NAT. CROAT. | VOL. 32 | No 1 | 127-142 | ZAGREB | June 30, 2023

original scientific paper / izvorni znanstveni rad
DOI 10.20302/NC.2023.32.8

BUTTERFLY FAUNA (LEPIDOPTERA: PAPILIONOIDEA) OF SVILAJA MOUNTAIN, DALMATIA

Rudi Verovnik[1], Gordana Glavan[1], Ivona Burić[2] & Toni Koren[2]

[1]University of Ljubljana, Biotechnical Faculty, Department of Biology, Jamnikarjeva 101, 1000 Ljubljana, Slovenia (rudi.verovnik@bf.uni-lj.si & gordana.glavan@bf.uni-lj.si)

[2]Association Hyla, I. Lipovac 7, 10000 Zagreb, Croatia (ivona.buric@hhdhyla.hr & toni.koren@hhdhyla.hr)

Verovnik, R., Glavan, G., Burić, I. & Koren, T.: Butterfly fauna (Lepidoptera: Papilionoidea) of Svilaja Mountain, Dalmatia. Nat. Croat., Vol. 32, No. 1, 127-142, Zagreb.

Svilaja is a 30 km-long mountain range in the Outer Dinarides in the hinterland of northern Dalmatia, between the rivers Cetina and Čikola. It has never been the target of systematic butterfly surveys and its fauna remained completely unknown. During our surveys from 2019 to 2022, we recorded 112 butterfly species at 37 sites. The butterfly richness of the Svilaja Mountain is higher than that of the Mosor and Kozjak Mountains nearer to the coast, but similar to that of the Biokovo Mountains and lower than that of the nearby, much larger Dinara Mountains. However, the biogeographical composition of the mountains compared is similar, with dominant Euro-Siberian and Euro-Oriental faunal elements, but an obvious decrease in the number of montane species in all other mountains compared to the Dinara Mountains. New records are discussed for some species for which there is little information for Croatia or Dalmatia, such as *Carcharodus orientalis*, *Pyrgus carthami*, *Tarucus balkanicus*, *Aricia artaxerxes*, *Polyommatus ripartii*, *Melitaea ornata*, *Melitaea athalia*, *Coenonympha rhodopensis* and *Hyponephele lupina*. Although most of Svilaja Mountain is part of the Natura 2000 network, many of the sites with high conservation value are located outside the area. Overall, the abandonment and overgrowth of grasslands present the most imminent threat to butterfly diversity in the region.

Key words: Croatia, distribution, faunistics, biogeography, conservation

Verovnik, R., Glavan, G., Burić, I. & Koren, T.: Fauna danjih leptira (Lepidoptera: Papilionoidea) planine Svilaje, Dalmacija. Nat. Croat., Vol. 32, No. 1, 127-142, Zagreb.

Svilaja je 30 km dugačak planinski lanac koji se nalazi u vanjskim Dinaridima u zaleđu sjeverne Dalmacije, između rijeka Cetine i Čikole. To područje nikada nije bilo predmetom nikakvih sustavnih istraživanja leptira, a njegova je fauna ostala potpuno nepoznata. Tijekom istraživanja provedenih od 2019. do 2022., na 37 lokaliteta zabilježili smo 112 vrsta leptira. Bogatstvo leptira na Svilaji veće je nego na planinama Mosoru i Kozjaku uz obalu, slično kao na Biokovu, a manje nego na obližnjem, mnogo većem masivu Dinare. Biogeografski sastav uspoređivanih planina je, međutim, sličan, s dominantnim euro-sibirskim i euro-orijentalnim faunističkim elementima, ali i očitim smanjenjem broja planinskih vrsta na svim tim planinama u usporedbi s masivom Dinare. Dodatno, raspravljeni su novi nalazi nekih vrsta s malo dostupnih podataka za Hrvatsku ili Dalmaciju, kao što su *Carcharodus orientalis, Pyrgus carthami, Tarucus balkanicus, Aricia artaxerxes, Polyommatus ripartii, Melitaea ornata, Melitaea athalia, Coenonympha rhodopensis* i *Hyponephele lupina*. Iako je veći dio planine Svilaje uključen u mrežu Natura 2000, mnoga područja visoke konzervacijske vrijednosti nalaze se izvan tog područja. Općenito najveću prijetnju raznolikosti leptira istraživane planine predstavlja napuštanje i zarastanje travnjaka.

Ključne riječi: Hrvatska, rasprostranjenost, faunistika, biogeografija, zaštita

INTRODUCTION

Svilaja (1508 m) is a prominent mountain in Dalmatian Zagora and belongs to the Outer Dinarides (Poljak, 2007). Its ridge extends about 30 km from the Adriatic coast in a north-west to south-east direction. Inland, it lies in the shadow of the higher Dinara mountains, including Dinara *sensu stricto* (1810 m), Troglav (1912 m) and Kamešnica (1855 m), the latter two peaks already across the border with Bosnia and Herzegovina. Svilaja Mountain is characterised by a predominantly karstic relief and is bordered by large poljes (Mućko Polje, Petrovo Polje, Sinjsko Polje, Vrličko Polje) at elevations between 300 and 400 m. The upper part of the ephemeral Čikola River to the west and the Cetina River with Lake Peruča to the east are other prominent geographical features that border the mountain (Fig. 1). The main ridge is about 30 km long and 15 km wide, with steep slopes towards the northeast and gentler slopes in other directions.

The geology is dominated by carbonate rocks, primarily Jurassic and Triassic limestones and dolomites (Papeš *et al.*, 1982). Svilaja Mountain has a moderately warm humid climate with hot summers according to Köppen's climate classification (Köppen & Geiger, 1954). The original vegetation was dominated by deciduous oak forests of the vegetation class *Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959 at lower altitudes, while mesophilic deciduous and mixed forests of the class *Carpino-Fagetea sylvaticae* Jakucs ex Passarge 1968 are present at higher altitudes and on the northern slopes of the mountain (Škvorc *et al.*, 2017; Milović *et al.*, 2020). However, in

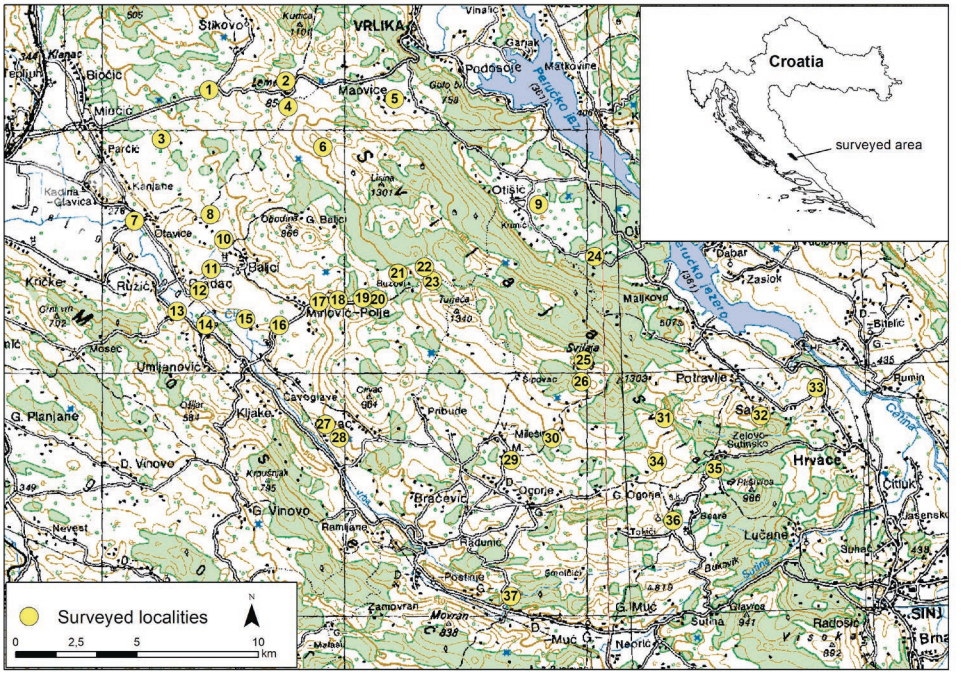

Fig. 1. Map of sampling localities where butterflies were surveyed on Svilaja Mountain. Localities are numbered from northeast to southwest and correspond to locality numbers in Materials and methods section.

