjeva senožet; G) Gozdna poseka; H) Gozd ob kolovozu (glavni del); I) Gozd ob kolovozu (del s skalnimi stenami).

Results

Altogether, 80 species and 5,012 specimens were observed between 27.5. and 8.9.2018. Among these, 1,050 specimens and 52 species were observed on pastures, 890 specimens and 53 species in intensive grasslands, 763 specimens and 53 species inside forest clearings, and 2,309 specimens and 65 species in extensive grasslands. The complete butterfly survey of Mt. Blegoš, Mt. Koprivnik and their surroundings, which also included additional location-specific surveys in 2019 and 2020, yielded altogether 85 species (Tab. 2). Of these, 9 species are listed as vulnerable, while two are considered endangered in either Slovenia or Europe (Tab. 2). Most of those species were found on more than one occasion and in more than one locality.

Table 2. Population densities of individual species per survey per 100 m of transect/locality in 2018, with the addition of species observed only in 2019 or 2020. Nomenclature follows Verovnik (2019). X – Species found only in the vicinity of the transect; Y – Species observed only in 2019 and/or in 2020, but not in 2018.

Tabela 2. Populacijska gostota posamezne vrste na vzorčenje na 100 m transekta v 2018, z dodatkom vrst, ki so bile najdene samo v letu 2019 ali 2020. Poimenovanje je povzeto po Verovnik (2019). X – Vrsta najdena samo v okolici transekta; Y – Vrsta opažena samo v letu 2019 in/ali 2020, ne pa tudi v letu 2018.

Family	Species \ Locality	1	2	3	4	5	6	7	8
Papilionidae	<i>Papilio machaon</i>	Y		0.05	0.17		X	X	0.02
	<i>Iphiclides podalirius</i>				Y				
	<i>Parnassius mnemosyne</i>	0.06	0.05	1.17	0.02	2.52	0.04	0.66	0.17
Pieridae	<i>Aporia crataegi</i>		0.05						
	<i>Pieris brassicae</i>	0.06	0.05	0.24	0.10	0.21	0.31	0.13	0.09
	<i>Pieris rapae</i>	0.12	0.10	0.07	0.12	0.08	0.29	0.16	0.09
	<i>Pieris bryoniae</i>						0.01	0.03	
	<i>Pieris napi</i>	0.24	0.72	0.83	0.55	0.88	0.65	0.21	0.06
	<i>Anthocharis cardamines</i>	X		X		0.08	0.09	0.03	
	<i>Colias alfacariensis/hyale</i>			0.02	X				0.02
	<i>Colias crocea</i>	0.71	0.05	0.05	0.24	0.08	0.09	0.42	0.39
	<i>Gonepteryx rhamni</i>		0.10	0.02	0.02	0.17	0.30	0.08	
	<i>Leptidea sinapis/juvernica</i>	1.49	0.41	1.07	0.10	0.04	0.09	0.05	
Lycaenidae	<i>Satyrium ilicis</i>				0.02				
	<i>Satyrium spini</i>				1.71		0.25		
	<i>Callophrys rubi</i>				0.02		Y	0.03	
	<i>Lycaena phlaeas</i>	Y				0.04			
	<i>Lycaena virgaureae</i>		0.10	0.07	0.05	0.04			
	<i>Lycaena tityrus</i>	0.48	0.21	0.12	0.02			0.08	0.02
	<i>Lycaena alciphron</i>	0.36	0.21	0.07					
	<i>Lycaena hippothoe</i>	2.74	0.10	0.26	0.02			0.40	0.09
	<i>Celastrina argiolus</i>			0.02		X	0.03	0.03	
	<i>Cupido minimus</i>	0.42	0.10	0.21	0.55	0.08	0.01	0.53	0.37
	<i>Phengaris alcon</i>							0.08	
	<i>Phengaris arion</i>				0.02		0.03	0.03	
	<i>Plebejus argus</i>	0.18		0.07	0.07			0.16	
	<i>Aricia agestis</i>	0.95		0.43	0.02	X		0.08	0.13
	<i>Aricia artaxerxes</i>	X		0.12	Y			0.03	0.06
	<i>Cyaniris semiargus</i>	0.48	0.72	0.38	0.02	0.04	0.03	0.66	0.89
	<i>Lysandra bellargus</i>	0.30		0.05	0.05			0.05	0.02
	<i>Lysandra coridon</i>	0.06	1.85	0.14	1.43	0.21	0.03	1.90	0.19
	<i>Polyommatus dorylas</i>	0.48			0.02			0.34	0.15
	<i>Polyommatus icarus</i>	0.83	0.21	0.07	0.12	0.04		1.30	0.19
Riodinidae	<i>Hamearis lucina</i>		0.21	0.10	0.05		0.01	0.03	0.06
Nymphalidae	<i>Apatura iris</i>					X			
	<i>Limenitis populi</i>					X			
	<i>Limenitis reducta</i>						0.03		
	<i>Issoria lathonia</i>			0.07	X	0.17	X	X	0.02
	<i>Argynnis paphia</i>		0.36	0.14	0.14	0.97	0.25	X	0.02
	<i>Speyeria aglaja</i>	0.18	0.31	0.43	0.02	0.13		0.21	0.09
	<i>Fabriciana adippe</i>			0.05	Y	0.08	0.03		
	<i>Brenthis daphne</i>		0.05	0.12	0.05	0.13	0.01		
	<i>Boloria euphrosyne</i>	Y	0.05	0.45	0.52	1.34	0.39	0.08	X
	<i>Boloria dia</i>	3.33	0.15	0.07	X	0.17			
	<i>Aglais io</i>	0.12	0.10	0.14	0.07	3.15	0.05	X	0.02
	<i>Aglais urticae</i>	X	0.10	0.07	0.14	0.08	0.10	0.21	0.63
	<i>Polygonia c-album</i>		0.10				X	0.01	0.03

Family	Species \ Locality	1	2	3	4	5	6	7	8
	<i>Nymphalis polychloros</i>		X				0.01		
	<i>Nymphalis antiopa</i>		Y						
	<i>Vanessa atalanta</i>	X	0.15	0.02	0.05	0.21	0.08	X	0.02
	<i>Vanessa cardui</i>	0.12		0.07	0.26	0.04	0.05	0.13	0.04
	<i>Melitaea cinxia</i>	0.54	0.05	0.05					0.03
	<i>Melitaea phoebe</i>		0.05	0.14	0.05				0.03
	<i>Melitaea diamina</i>		0.10	0.36					
	<i>Melitaea britomartis</i>				Y				
	<i>Melitaea didyma</i>	1.55	X	0.02	0.05		0.01		
	<i>Melitaea athalia</i>	2.32	1.64	1.81	0.14	0.13	X	0.03	
	<i>Euphydryas maturna</i>			0.07	0.07				
	<i>Euphydryas aurinia</i>			0.02	0.36	0.29			
	<i>Melanargia galathea</i>	0.48	3.44	4.45	6.90	X	0.19	0.05	0.04
	<i>Hipparchia fagi</i>				X				
	<i>Minois dryas</i>				0.07				
	<i>Brintesia circe</i>	0.06	X	0.05	0.21	0.04	0.01		0.02
	<i>Erebia ligea</i>		0.15	0.50	0.05	0.08	0.05		
	<i>Erebia aethiops</i>		0.10		1.07	X	0.23		Y
	<i>Erebia medusa</i>	0.42	1.38	1.64	1.55	X	0.13	0.37	0.41
	<i>Erebia stiria</i>						0.43		
	<i>Erebia euryale</i>					Y			Y
	<i>Maniola jurtina</i>	1.96	3.64	0.52	0.24	0.13	0.06	0.05	0.02
	<i>Coenonympha pamphilus</i>	4.46	0.10	0.31	0.12	0.04		1.14	0.15
	<i>Coenonympha arcania</i>	0.06	2.41	2.19	11.67	0.04	0.33	0.05	0.02
	<i>Pararge aegeria</i>					X	Y		
	<i>Lasiommata megera</i>				0.14		0.01		
	<i>Lasiommata maera</i>		0.10	0.33	0.43	0.04	0.64	0.08	0.04
	<i>Lasiommata petropolitana</i>						Y		
	<i>Lopinga achine</i>		0.15		0.02		0.03		
Hesperiidae	<i>Pyrgus malvae</i>	0.18	0.15	0.17	0.10	Y		0.21	0.02
	<i>Pyrgus alveus</i>					0.04		0.03	0.02
	<i>Erynnis tages</i>	0.12	0.05	0.07	0.02	0.08	0.03	0.71	0.11
	<i>Carterocephalus palaemon</i>		0.21	0.36					
	<i>Heteropterus morpheus</i>				X				
	<i>Thymelicus lineola</i>	0.60		0.02				0.03	
	<i>Thymelicus sylvestris</i>	X	0.31	0.33	Y	0.08			
	<i>Hesperia comma</i>	0.60	0.62	0.14	0.14	0.46	0.01	8.28	2.12
	<i>Ochlodes sylvanus</i>	X	1.08	3.00	0.93	0.13	0.41	0.16	
Number of species	85	43	49	57	63	49	48	50	39