the 19th and in the first half of the 20th century most of the mountain was devoid of forests due to widespread pasturing and conversion to arable land (Durbešić & Fuerst-Bjeliš, 2016). This trend has reversed significantly in the last 50 years due to depopulation of the region and cessation of grazing. Nevertheless, calcareous grasslands still dominate, especially on the southern slopes of the mountain, aided by regular wildfires in last two decades (Durbešić & Fuerst-Bjeliš, 2016).

Apart from a single record of *Proterebia phegea* in the northern part of Svilaja Mountain (Koren *et al*., 2010) and one of *Tarucus balkanicus* at the western edge of the mountain (Koren *et al*., 2022), we were unable to find any other published information on the butterfly fauna of the mountain. This is despite its historical proximity to well surveyed areas, such as Knin town (Hafner, 1994) and recent studies of the butterfly fauna of the neighbouring mountains Dinara (Tvrtković *et al*., 2012; Koren & Lauš, 2013), Kozjak (Koren *et al*., 2019), Mosor (Koren *et al*., 2020a), and Biokovo (Mihoci *et al*., 2011; Kačírek, 2017). Svilaja Mountain can however be considered one of the biodiversity hotspots for vascular flora in Dalmatia with 1285 taxa recorded (Milović *et al*., 2021).

The main aims of our study are: (1) to give a first comprehensive overview of the butterfly fauna (Papilionoidea) of the Svilaja Mountain, (2) outline the distribution of observed species, and (3) compare the biogeographical composition of the butterfly fauna with that of neighbouring mountains. We also discuss wider distribution patterns and potential threats to the selected species. The results of our study are an important contribution to the knowledge of the butterfly fauna in Croatia and represents a continuation of research focused on the mountains of the Dalmatian region.

MATERIALS AND METHODS

The field surveys were mainly conducted in the period from 2019 to 2022, but we also include unpublished records from previous years. Fieldwork was planned based on Google Earth imagery, favouring localities with diverse landscape and habitats, and in part, on the known distribution of butterfly larval host plants from Milović *et al.* (2021). A total of 37 localities were visited during the survey (Fig. 1), the most interesting of those on several occasions so as to cover the entire butterfly season.

The spatial processing and visualisation of the data was done with in the program ARC GIS desktop. Butterflies were identified using standard field guides (Lafranchis, 2004; Tolman & Lewington, 2008). Identification of the *Hipparchia fagi/syriaca* complex was based on examination of the male Jullien organ in the field (Lorković, 1976; Lafranchis, 2004). The specimens of the genera *Plebejus*, *Melitaea* and *Leptidea* were identified by examining the male or female genital structures. The nomenclature follows Wiemers *et al.* (2018). Comparisons of species composition among selected mountains were made based on biogeographical affiliations of the butterflies, generally following Kudrna *et al.* (2015). The conservation value of each locality was calculated by weighting the species included in the red lists of Croatia (Šašić *et al*., 2015) or Europe (Van Swaay *et al*., 2010): 2x for Near Threatened species (NT) and 3x for Vulnerable species (VU). In addition, species listed in the Annexes II and/or IV of the European Habitats Directive were weighted 5x. Each species was counted only once with the highest available weight.

List of localities

The list of localities contains the relevant toponyms, a short description of the habitat, altitude, coordinates, dates of the visits, and observers. Localities are arranged in geographical order from northwest to southeast (Fig. 1).

1. Miočić, Vukovića staje E of the village; partially overgrown pastures and calcareous grasslands; 565 m a.s.l.; 43°53′30.78″N, 16°17′41.38″E; 10.5.2019, 27.6.2019, 31.7.2019, Koren
2. Miočić, Lemeš pass, small gully N of the main road near the pass; rocky pastures, road verges, flower rich slopes; 750 m a.s.l.; 43°53′41.17″N, 16°20′3.55″E; 5.6.2021, 10.7.2021, 2.8.2021, 30.4.2022, Glavan, Verovnik
3. Miočić, along the side road E of the village at Raketića staje; rocky calcareous grassland in different stages of abandonment; 445 m a.s.l.; 43°52′26.34″N, 16°16′12.01″E; 10.5.2019, 27.6.2019, 31.7.2019, Koren, 5.6.2021, Glavan, Verovnik
4. Miočić, Lemeš pass, Režića staje E of the village; calcareous grasslands and pastures; 900 m a.s.l.; 43°53′6.89″N, 6°20′6.92″E; 10.5.2019, 27.6.2019, 31.7.2019, Koren, 8.9.2022, Bužleta
5. Maovice, grasslands E of the village cemetery; cultivated meadows, woodland edges; 420 m a.s.l.; 43°53′14.78″N, 16°23′23.73″E; 30.4.2022, Glavan, Verovnik
6. Svilaja, Debelo brdo, ridge south of the access road; rocky calcareous grasslands and pastures; 1060 m a.s.l.; 43°52′12.33″N, 16°21′9.70″E; 3.7.2009, 20.5.2010, Koren
7. Otavice, along the Čikola river at Bučići village; hay meadows, pastures, fields; 270 m a.s.l.; 43°50′38.11″N, 16°15′20.15″E; 8.5.2019, 27.6.2019, 29.7.2019, Koren, 27.4.2020, Martinović
8. Otavice, along the road N of Vulići settlement; mesic meadows, rocky calcareous grasslands and pastures; 440 m a.s.l.; 43°50′45.02″N, 16°17′40.26″E; 10.5.2019, Koren
9. Otišić, Krunići, along the road to Rosići village; partially overgrown calcareous grasslands; 420 m a.s.l.; 43°50′50.77″N, 16°27′46.44″E; 13.5.2020, Burić
10. Baljci, abandoned settlement and pastures NW of the village; track through deciduous woods, abandoned calcareous grasslands; 420 m a.s.l.; 43°50′11.45″N, 16°18′4.52″E; 25.4.2021, Glavan, Verovnik
11. Gradac, small valley along the road to Baljci; abandoned mesic meadow, rocky pasture, road verges and woodland edge; 355 m a.s.l.; 43°49′32.28″N, 16°17′40.15″E; 25.4.2021, 5.6.2021, Glavan, Verovnik, 25.9.2021, Verovnik
12. Gradac, below the slopes SE of the village; pastures, ruderal areas along the paths; 325 m a.s.l.; 43°49′3.73″N, 16°17′17.98″E; 25.4.2021, Glavan, Verovnik
13. Umljanović, Strunje, along the Čikola river N of the settlement; mesic meadows, edge of riparian woods; 280 m a.s.l.; 43°48′36.68″N, 16°16′36.19″E; 8.5.2019, 28.6.2019, 29.7.2019, 29.7.2019, Koren
14. Umljanović, along the road towards the Čikola river N of the village; humid hay meadows, orchards; 280 m a.s.l.; 43°48′17.55″N, 16°17′28.24″E; 8.5.2019, 28.6.2019, 29.7.2019, Koren
15. Mirlović polje, at a tributary spring of the Čikola River, W of the village Kanjovača; rocky grasslands, overgrown areas, riparian vegetation; 290 m a.s.l.;

43°48’25.01”N, 16°18’41.96”E; 8.5.2019, 27.6.2019, 29.7.2019, Koren, 25.4.2021, 5.6.2021, 2.8.2021, 29.7.2022, Glavan, Verovnik, 25.9.2021, Verovnik

16. Mirlović polje, along the road in a small gorge above the village Cerje; rocky slopes with thorny bushes, abandoned pastures, small pond; 355 m a.s.l.; 43°48’15.83”N, 16°19’44.05”E; 27.6.2019, 29.7.2019, Koren, 25.4.2021, 5.6.2021, 5.6.2022, Glavan, Verovnik, 25.9.2021, Verovnik
17. Mirlović polje, along the road below Donje Selo settlement; road verges, bushy slopes, mesic meadows; 450 m a.s.l.; 43°48’45.96”N, 16°20’58.16”E; 27.6.2019, 29.7.2019, Koren
18. Mirlović polje, glades along the road above the Donje Selo settlement; road verges, bushy slopes, mesic meadows; 510 m a.s.l.; 43°48’48.24”N, 16°21’33.48”E; 5.6.2022, 29.7.2022, Glavan, Verovnik
19. Mirlović polje, Buzovi, abandoned terraces E of the village; overgrown meadows with tall herbs; 680 m a.s.l.; 43°48’50.08”N, 16°22’18.07”E; 24.6.2022, Verovnik
20. Mirlović polje, along the road above and E of village Drvenjak; road verges, ruderal areas, open deciduous woods; 730 m a.s.l.; 43°48’49.39”N, 16°22’41.78”E; 5.6.2022, Glavan, Verovnik
21. Mirlović polje, grasslands at Prijeke Njive; flower rich calcareous hay meadows; 950 m a.s.l.; 43°49’22.36”N, 16°23’24.67”E; 5.6.2022, Glavan, Verovnik, 24.6.2022, Verovnik
22. Mirlović polje, rocky pastures W of Lepina dolina; partially overgrown pastures, calcareous grasslands; 1080 m a.s.l.; 43°49’30.38”N, 16°24’13.69”E; 24.6.2022, Verovnik
23. Mirlović polje, in Lepina dolina depression; humid grasslands, dry calcareous grasslands; 1040 m a.s.l.; 43°49’19.28”N, 16°24’24.75”E; 24.6.2022, Verovnik
24. Otišić, along the road sw of the Borkovići settlement; calcareous meadows, woodland edges; 420 m a.s.l.; 43°49’40.15”N, 16°29’28.10”E; 30.4.2022, Glavan, Verovnik
25. Svilaja, ridge to the SE and the peak of Mt. Svilaja; rocky calcareous grasslands, mesic meadows in small dolinas; 1440–1508 m a.s.l.; 43°47’22.30”N, 16°29’4.38”E; 10.7.2021, 2.8.2021, Glavan, Verovnik
26. Svilaja, around water reservoir S of the main peak; humid meadows, dry rocky pastures; 1240–1280 m a.s.l.; 43°46’53.73”N, 16°28’59.64”E; 10.7.2021, 2.8.2021, Glavan, Verovnik
27. Crivac, on a small hill with transmitter above Dolnje Polje village; abandoned rocky pastures with juniper bushes, woodland edge; 460 m a.s.l.; 43°46’0.27”N, 16°21’9.80”E; 25.4.2021, Glavan, Verovnik
28. Crivac, small gorge just above Dolnje Polje village; rocky slopes with thorny bushes, road verge; 430 m a.s.l.; 43°45’52.07”N, 16°21’16.37”E; 25.4.2021, 5.6.2021, 2.8.2021, Glavan, Verovnik
29. Donje Ogorje, along the road SE of Mala Milešina village; partially overgrown calcareous grasslands, pastures; 665 m a.s.l.; 43°45’10.92”N, 16°26’47.61”E; 10.5.2019, 27.6.2019, Koren
30. Svilaja, Milešina, along the road to Svilaja at Trolokve; overgrown calcareous grasslands, road verges; 940 m a.s.l.; 43°45’39.02”N, 16°28’3.57”E; 2.8.2021, Glavan, Verovnik

31. Svilaja, along the road at the Orlove Stine Mountain hut; flower rich calcareous grasslands, road verges, woods; 1030–1060 m a.s.l.; 43°46'3.24"N, 16°31'31.14"E; 30.6.2019, 31.7.2019, Koren, 5.6.2021, Glavan, Verovnik
32. Satrić, in the gorge, SE of the Lončari settlement; rocky slopes, abandoned pastures, orchards; 460 m a.s.l.; 43°46'4.22"N, 16°34'28.69"E; 30.4.2022, 29.7.2022, Glavan, Verovnik
33. Satrić, along the road E of the villages; overgrown calcareous grasslands, open pine woods; 440 m a.s.l.; 43°46'39.79"N, 16°36'12.16"E; 29.7.2022, Glavan, Verovnik
34. Svilaja, Gole kose, along the road at the turn to the Orlove Stine Mountain hut; flower rich calcareous grasslands, woodland edges; 920 – 950 m a.s.l.; 43°45'5.34"N, 16°31'16.24"E; 30.6.2019, 27.7.2019, 31.7.2019, Koren, 5.6.2021, 10.7.2021, 29.7.2022, Glavan, Verovnik, 12.6.2022, Burić
35. Zelovo, pastures and dolinas S of the village; calcareous grasslands, ruderal area along the road; 815 m a.s.l.; 43°44'54.43"N, 16°33'2.33"E; 30.4.2022, Glavan, Verovnik
36. Zelovo, Kokani, small gully N of the village; partially overgrown mesic meadows, woodland edges; 885 m a.s.l.; 43°43'46.61"N, 16°31'44.06"E; 12.6.2022, Burić
37. Gornje Postinje, along the road to Bidnići village; open pine woods, road verges, woodland edges; 505 m a.s.l.; 43°42'9.55"N, 16°26'43.07"; 21.6.2021, 25.6.2021, 2.7.2021, 31.7.2022, Đapić

RESULTS AND DISCUSSION

Our surveys provide the first comprehensive overview of the butterfly fauna of Svilaja Mountain including the foothills and edges of karst poljes bordering the mountain. However, it must be emphasised that part of the mountain range, particularly the central part of the main ridge, was inaccessible due to minefields and was not surveyed. Nevertheless, we are confident that our records provide a good phenological and geographical coverage of the butterfly fauna of the studied area.

Overall 112 butterfly species were recorded at 37 localities across Svilaja Mountain (Tab 1). More than 30 species were recorded at 10 localities, however, five of these harboured more than 50 species (loc. 2, 15, 16, 31, 34). The two most diverse localities are at the opposite ends of the mountain range at the turn for Orlove stine hut (loc. 34) in the southeast and Lemeš pass (loc. 2) in the northwest, with 73 and 61 species, respectively. Of the species observed, nine were recorded at 20 or more sites (Tab. 1) and could be considered widespread: *Iphiclides podalirius*, *Pieris ergane*, *Colias crocea*, *Aricia agestis*, *Polyommatus icarus*, *Lasiommata megera*, *Coenonympha pamphilus*, *Maniola jurtina*, and *Melanargia galathea*.

Several species with restricted ranges or considered rare in Croatia are discussed in more detail:

Carcharodus orientalis Reverdin, 1913

There are only limited records for the species from Croatia, and its distribution is not yet fully understood, possibly due to its similarity with other species of the genus. It has however been recorded from neighbouring regions of northern Dalmatia (Verovnik *et al.*, 2015), Kozjak Mountain (Koren *et al.*, 2019), Mosor Mountain (koren

Tab. 1. List of species observed from Svilaja Mountain with the locality numbers corresponding to the list of localities in Materials and methods section.