It is worth noting that the detailed data on exact dates of finding the species and their abundances were not included, due to the sheer amount of obtained information (eight tables were merged in one), but are available on request from the authors of the paper.

Table 3. Conservation status of butterfly species observed on Mt. Blegoš, Mt. Koprivnik and their surroundings in Slovenian and in European context. The European conservation status of butterfly species is based on van Swaay et al. (2010), while the Slovenian conservation status is based on rules on the classification of endangered plant and animal species in the Red List (Ur. l. RS 2002). LC – least concern species, NT – near threatened species, VU – vulnerable species, EN – endangered species.

Tabela 3. Varstveni status ogroženih vrst metuljev, najdenih na Blegošu, Koprivniku in v njuni okolici v Sloveniji in Evropi. Status ogroženosti v Evropi bazira na van Swaay et al. (2010), medtem ko varstveni status v Sloveniji bazira na pravilniku o uvrstitvi ogroženih rastlinskih in živalskih vrst v rdeči seznam (Ur. l. RS 2002). LC – vrsta zunaj nevarnosti, NT – vrsta blizu ogroženosti, VU – ranljiva vrsta, EN – prizadeta vrsta.

Family	Species	Conservation status in Slovenia	Conservation status in Europe	Inclusion into the Decree on protected wild animal species (UR. l. RS 2004b)
Papilionidae	<i>Parnassius mnemosyne</i>	VU	NT	Appendices 1, 2
Lycaenidae	<i>Lycaena alciphron</i>	VU	LC	Not included
	<i>Lycaena hippothoe</i>	VU	LC	Not included
	<i>Phengaris alcon</i>	EN	LC	Appendices 1, 2
	<i>Phengaris arion</i>	VU	EN	Appendices 1, 2
Nymphalidae	<i>Melitaea diamina</i>	VU	LC	Not included
	<i>Melitaea britomartis</i>	VU	NT	Not included
	<i>Euphydryas maturna</i>	VU	VU	Appendices 1, 2
	<i>Euphydryas aurinia</i>	VU	LC	Appendices 1, 2
	<i>Lopinga achine</i>	LC	VU	Appendices 1, 2
Hesperiidae	<i>Pyrgus alveus</i>	VU	LC	Not included

Table 4. Comparison of all eight transects and the number of butterflies/species found during 2018 surveys.

Tabela 4. Primerjava vseh osmih transektov in števila metuljev/vrst, popisanih v letu 2018.

Transect/locality (No.)	Habitat type	No. species on wider locality	No. species on transect	Transect length [m]
1 - Meadow under Mt. Koprivnik	intensive grassland	40	34	120
2 - Potok	intensive grassland	48	45	150
3 - Mt. Koprivnik	extensive grassland	57	56	300
4 - Likar's hayfield	extensive grassland	58	53	300
5 - Forest clearing	forest clearing	47	38	170
6 - Forest by the macadam	forest clearing	45	42	570
7 - Mt. Blegoš: meadow under the hilltop	pasture	50	45	270
8 - Mt. Blegoš: hilltop	pasture	37	36	330