List of species	Locality number
Hesperiidae	
1. *Erynnis tages* (Linnaeus, 1758)	1, 2, 3, 4, 5, 6, 11, 12, 13, 14, 15, 18, 25, 28, 29, 31, 32, 34, 35
2. *Carcharodus alceae* (Esper, 1780)	5, 15, 16, 18, 19, 35
3. *Carcharodus orientalis* Reverdin, 1913	15, 16, 18, 28
4. *Carcharodus lavatherae* (Esper, 1783)	16, 25
5. *Spialia orbifer* (Hübner, 1823)	2, 3, 11, 15, 16, 20, 21, 22, 28, 29, 34
6. *Pyrgus armoricanus* (Oberthür, 1910)	2, 3, 11, 14, 15, 16, 18, 21, 31, 32, 34
7. *Pyrgus carthami* (Hübner, 1813)	34
8. *Pyrgus malvae* (Linnaeus, 1758)	5, 8, 9, 13, 14, 16, 24, 32, 34
9. *Pyrgus serratulae* (Rambur, 1839)	21, 25
10. *Pyrgus sidae* (Esper, 1784)	3, 16, 18, 21
11. *Thymelicus acteon* (Rottemburg, 1775)	3, 13, 15, 16, 17, 18, 21, 28, 29
12. *Thymelicus lineola* (Ochsenheimer, 1808)	4, 15, 26, 31, 34
13. *Thymelicus sylvestris* (Poda, 1761)	11, 14, 16
14. *Ochlodes sylvanus* (Esper, 1777)	2, 4, 15, 16, 18, 21, 22, 25, 26, 31, 34, 37
Papilionidae	
15. *Parnassius mnemosyne* (Linnaeus, 1758)	21, 34
16. *Iphiclides podalirius* (Linnaeus, 1758)	1, 2, 3, 4, 6, 8, 10, 11, 13, 14, 15, 16, 17, 19, 21, 22, 23, 26, 29, 30, 31, 32, 34, 36, 37
17. *Papilio machaon* Linnaeus, 1758	1, 2, 3, 4, 6, 7, 11, 12, 16, 18, 19, 25, 27, 30, 31, 34, 36
18. *Zerynthia polyxena* ([Denis & Schiffermüller], 1775)	2, 5, 7, 15, 24, 32, 35
Pieridae	
19. *Leptidea* cf. *sinapis* (Linnaeus, 1758)	2, 3, 5, 6, 7, 13, 14, 15, 24, 26, 31, 32, 34
20. *Anthocharis cardamines* (Linnaeus, 1758)	1, 2, 3, 6, 8, 10, 11, 14, 15, 16, 24, 27, 28, 32
21. *Aporia crataegi* (Linnaeus, 1758)	2, 4, 11, 16, 18, 21, 22, 23, 28, 31, 34, 36
22. *Pieris brassicae* (Linnaeus, 1758)	2, 10, 11, 12, 15, 16, 18, 25, 28, 32, 34, 35
23. *Pieris ergane* (Geyer, 1828)	1, 2, 3, 4, 6, 7, 9, 11, 12, 13, 14, 15, 16, 17, 18, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 34
24. *Pieris mannii* (Mayer, 1851)	10, 13, 15, 16, 24, 31, 34
25. *Pieris rapae* (Linnaeus, 1758)	3, 5, 7, 13, 14, 15, 16, 17, 18, 28, 31, 32
26. *Pieris balcana* Lorković, 1969	2, 7, 10, 13, 15, 29, 31, 34
27. *Pontia edusa* (Fabricius, 1777)	7, 14, 15, 16, 19, 26, 28, 34
28. *Colias crocea* (Geoffroy, 1785)	1, 2, 5, 7, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 25, 26, 27, 31, 32, 34, 36
29. *Colias alfacariensis* Ribbe, 1905	2, 6, 11, 15, 26, 28, 29, 31, 32, 34
30. *Colias hyale* (Linnaeus, 1758)	11

List of species	Locality number
31. *Gonepteryx rhamni* (Linnaeus, 1758)	1, 6, 9, 10, 13, 16, 18, 20, 21, 24, 31, 32, 34
32. *Gonepteryx cleopatra* (Linnaeus, 1767)	16, 18, 37
Lycaenidae	
33. *Lycaena phlaeas* (Linnaeus, 1760)	2, 11, 12, 14, 15, 16, 18, 19, 20, 21, 27, 32, 34, 35, 37
34. *Callophrys rubi* (Linnaeus, 1758)	1, 2, 6, 10, 15, 16, 24, 27, 28, 32, 34, 35
35. *Satyrium acaciae* (Fabricius, 1787)	2, 34
36. *Satyrium ilicis* (Esper, 1779)	2, 18, 19, 20, 21, 23, 31
37. *Satyrium spini* ([Denis & Schiffermüller], 1775)	1, 2, 4, 13, 15, 16, 18, 20, 21, 22, 23, 25, 26, 28, 31, 34, 37
38. *Satyrium w-album* (Knoch, 1782)	19
39. *Tarucus balkanicus* (Freyer, 1844)	15, 16
40. *Leptotes pirithous* (Linnaeus, 1767)	2, 13, 15
41. *Cupido minimus* (Fuessly, 1775)	1, 2, 3, 4, 7, 8, 9, 13, 14, 15, 16, 22, 31, 34
42. *Cupido osiris* (Meigen, 1829)	2, 20, 21
43. *Cupido argiades* (Pallas, 1771)	14, 15
44. *Celastrina argiolus* (Linnaeus, 1758)	2, 11, 13, 14, 15, 16, 18, 19, 20, 21, 31, 34
45. *Scolitantides orion* (Pallas, 1771)	2, 31, 34
46. *Pseudophilotes vicrama* (Moore, 1865)	2, 6, 11, 12, 13, 15, 16, 18, 25, 27, 32, 34
47. *Glaucopsyche alexis* (Poda, 1761)	1, 2, 3, 6, 7, 9, 10, 13, 14, 15, 16, 18, 21, 24, 27, 28, 29, 32
48. *Iolana iolas* (Ochsenheimer, 1816)	18, 20
49. *Phengaris alcon* ([Denis & Schiffermüller], 1775)	26, 34
50. *Plebejus argus* (Linnaeus, 1758)	2, 4, 7, 9, 11, 13, 14, 15, 16, 17, 18, 21, 25, 28, 29, 31, 33, 34
51. *Plebejus idas* (Linnaeus, 1761)	18, 21, 22, 23, 25, 28, 31, 34
52. *Plebejus argyrognomon* (Bergsträsser, 1779)	18
53. *Aricia agestis* ([Denis & Schiffermüller], 1775)	1, 2, 3, 7, 10, 11, 13, 14, 15, 16, 17, 19, 20, 21, 23, 25, 28, 29, 31, 34
54. *Aricia artaxerxes* (Fabricius, 1793)	21, 22, 34
55. *Cyaniris semiargus* (Rottemburg, 1775)	2, 16, 21, 26, 34
56. *Lysandra bellargus* (Rottemburg, 1775)	1, 2, 3, 7, 9, 11, 15, 16, 18, 20, 21, 28, 32, 34, 36
57. *Lysandra coridon* (Poda, 1761)	1, 2, 4, 25, 26, 31, 32, 33, 34
58. *Polyommatus escheri* (Hübner, 1823)	2, 11, 20
59. *Polyommatus dorylas* ([Denis & Schiffermüller], 1775)	2, 4, 11, 25, 26, 31, 34
60. *Polyommatus amandus* (Schneider, 1792)	21, 23, 31, 34
61. *Polyommatus icarus* (Rottemburg, 1775)	1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 21, 23, 26, 28, 29, 31, 32, 34, 37
62. *Polyommatus thersites* (Cantener, 1835)	2, 13, 18, 21, 22, 34
63. *Polyommatus admetus* (Esper, 1783)	2, 17, 21, 34
64. *Polyommatus ripartii* (Freyer, 1830)	2

List of species	Locality number
65. *Polyommatus daphnis* ([Denis & Schiffermüller], 1775)	2, 25, 31
Nymphalidae	
66. *Libythea celtis* (Laicharting, 1782)	2, 3, 4, 10, 15, 16, 18, 19, 20, 21
67. *Argynnis pandora* ([Denis & Schiffermüller], 1775)	4, 16, 18, 30, 33, 34
68. *Argynnis paphia* (Linnaeus, 1758)	2, 23, 25, 30, 31, 33, 34, 36, 37
69. *Fabriciana adippe* ([Denis & Schiffermüller], 1775)	1, 4, 31, 34
70. *Fabriciana niobe* (Linnaeus, 1758)	2, 4, 16, 18, 21, 22, 26, 28, 34, 36
71. *Speyeria aglaja* (Linnaeus, 1758)	4, 25, 26, 34
72. *Issoria lathonia* (Linnaeus, 1758)	1, 2, 4, 5, 11, 12, 14, 15, 16, 18, 21, 22, 24, 25, 26, 28, 31, 32, 34
73. *Vanessa atalanta* (Linnaeus, 1758)	2, 11, 15, 16, 31, 34, 35
74. *Vanessa cardui* (Linnaeus, 1758)	1, 3, 4, 7, 13, 14, 15, 16, 17, 18, 21, 22, 23, 25, 26, 31, 33, 34, 35
75. *Boloria dia* (Linnaeus, 1767)	34
76. *Brenthis daphne* (Bergsträsser, 1780)	34
77. *Brenthis hecate* ([Denis & Schiffermüller], 1775)	4, 16, 18, 19, 21, 23, 25, 26, 31, 34, 36
78. *Brenthis ino* (Rottemburg, 1775)	31, 34
79. *Aglais io* (Linnaeus, 1758)	31, 32, 35
80. *Aglais urticae* (Linnaeus, 1758)	31
81. *Nymphalis polychloros* (Linnaeus, 1758)	5, 18, 20, 21, 23, 28
82. *Nymphalis antiopa* (Linnaeus, 1758)	23
83. *Melitaea athalia* (Rottemburg, 1775)	31, 34
84. *Melitaea cinxia* (Linnaeus, 1758)	1, 2, 3, 6, 7, 8, 9, 15, 21, 24, 28, 29, 31, 34
85. *Melitaea didyma* (Esper, 1778)	2, 3, 4, 7, 11, 13, 15, 16, 17, 18, 21, 22, 28, 32, 36
86. *Melitaea phoebe* ([Denis & Schiffermüller], 1775)	15
87. *Melitaea ornata* Christoph, 1893	15, 16, 20, 29, 36
88. *Melitaea trivia* ([Denis & Schiffermüller], 1775)	4, 25, 34, 36
89. *Euphydryas aurinia* (Rottemburg, 1775)	1, 3, 6, 8, 10, 11, 21, 27, 31, 34
90. *Limenitis reducta* Staudinger, 1901	2, 3, 11, 13, 15, 16, 18, 21, 23, 26, 28, 30, 31, 32, 33, 34, 36, 37
91. *Neptis rivularis* (Scopoli, 1763)	26, 31, 34
92. *Lasiommata maera* (Linnaeus, 1758)	2, 4, 16, 21, 22, 31, 34, 36
93. *Lasiommata megera* (Linnaeus, 1767)	1, 2, 3, 5, 6, 8, 9, 10, 11, 12, 13, 15, 16, 20, 21, 22, 24, 25, 27, 28, 31, 32, 34, 35, 37
94. *Coenonympha arcania* (Linnaeus, 1760)	2, 31, 34, 36
95. *Coenonympha pamphilus* (Linnaeus, 1758)	1, 2, 3, 4, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 28, 29, 31, 32, 33, 34, 35, 36
96. *Coenonympha rhodopensis* (Elwes, 1900)	25
97. *Pyronia tithonus* (Linnaeus, 1771)	2, 34

List of species	Locality number
98. *Maniola jurtina* (Linnaeus, 1758)	1, 2, 3, 4, 7, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 26, 28, 29, 31, 33, 34
99. *Hyponephele lycaon* (Kühn, 1774)	25, 26
100. *Hyponephele lupina* (Costa, 1836)	2, 4, 21, 22
101. *Erebia medusa* ([Denis & Schiffermüller], 1775)	31, 34
102. *Proterebia phegea* (Borkhausen, 1788)	1, 2, 4, 5, 10, 11, 15, 16, 24, 27, 28, 29, 35
103. *Melanargia galathea* (Linnaeus, 1758)	1, 2, 3, 4, 7, 11, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 25, 26, 29, 31, 34, 36, 37
104. *Melanargia larissa* (Geyer, 1828)	16, 21, 25, 26, 28
105. *Satyrus ferula* (Fabricius, 1793)	25, 26, 31, 34
106. *Hipparchia fagi* (Scopoli, 1763)	4, 21, 22, 23, 25, 26, 32, 34
107. *Hipparchia statilinus* (Hufnagel, 1766)	11, 13, 15, 16, 33
108. *Hipparchia semele* (Linnaeus, 1758)	1, 2, 3, 4, 11, 14, 15, 16, 18, 20, 21, 22, 23, 25, 26, 31, 32, 34
109. *Hipparchia syriaca* (Staudinger, 1871)	2, 13, 14, 15, 16, 18, 32
110. *Brintesia circe* (Fabricius, 1775)	2, 3, 4, 11, 13, 14, 15, 19, 21, 22, 23, 25, 26, 31, 34
111. *Chazara briseis* (Linnaeus, 1764)	2, 4, 11, 15, 16, 26, 30, 33, 34
112. *Arethusana arethusa* ([Denis & Schiffermüller], 1775)	2, 34

et al., 2020a), and Biokovo Mountains (Kačirek, 2017). It is a typical thermophilous butterfly associated with rocky terrain in gorges and gullies along the Croatian coastline. This corresponds well with the habitats in Mirlović polje locations (loc. 15, 16, 18) and in the gully above Crivac village (loc. 28). A white flowering *Stachys* sp. and *Marrubium incanum* Desr. were present in abundance at those localities, representing possible local hostplants of the species (Tolman & Lewington, 2008). Adults were observed only at the beginning of June, so it is possible that they fly only in a single generation on the mountain. This is in stark contrast with the nearby coastal populations in northern Dalmatia, where they potentially develop up to three generations (Verovnik *et al.*, 2015).

Pyrgus carthami (Hübner, 1813)

It is a rather local species in Croatia, so far only reported from Istria (koren *et al.*, 2018), Velebit Mountains (Mihoci *et al.*, 2007; Tvrtković *et al.*, 2015), and the surroundings of Knin (Hafner, 1994). It is interesting to note that it was not found in the nearby Dinara Mountains despite intensive surveys (Tvrtković *et al.*, 2012; Koren & Lauš, 2013). The record from Svilaja Mountain is thus the southernmost confirmed sighting in Croatia. Two fresh males were observed on 5.6.2021 at the turn for Orlove stine hut (loc. 34), the most diverse locality on the mountain.