Discussion

Until now, the butterfly fauna of Mt. Blegoš and Mt. Koprivnik has been relatively poorly studied, as the latest records date back more than 15 (Withrington 2003) or more than 40 years (Carnelutti 1980). The relatively high number of species recorded in the surveyed area, compared to similar areas such as Šentvid plateau (Torkar et al. 2013) or Cerkljansko-Idrijsko region (Verovnik 2000), could be explained by sampling during the main adult butterfly season in eight different localities, coupled with sampling during the period of 3 years, as well as the influence of different climates. Compared to previously mentioned surveys (Verovnik 2000, Torkar et al. 2013), almost 10 % more species have been observed around Mt. Blegoš and Mt. Koprivnik. As Mt. Blegoš with its 1,562 m is considered a low mountain, many species found here are typical of higher altitudes (above 1,000 m). These are: *Pyrgus alveus*, *Phengaris alcon* f. *rebeli*, *Lasiommata petropolitana*, *Pieris bryoniae*, *Aricia artaxerxes*, *Erebia stiria* and *Erebia euryale* (Verovnik et al. 2012).

Among the species mentioned, *P. bryoniae*, *P. alveus*, *A. artaxerxes* and *P. alcon* f. *rebeli* are occasionally also found in the lowland areas (Verovnik et al. 2012). *E. stiria* and *L. petropolitana* are more petrophilous and were observed on cliffs along a macadam road below Mt. Blegoš (Fig. 2 - I). The latter species was already mentioned for Mt. Blegoš by Withrington (2003), but without precise location. *P. alcon* f. *rebeli* was first recorded in 2018, but only a single imago was observed on the transect, and not more than 3 were seen in the locality altogether. However, in July 2020, at least 5 imagines were present, giving hope that this tiny population might still survive. On the other hand, a related species, *Phengaris arion*, was found in three localities, two of those situated at lower altitudes. The species is localised but widespread in the wider region, including the village of Trebija (Verovnik et al. 2012), Slajka Hill, Makovce plateau, and Jelovica below Mt. Blegoš (own observations in 2020).

Among other observed butterflies, *Euphydryas* species were most common in extensive meadows, but are present also in wider area of Škofjeloško hribovje (Verovnik et al. 2012). The species *E. euryale* and *Erebia ligea* were found only on few occasions during the 2018 surveys, but were very common in 2017 and 2019 (own observations). Biennial development, resulting in much higher adult numbers in alternate years, is a common feature of this genus (Warren 1936, Kleckova et al. 2015). The low abundance of both species in 2018 could be attributed to constant rainy afternoons that dominated during flight period and to the lack of suitable nectar sources.

When compared to the nearby Cerkljansko-Idrijsko region and particularly its highest peak Mt. Porezen (1630 m), the butterfly fauna of Mt. Blegoš and Mt. Koprivnik is surprisingly richer, also containing more species characteristic of altitudes above 1,000 m (Verovnik 2000). This is especially evident even when comparing the number of species for the relatively close survey dates of 27.7.–2.8. for Mt. Porezen (4 localities) and 30.7. for Mt. Blegoš and Mt. Koprivnik (8 localities). The number of species found on these dates on Mt. Blegoš and Mt. Koprivnik reaches 42, while the number of species found on Mt. Porezen was only 24. This might be partially explained by the non-carboniferous soil dominating Mt. Porezen, and different climate surrounding the mountains. In terms of species characteristic for altitudes above 1,000 m, only *Erebia pronoe*, which is still common around the peak of Mt. Porezen, was not recorded on

Mt. Blegoš. Interestingly, there is a specimen of *E. pronoe* collected by Mate Hafner in 1911 in the collection of Slovenia NHM (Verovnik et al. 2012) from Mt. Blegoš, a record neglected in the overview by Carnelutti (1980).

Since the latest records of biodiversity in 1980, agricultural activities became more intensive. Yet, while predominantly lowland habitats are mostly machined and fertilized, many habitats at higher altitudes are in the final overgrowth phase due to isolated intensive grazing (sheep, goats and cattle) and abandonment of mowing (Ilešič 1938). The most obvious is the overgrowing of the higher meadows of Mt. Koprivnik, where mowing or grazing is completely absent. Only the meadows by the macadam road leading to Črni Kal below Mt. Koprivnik are intensively mown. On the other hand, the intensification of agriculture impacted the grazing activity in the highest meadows of Mt. Blegoš. Due to isolated grazing with cattle, some larval food or host plants, such as *Gentiana cruciata* and once common *Arnica montana*, are being diminished in number. Lower meadows are sparse and occur mainly in very steep and exposed areas, such as »Forest by the macadam« and »Likar's hayfield« transects. The latter presents the largest meadow area, where overgrowing is less problematic for the time being. Thus, habitat loss, due to rapid overgrowing and intensive grazing, is the greatest danger to the biodiversity of local butterflies. Some butterflies, like *Parnassius apollo*, have already disappeared presumably owing to this very reason.

Based on the uniqueness of the habitat and the diversity of butterflies found we defined 4 nature conservation important localities for butterflies in the region, based on the surveyed transect routes: »Mt. Koprivnik«, »Likar's hayfield«, »Forest by the macadam« and »Mt. Blegoš: meadow under the hilltop«.

Transects »Mt. Koprivnik« and »Likar's Hayfield« are the two most important sites with extensive meadows. Unfortunately, both localities, especially meadows of »Mt. Koprivnik«, are subject to overgrowing. Meadows of »Likar's hayfield« are especially characterised by the minor sub-Mediterranean influence as indicated by the presence of thermophilous species such as *Satyrium spini*, *Lysandra coridon*, *Minois dryas*, and *Hipparchia fagi*. The area consists of south-facing dry bushy grasslands, where in addition *Libelloides macaronius* is abundant, despite not being reported for the Škofjeloško hribovje (Devetak et. al. 2007). However, the find is not surprising, as it was also recently discovered in NW Slovenia on the Šentvid plateau (Torkar 2021). Both »Mt. Koprivnik« and »Likar's Hayfield« have the highest number of species recorded and are important for both – unique fauna and flora.

The »Forest by the macadam« represents the longest and most heterogeneous transect, consisting mainly of forest clearings, which is in the centre characterised by approximately 50 m of rocky cliffs. This unique habitat for the region hosts the two petrophilous species *L. petropolitana* and *E. stiria*. Despite not being listed as threatened in Slovenia or wider, their isolated occurrence on Mt. Blegoš is still of conservation importance.

The last among the important transects is »Mt. Blegoš: meadow under the hilltop«, which represents the largest open pasture partially intensively grazed by cattle. The impact of intensive grazing is manifested by trampled ground and low herbal height. The steeper rockier parts to the northeast of Mt. Blegoš peak are now mostly overgrown by trees. The locality is of particular conservation importance due to the presence of a small colony of *P. alcon* f. *rebeli* and its host plant *G. cruciata*.

From the conservation point of view, the presence of both *Euphydryas* species, *Parnassius mnemosyne*, *Lopinga achine* and *P. arion*, all included in the Annexes II and/or IV of the Habitats Directive, (OJ EC 1992) is of great importance. Their presence merits further investigations into their population size, distribution, threats and could provide foundations for long term conservation of their habitats and butterfly richness as a whole in both studied mountains.