Tarucus balkanicus (Freyer, 1793)

The distribution and habitats of the species in Croatia have recently been reviewed (Koren *et al.*, 2022) including the record from Svilaja Mountain at the tributary spring

of Čikola River (loc. 15). In 2022, the species has been recorded from a nearby small gorge above the village Cerje (loc. 16). The distribution of the species on Svilaja Mountain is thus very limited despite the abundance of its hostplant *Paliurus spina-christi* Mill., one of the dominant species encroaching on abandoned pastures on the southwestern slopes of the mountain. It should be emphasized, that these locations are the furthest away from the coast among all those known for the species in Croatia.

Aricia artaxerxes (Fabricius, 1793)

This Boreo-Montane species is not limited to mountain areas as it also utilizes dry calcareous grasslands at lower elevations elsewhere in the region (Verovnik *et al.*, 2012). Its distribution in Croatia has been summarised by Koren (2012) and so far, it is known only from the high mountains in Gorski Kotar to the north and as far as Biokovo Mountains in the south (Mihoci *et al.*, 2011). It is also widespread on the nearby Dinara Mountains (Koren, 2012), so its presence on Svilaja Mountain was expected. However, it was observed on flower-rich calcareous grasslands on south facing slopes of the mountain at medium elevations (920– 1080 m), rather than on the highest peaks. At Prijeke Njive (loc. 21) it was flying together with thermophilous species such as *Pyrgus sidae*, *Cupido osiris*, *Polyommatus admetus* and *P. thersites*. It should be noted that on 23.6.2022 the species was observed imbibing minerals at Krupa Monastery (44°11'22.86"N, 15°53'12.91"E) at an altitude of only 100 m a.s.l. (Verovnik, pers. obs.), but it was likely lured down from nearby Velebit Mountains by extremely dry and hot early summer conditions.

Polyommatus ripartii (Freyer, 1830)

It has only recently been reported for Croatia from the spring of the Zrmanja River (Koren, 2010), and is now known from several localities in nearby Plješevica Mountain (Koren *et al.*, 2020b). The record from Mosor Mountain (Dincă *et al.*, 2013) has not been confirmed during recent intensive surveys (Koren *et al.*, 2020a). A numerous population was found in a small valley at Lemeš Pass (loc. 2) in 2021 representing the fourth distinct area of the distribution of the species in Croatia. It was syntopic with more widespread but still localized species in Croatia, *Polyommatus admetus*, *P. thersites*, and *Cupido osiris*, all utilizing the same host plant *Onobrychis* spp. growing in profusion on pastures and eroded slopes along a local unpaved road. Adults were congregating on flowering brambles amongst a large diversity of other blues.

Melitaea ornata Christoph, 1893

Due to its similarity to the more widespread *Melitaea phoebe* ([Denis & Schiffermüller], 1775), its distribution in Croatia is not well understood or documented (Koren & Štih, 2013). So far it has been recorded in Istria in the north, on the inland Medvednica Mountain near the capital city of Zagreb, and several locations along the Adriatic coast as far as Snježnica Mountain close to Montenegro in the southeast. It was recently recorded at several localities in northern Dalmatia (Verovnik *et al.*, 2015) and a single locality on Mosor Mountain (Koren *et al.*, 2020a), so its presence on Svilaja Mountain was anticipated. We found the species on several localities near Mirlovič polje (loc. 15, 16, 20), at Donje Ogorje (loc. 29), and Zelovo (36), all on the southwestern side of the mountain. The species prefers dry rocky terrain and was found syntopic with *Carcharodus orientalis* at several localities.

Melitaea athalia (Rottemburg, 1775)

Although considered the most widespread among *Melitaea* species in Croatia (Popović *et al.*, 2020), the records in Dalmatia are sparse, and the species was not recorded from any of the well surveyed mountain ranges further south (Mihoci *et al.*, 2011; Kačírek, 2017; Koren *et al.*, 2019; Koren *et al.*, 2020a). It has however been recorded in the nearby Dinara Mountains, which together with Svilaja Mountain possibly form the southern limit of the distribution of the species in Croatia. We observed the species at two localities along the road to Orlove stine hut (loc. 31, 34), possibly forming a single population on the mountain. Adults were numerous, commonly observed nectaring on diverse flowers in sheltered small karst dolinas.

Coenonympha rhodopensis (Elwes, 1900)

This is the only true Montane species occurring on Svilaja Mountain. It was recorded only once from the vicinity of the highest peak (loc. 25) on 10.7.2021. A single worn male was observed in more mesic conditions in a small dolina near the peak, indicating its preferences for tall grasses and sheltered conditions (Verovnik, pers. obs.). The specimen was recorded at the end of the flight period of the species, but additional surveys in peak season in mid-June elsewhere along the ridge in 2022 were unsuccessful. The species is widespread on the nearby Dinara Mountains (Tvrtković *et al.*, 2012; Koren & Lauš, 2013), Velebit Mountains (Mihoci *et al.*, 2007; Tvrtković *et al.*, 2015), and also the highest parts of Biokovo Mountains (Kačírek, 2017). Given the current climate change, it could be considered the most threatened butterfly species in Svilaja Mountain and is likely to go extinct here in the coming decades.

Hyponephele lupina (Costa, 1836)

The species is known from the nearby Knin region (Hafner, 1994), Zrmanja and Karišnica valleys in northern Dalmatia (Koren *et al.*, 2011; Verovnik *et al.*, 2015) with a historic record from Kozjak Mountain (Stauder, 1921–1923). It was recorded from two separate areas on Svilaja Mountain at Lemeš Pass (Loc. 2, 4) and above Mirlović polje (loc. 21, 22) at medium elevations (950–1080 m a.s.l.). These are the highest recorded localities for the species in Croatia; until recently the species has been considered limited to lowland coastal areas (koren *et al.*, 2019) and replaced by the more widespread *H. lycaon* at higher elevations. True to this statement *H. lycaon* was observed only at the highest peak and its southern slopes on Svilaja Mountain, so at higher altitudes than *H. lupina*.

It is also worth mentioning the indicative absence of the two typical forest species *Pararge aegeria* (Linnaeus, 1758) and *Polygonia c-album* (Linnaeus, 1758), which are otherwise widespread in the Dalmatian hinterland (Verovnik *et al.*, 2015; Koren *et al.*, 2020a) and have even been reported from some islands (Withrington & Verovnik, 2008). A possible explanation could be the large-scale deforestation of Svilaja Mountain in the 19th and first half of the 20th century (Durbešić & Fuerst-Bjeliš, 2016) which led to a lack of mature forests on the mountain. However, it is likely that both species will be found in the future in particularly in the higher parts of the north-east facing slopes of the mountain.

A comparison of the biogeographical affiliation of the butterfly species of the selected mountains of Dalmatia and its hinterland (Tab. 2) reveals some similarities be-

Tab. 2. Comparison of the butterfly diversity and the biogeographic composition (modified from Kudrna *et al.*, 2015) among selected mountain ranges of Dalmatia aligned in the northwest-southwest direction. Altitudinal span of the sampled localities in each mountain is added. ES - Euro-Siberian, EO - Euro-Oriental, Mon – Montane or Boreo-Montane, Hol - Holarctic, EM - Euro-Meridional, MED - Mediterranean.