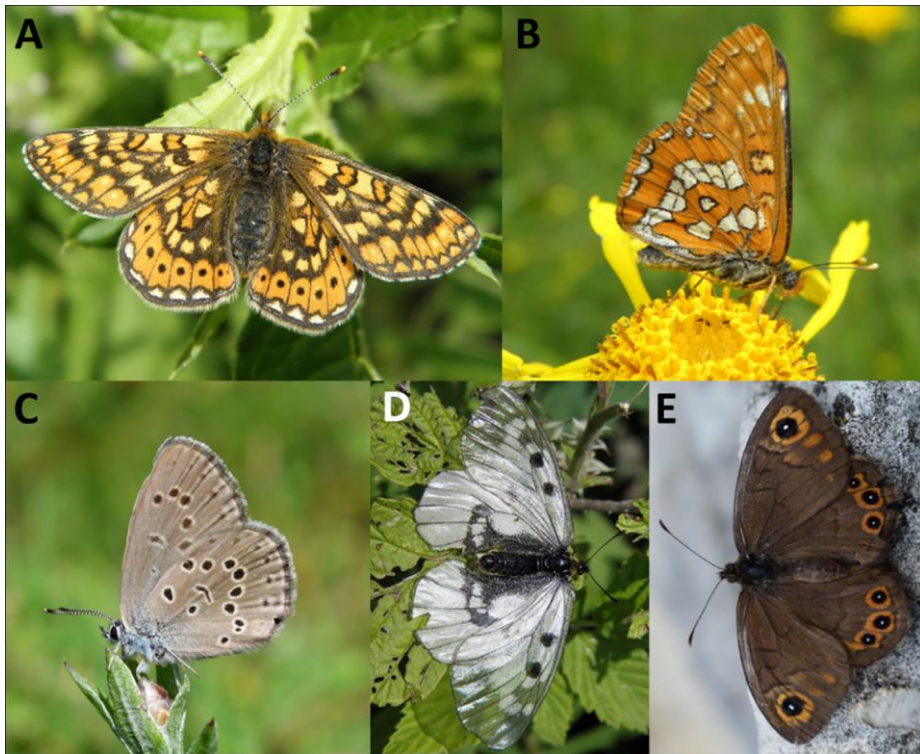


Figure 3. Selection of butterfly species of conservation concern found on Mt. Blegoš, Mt. Koprivnik and their surroundings: A – *Euphydryas aurinia* (Mt. Koprivnik, 3.6.2018); B – *Euphydryas maturna* (Likar's hayfield, 10.6.2018); C – *Phengaris alcon f. rebeli* (Mt. Blegoš: meadow under the hilltop, 20.7.2020); D – *Parnassius mnemosyne* (Mt. Koprivnik, 4.7.2017); E – *Lasiommata petropolitana* (Forest by the macadam, 2.6.2019)

Slika 3. Nekatere izmed naravovarstveno pomembnih vrst dnevnih metuljev, najdenih na Blegošu, Koprivniku in v njuni okolici: A – *Euphydryas aurinia* (Koprivnik, 3.6.2018); B – *Euphydryas maturna* (Likarjeva senožet, 10.6.2018); C – *Phengaris alcon f. rebeli* (Blegoš: travnik pod vrhom, 20.7.2020); D – *Parnassius mnemosyne* (Koprivnik, 4.7.2017); E – *Lasiommata petropolitana* (Gozd ob kolovozu, 2.6.2019)

Conclusions

The complete butterfly survey of Mt. Blegoš, Mt. Koprivnik and their surroundings, which took place between 27.5. and 8.9.2018 and included additional location-specific surveys in 2019 and 2020, yielded altogether 85 species, which amounts to 47 % of the butterfly fauna of Slovenia (Verovnik 2019). Among the surveyed species, 11 are defined as vulnerable or endangered in Slovenia or Europe (Ur. 1. RS 2002, Van Swaay et al. 2010).

The most interesting find is *P. alcon* f. *rebeli*, observed only in the high-lying pastures of Mt. Blegoš, not mentioned in the previous surveys. Abandonment of extensive farming, overgrowing of habitats and intensive grazing are the most likely causes for the absence of *Boloria pales*. The localities were also monitored for the presence of *Sedum album*, a larval food plant for the locally already extinct butterfly *P. apollo* (Carnelutti 1980), but unfortunately the plant has never been found.

The authors conclude that Mt. Blegoš and its wider surroundings are an important and biodiversity rich area worth preserving, and that its inclusion in the Natura 2000 conservation network is well deserved. The study also reveals some of the problems with the habitat loss which might arise in the future, due to the abandonment of mowing and grazing in certain areas. In order to preserve such habitats, the old farming practices should be re-implemented, wherever possible.