Mountain	Altitudinal span (m)	No. of species	ES	EO	Mon	Hol	EM	MED	other
Dinara	250–1910	128	61	42	8	6	8	0	3
Svilaja	270–1508	112	52	40	2	7	8	1	2
Kozjak	110–740	87	35	34	0	7	6	1	4
Mosor	50–1100	96	38	41	1	7	5	1	3
Biokovo	90–1760	116	47	45	3	6	7	4	4

tween them, in particularly the dominance of the Euro-Siberian and Euro-Oriental elements in all mountains. However, more Euro-Siberian species are present in the two northern ranges, Dinara and Svilaja, than in the southern three ranges which are also closer to the Adriatic coast. Montane elements are underrepresented in all selected mountains compared with Dinara Mountains with eight species. On Svilaja Mountain, only *Coenonympha rhodopensis* (Montane) and *Aricia artaxerxes* (Boreo-Montane) were observed. The lack of sufficient altitude and a developed subalpine vegetation belt are the main reasons for this. On the other side of the biogeographical spectrum, the Biokovo Mountains, which rise steeply from the Adriatic coast, host four Mediterranean species, while among these only *Gonepteryx cleopatra* is represented on Svilaja Mountain and none on Dinara Mountains.

Among the butterfly species recorded from Svilaja Mountain, eleven are listed in threat categories in the Croatian national Red Data Book: *Phengaris alcon* as Vulnerable (VU), and *Papilio machaon*, *Zerynthia polyxena*, *Parnassius mnemosyne*, *Glaucopsyche alexis*, *Pseudophilotes vicrama*, *Scolitantides orion*, *Polyommatus thersites*, *Euphydryas aurinia*, *Proterebia phegea*, *Erebia medusa* as Near Threatened (NT) (Šašić *et al.*, 2015). Additionally, eight species are listed in the European Red List of Butterflies as near threatened (Van Swaay *et al.*, 2010): *Thymelicus acteon*, *Carcharodus lavatherae*, *Iolana iolas*, *Pseudophilotes vicrama*, *Polyommatus dorylas*, *Chazara briseis*, *Hipparchia statilinus*, and *Parnassius mnemosyne*. Four species recorded in the area are included in the European Habitats Directive Annexes II and/or IV: *Parnassius mnemosyne*, *Zerynthia polyxena*, *Euphydryas aurinia*, and *Proterebia phegea*. The latter is registered as a qualifying species for the Natura 2000 site HR2000922-Svilaja, which includes most of the main range of the mountain. Although *P. phegea* is likely widespread on Svilaja Mountain, most of the localities where we recorded the species are outside the designated Natura 2000 site. Furthermore, all but one locality with a conservation value above 50 are outside the boundaries of the Natura 2000 site (Fig 2). This could be significant as possible further development of windmill fields could seriously threaten these local biodiversity hotspots.

As in other parts of Dalmatia, especially in the hinterland, two contrasting changes in agricultural practices can be observed: abandonment of hay meadows or pasturing leading to grasslands becoming overgrown, and intensification of grazing causing severe grassland degradation and erosion. The latter is rarely observable on Svilaja Mountain, while the abandonment is omnipresent as most grassland areas visited were

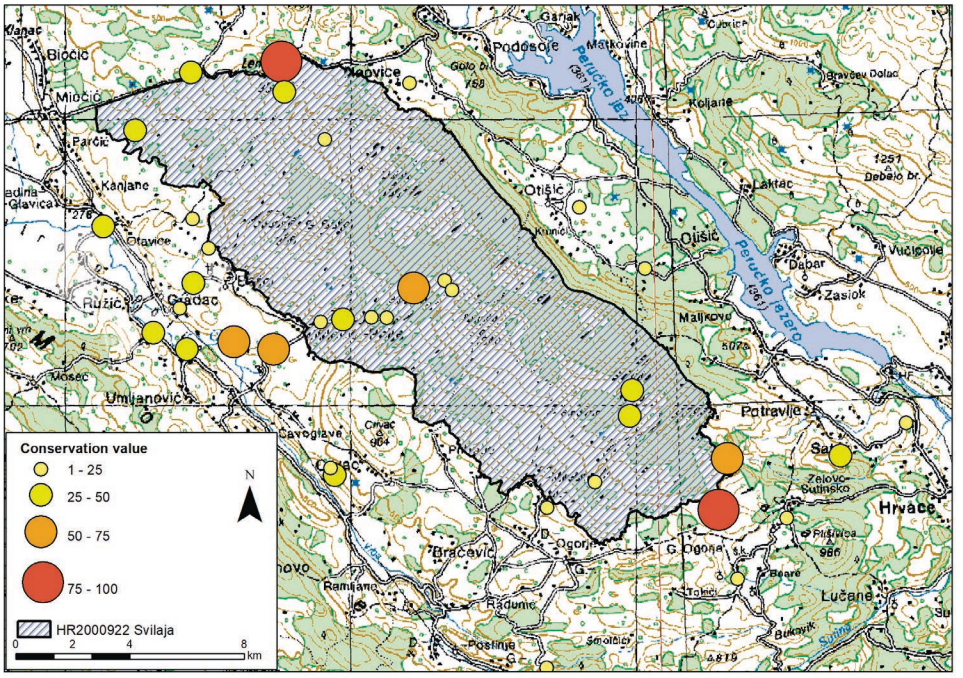

Fig. 2. Conservation value of individual localities on Svilaja Mountain in relation to the designated Natura 2000 area.

in different stages of becoming overgrown. The early stages of abandonment favour the diversity of a local butterfly fauna, but soon grassland habitat specialist species start to decline. Restoring light grazing is therefore of great importance to the maintenance of butterfly-rich habitats on Svilaja Mountain. Localities with the highest butterfly diversity and with the presence of species of conservation concern should be prioritized for habitat management when feasible.

ACKNOWLEDGMENTS

We are grateful to Jan Verovnik, Matea Martinović, Filip Bužleta, Katarina Koller Šarić and Ivan Đapić for their help during field work and collation of data with Biologer application. The surveys were in part funded by the Slovenian research agency (program P1-0184). This research was done with the permit of Ministry of environment and sustainable development: UP/1-612-07/21-48/65; 517-10-1-1-21-5.

Received December 8, 2022

REFERENCES

Dincă, V., Runquist, M., Nilsson, M. & Vila, R., 2013: Dispersal, fragmentation, and isolation shape the phylogeography of the European lineages of *Polyommatus (Agrodiaetus) ripartii* (Lepidoptera: Lycaenidae). The Biological Journal of the Linnean Society **109**, 817–829.

Durbešić, A. & Fuerst-Bjeliš, B., 2016: Tipovi i trendovi promjene pejzaža planine Svilaje – Ogorje, Ekonomska i Ekohistorija **12** (12), 208–221.

Hafner, I., 1994: Verzeichnis der bei Knin gesammelten Schmetterlinge (Lepidoptera). Natura Croatica **3** (2), 119–184.

Kačírek, A., 2017: Contribution to the knowledge of the butterfly fauna (Lepidoptera: Papilionoidea, Hesperioidea) of the Biokovo and Rilić mountain ranges (Croatia, Central Dalmatia). Klapalekiana **53**, 27–50.

Köppen, W. & Geiger, R., 1954: Klima der Erde. Darmstadt: Justus Perthe.

Koren, T., Lauš, B., Burić, I., Štih, A., Kulijer, D., Dender, D., Kranželić, D., Schmidt, B. & Verovnik, R., 2022: New records of *Tarucus balkanicus* at the northern limit of its distribution along the Adriatic coast (Lepidoptera: Papilionoidea, Lycaenidae). Fragmenta entomologica **54** (1), 143–150.

Koren, T., Burić, I., Glavan, G. & Verovnik, R., 2020a: The butterfly (Lepidoptera: Papilionoidea) diversity of Mt. Mosor in Dalmatia, Croatia. Natura Sloveniae **22**(2), 43–68.

Koren, T., Lauš, B., Tvrtković, N. & Verovnik, R., 2020b: Butterfly diversity of Lička Plješevica Mountain chain, Croatia (Lepidoptera: Papilionoidea). Shilap Revista de lepidopterología **48** (190), 257–283.

Koren T., Burić, I., Glavan, G. & Verovnik, R., 2019: Contribution to the knowledge of the butterfly fauna (Lepidoptera: Papilionoidea) of Mt Kozjak, Split, Croatia. Natura Croatica **28**, 21–33.

Koren T., Withrington D., Štih A. & Gros, P., 2018: The butterflies of the Istria county (Istria, Croatia): A review of their distribution, status and conservation requirements (Lepidoptera, Rhopalocera). Gortania. Botanica, Zoologia **40**, 95–114.

Koren, T. & Lauš, B., 2013: Dinara Massif – a new hotspot for the butterfly (Papilionoidea) diversity of the Dinaric Arc. Nota Lepidopterologica **36**, 109–126.

Koren, T. & Štih A., 2013: On the occurrence of Eastern knapweed fritillary, Melitaea ornata (Lepidoptera: Nymphalidae) in Croatia. Phegea **41** (3), 63–66.

Koren, T., Bjelić, M., Božinovska, E., Štih, A. & Burić, I., 2011: Contribution to the knowledge of butterfly fauna (Lepidoptera: Rhopalocera) of Zrmanja river region Croatia. Acta Entomologica Slovenica **19** (2), 155–168.

Koren, T., 2010: First finding of Ripart's Anomalous Blue *Polyommatus (Agrodiaetus) ripartii* (Freyer, 1830) (Lepidoptera, Lycaenidae) in Croatia. Natura Croatica **19**, 463–467.

Koren, T., 2012: New records of three species of the genus *Aricia* Reichenbach, 1817 (Lepidoptera, Lycenidae) in Croatia. Acta Entomologica Slovenica **20** (2), 135–146.

Koren, T., Burić, I., Štih, A., Zakšek, V. & Verovnik, R., 2010: New data about the distribution and altitudinal span of the Dalmatian ringlet, Proterebia afra dalmata (Godart, [1824]) (Lepidoptera: Satyrinae) in Croatia. Acta Entomologica Slovenica **18**, 143–150.

Kudrna, O., Pennerstorfer, J. & Lux, K., 2015: Distribution Atlas of European Butterflies and Skippers. Peks, Schwanfeld, pp. 632.

Lafranchis, T., 2004: Butterflies of Europe. Diatheo, Paris. 351 pp.

Lorković, Z., 1976: Taxonomische, ökologische und chorologische Beziehungen zwischen Hipparchia *fagi* Scop., *H. syriaca* Stgr. und *H. alcyone* D.&S. (Lepidopt. Satyridae). Acta entomologica Jugoslavica **12**, 11–33.

Mihoci, I., Hršak, V., Kučinić, M., Mičetić Stanković, V., Delić, A. & Tvrtković, N., 2011: Butterfly diversity and biogeography on the Croatian karst mountain Biokovo: Vertical distribution and preference for altitude and aspect? European Journal of Entomology **108**, 623–633.

Mihoci, I., Šašić, M. & Vuković, M., 2007: Contribution to the butterfly fauna (Hesperoidea & Papilionoidea) of the Velebit mountain, Croatia. Natura Croatica **16**, 29–62.

Milović, M., Pandža, M., Jasprica, N., Tafra, D. & Krpina, V., 2021: The vascular flora of Mt Svilaja (Outer Dinarides, South Croatia). Natura Croatica **30** (1), 85–144.

Milović, M., Jasprica, N., Tafra, D., Pandža, M. & Krpina, V., 2020: Prirodna obilježja Svilaje s pregledom istraživanja flore i vegetacije. Glasnik Hrvatskog botaničkog društva **8** (1) 29–50.

Papeš, J., Marinković, R., Raić, V., Magaš, N. & Sikirica, V., 1982: Osnovna geološka karta sfrj 1:100000, list Sinj K 33–10. Geološki zavod, Zagreb, Savezni geološki zavod, Beograd.

Poljak, Ž., 2007: Hrvatske planine, Cjeloviti hrvatski planinarski atlas. Zagreb: Golden marketing – Tehnička knjiga. 513 pp. Popović, M., Vasić, N., Koren, T., Burić, I., Živanović, N., Kulijer, D. & Golubović, A., 2020: Biologer: an open platform for collecting biodiversity data. Biodiversity Data Journal **8**.

Stauder, H., 1921–1923: Die Schmetterlingsfauna der illyro-adriatischen festland- und inselzone (faunula illyro-Adriatica). Zeitschrift für wissenschaftliche Insektenbiologie, Berlin **16** (1/2): 16–23, (3/4): 43–49, (5/6): 101–108, (7/8): 143–153, (9/10): 166–176, (11/12): 219 –224; **17** (1/2): 14–21, (3/4): 58–64, (5/6):

83–92, (7/8): 135–147, (9/12): 165–176; **18** (1/2): 10–18, (3/4): 58–68, (5/7): 106–114, (8/9): 187–202, (10/11): 253–267, (12): 317–327.

Šašić, M., Mihoci, I. & Kučinić, M., 2015. Crvena knjiga danjih leptira Hrvatske. Ministarstvo zastite okolisa i prirode, Drzavni zavod za zastitu prirode, Hrvatski prirodoslovni muzej, Zagreb, 180 pp.

Škvorc, Ž., Jasprica, N., Alegro, A., Kovačić, S., Franjić, J., Krstonošić, D., Vraneša, A. & Čarni, A., 2017: Vegetation of Croatia: Phytosociological classification of the high-rank syntaxa. Acta Botanica Croatica **76** (2), 200–224.

Tolman, T. & Lewington, R., 2008: Collins butterfly guide the most complete field guide to the butterflies of Britain and Europe. Collins, London. 384 pp.

Tvrtković, N., Verovnik, R., Lovrenčić, L., Vuković, M. & Šašić, M., 2015: New contributions to the knowledge of the butterfly fauna of Mt Velebit and the neighbouring area of Lika (Croatia). Natura Croatica **24**, 281–292.

Tvrtković, N., Šašić, M., Mihoci, I., Vuković, M. & Bjelić, M., 2012: Review of the butterfly fauna (Hesperioidea & Papilionoidea) of the Dinara mountain range. Natura Croatica **21**, 471–481.

Van Swaay, C., Cuttelod, A., Collins, S., Maes, D., López Munguira, M., Šašić, M., Settele, J., Verovnik, R., Verstrael, T., Warren, M., Wiemers, M. & Wynhof, I., 2010. European Red List of Butterflies. Publications Office of the European Union, Luxembourg, viii + 48 pp.

Verovnik, R., Koren, T. & Glavan, G., 2015: Contribution to the knowledge of the butterfly and skipper fauna of northern Dalmatia mainland. Natura Croatica **24** (2), 265–280.

Verovnik, R., Rebeušek, F. & Jež, M., 2012: Atlas of Butterflies (Lepidoptera: Rhopalocera) of Slovenia. Center za kartografijo favne in flore, Miklavž na Dravskem polju, 456 pp.

Wiemers M., Balletto E., Dincă V., Fric Z. F., Lamas G., Lukhtanov V., Munguira M.L., Van Swaay C.A.M, Vila R., Vliegenthart A., Wahlberg N. & Verovnik, R., 2018: An updated checklist of the European Butterflies (Lepidoptera: Papilionoidea). Zookeys **811**, 9–45.

Withrington, D. K. J. & Verovnik, R., 2008: Butterflies (Rhopalocera) of the Croatian islands. Entomologist's Gazette **59**, 3–25.