Povzetek

V članku predstavljamo popise favne dnevnih metuljev Blegoša in Koprivnika z njuno okolico, ki so potekali med 27. majem in 8. septembrom 2018 na 8 izbranih transektih. Med 14 popisi nam je uspelo zabeležiti 80 vrst dnevnih metuljev in njihovo število na posamezni popisni lokaciji/transektu. Med dodatnimi popisi v letih 2019 in 2020 smo opazili še 5 novih vrst metuljev, ki jih predhodno na teh lokacijah nismo našli. Vzorčenje je potekalo po principu metode transektnega monitoringa, kjer opazovalec počasi hodi po vnaprej začrtani poti in šteje metulje v vse smeri 2,5 m okoli sebe (levo, desno, spredaj in zgoraj) (Pollard 1977). Posamezne transekte, vključene v raziskavo, smo zbrali na podlagi nadmorske višine, dostopnosti in tipa habitata. Izmed zabeleženih metuljev zbujejo največ pozornosti *Parnassius mnemosyne*, *Lycaena hippothoe*, *Euphydryas maturna*, *Euphydryas aurinia*, *Melitaea britomartis*, *Melitaea diamina* in *Pyrgus alveus*, ki jih uvrščamo med ranljive vrste, medtem ko sta *Phengaris arion* in *Phengaris alcon* klasificirana kot ogroženi vrsti za Slovenijo. Medtem ko je bil *P. arion* najden na več kot eni lokaciji, je bil *P. alcon* zabeležen zgolj med dvema popisoma julija 2018 in 2020 na enem samem transektu. Njegova jajčeca smo leta 2018 našli tudi na rastlini *Gentiana cruciata* na isti lokaciji, a so bile do naslednjega popisa v juliju vse rastline že popasene. Med popisom smo posebno pozornost posvečali tudi vrstam, ki jih najdemo v visokogorju oz. na višjih nadmorskih višinah (nad 1000 m). Čeprav dveh vrst, ki smo ju tu beležili še pred nekaj desetletji, nismo našli (*Parnassius apollo*, *Boloria pales*) (Carnelutti 1980), so bile nekatere druge, kot so *Aricia artaxerxes*, *Pyrgus alveus*, *Erebia stiria* in *Lasiommata petropolitana*, najdene med popisi, zadnji dve vrsti zgolj na eni sami lokaciji. Slednja lokacija je bila tudi edina s strmejšim skalnatim previsom, kakršne je na Blegošu sicer že večinoma prerasel gozd. Posledično pričakujemo, da sta *E. stiria* in *L. petropolitana* tu redki vrsti, ki bi že v prihodnosti lahko dokončno izginili. Med popisom smo iskali tudi rastlino *Sedum album*, hranilno rastlino lokalno že izginulega metulja *Parnassius apollo*, vendar neuspešno. Izginitev hranilne rastline tega metulja gre pripisati zaraščanju skalnatih predelov Blegoša, kar je verjetno povezano tudi z izginitvijo še ene visokogorske vrste *Boloria pales*. V tem članku smo zato poudarili prav problem

izgube pomembnih habitatov v regiji zaradi zaraščanja in negativnega vpliva prekomerne paše. Na območju Koprivnika in določenih delih Blegoša je pašna aktivnost namreč opuščena, kar se kaže v zaraščanju ekstenzivnih suhih travišč, po drugi strani pa se na drugih predelih Blegoša pojavlja problem intenzivne paše z govedom, ki ogroža predvsem travniške vrste na vrhu in tik pod njim. V članku smo ocenili še pomembnost posameznih transektov kot tudi celotnega območja pri vključitvi v *Naturo 2000*.

References

- Carnelutti J. (1980): Metulji Blegoša in okolice, In: Ramovš A. (Ed.), Blegoš. Muzejsko društvo Škofja Loka, Škofja Loka, pp. 93-100.
- Čelik T., Verovnik R. (2020): Vpliv vojaških aktivnosti na ohranjanje vrstne pestrosti dnevnih metuljev na osrednjem vadišču slovenske vojske – poligon Poček. *Acta Biol. Slov.* 63(2): 45-63.
- Devetak D. (2007): A review of the owlflies of Slovenia (Neuroptera: Ascalaphidae). *Acta Entomol. Slov.* 15(2): 105-112.
- Ilešič S. (1938): Škofjeloško hribovje (Geografski opis Poljsanske in Selške doline). Zveza geografskih društev Slovenije, Ljubljana, 51 pp.
- Kleckova I., Vrba P., Konvicka M. (2015): Quantitative evidence for spatial variation in the biennial life cycle of the mountain butterfly *Erebia euryale* (Lepidoptera: Nymphalidae) in the Czech Republic. *Eur. J. Entomol.* 112(1): 114-119.
- Marinček L., Wraber T. (1980): Rastlinstvo Blegoša, In: Ramovš A. (Ed.), Blegoš. Muzejsko društvo Škofja Loka, Škofja Loka, pp. 93-100.
- Nadbath M. (2010): Meteorološka postaja Leskovica (Meteorological station Leskovica). Naše okolje, Agencija Republike Slovenije za Okolje, urad za Meteorologijo, Ljubljana, 6 pp.
- OJ EC (1992): Council Directive 92/43/EEC of 21. May 1992 on the conservation of natural habitats and of wild fauna and flora. *Official Journal of the European Communities L 206*, 22.7.1992: 7-50.
- Perko D., Orožen-Adamič M. (2001): Slovenija. Pokrajine in ljudje. Mladinska knjiga, Ljubljana, 735 pp.
- Pollard E. (1977): A method for assessing changes in the abundance of butterflies. *Biol. Conserv.* 12(2): 115-134.
- Šifrner M. (1974): Poglavitne značilnosti razvoja Škofjeloškega hribovja. *Loški razgledi* 21(1): 11-23.
- Tolman T., Lewington R. (2008): *Collins butterfly guide. The most complete guide to the butterflies of Britain and Europe.* HarperCollins Publishers Ltd., London, 384 pp.
- Torkar G., Drole B., Gomboc S. (2013): Contribution to the knowledge of the butterfly fauna (Lepidoptera: Rhopalocera) of the Šentvid plateau, NW Slovenia. *Acta Entomol. Slov.* 21(1): 47-58.
- Torkar G. (2021): Contribution to the knowledge on distribution of owl-fly *Libelloides macaronius* (Scopoli, 1763) in Slovenia, new records from the Šentvid plateau, NW Slovenia. *Acta Entomol. Slov.* 29(1): 113-116.

- Ur. l. RS (2002): Pravilnik o uvrstitvi ogroženih rastlinskih in živalskih vrst v rdeči seznam. Uradni list RS 82(02), 42(10): 6 pp.
- Ur. l. RS (2004a): Uredba o posebnih varstvenih območjih (območjih Natura 2000). Uradni list RS 14(49): 13173-13395.
- Ur. l. RS (2004b): Uredba o zavarovanih prosto živečih živalskih vrstah. Uradni list RS 57(93), 61(93) – popr., 69(00), 98(02) in 46(04): 20 pp.
- Van Swaay C., Cuttelod A., Collins S., Maes D., Munguira M. L., Šašič M., Settele J., Verovnik R., Verstrael T., Warren M., Wiemers M., Wynhoff I. (2010): European red list of butterflies. Publications Office of the European Union, Luxembourg, 58 pp.
- Verovnik R. (2000): A contribution to the knowledge of the butterfly fauna (Lepidoptera: Rhopalocera) of the Cerkljansko-Idrijsko region, west Slovenia, with notes on their vertical distribution. Nat. Slov. 2(2): 47-59.
- Verovnik R., Rebeušek F., Jež M. (2012): Atlas dnevnih metuljev (Lepidoptera: Rhopalocera) Slovenije, Atlas of butterflies (Lepidoptera: Rhopalocera) of Slovenia. Center za kartografijo favne in flore, Miklavž na Dravskem polju, 456 pp.
- Verovnik R. (2019): Prenovljeni seznam dnevnih metuljev (Lepidoptera: Papilionidea) Slovenije. Acta Entomol. Slov. 27(1): 5-15.
- Vertačnik G., Bertalanč R. (2017): Podnebna spremenljivost Slovenije v obdobju 1961-2011. 3, Značilnosti podnebja v Sloveniji. Ministrstvo za okolje in prostor, Agencija RS za okolje, Ljubljana, 197 pp.
- Warren B.C.S. (1936): Monograph of the genus *Erebia*. Adlard and Son, London, 407: 104 pp.
- Withrington D. (2003). Butterflies in Slovenia. LeWit, Peterborough, 39 pp.