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Contribution to the knowledge of the butterfly fauna (Lepidoptera: Papilionoidea) of Central Slovenia

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Abstract. The southwestern Posavsko hills and northern Suha krajina are among the least studied areas regarding the butterfly fauna in Slovenia. To fill this knowledge gap, we selected all unpublished records of butterflies since 2014, in addition to the focused field surveys performed in the 2019–2022 period. We recorded a total of 105 butterfly species, presenting almost 60% of all species found in Slovenia. Among the species found, there are several habitat specialists of high conservation importance, e.g., *Leptidea morsei*, *Euphydryas aurinia*, *Parnassius mnemosyne*, *Phengaris arion*, *Carcharodus floccifera*, *Lycaena dispar*. Locations harbouring these species and those with the highest species richness are of great importance for preserving the diverse butterfly fauna of the region.

Key words: southwestern Posavsko hills, northern Suha krajina, faunistics, conservation, field surveys, species richness

Izvleček. Prispevek k poznavanju favne metuljev (Lepidoptera: Papilionoidea) centralne Slovenije – Jugozahodni del Posavskega hribovja in severni del Suhe krajine sta glede favne dnevnih metuljev v Sloveniji med najslabše raziskanimi območji. V ta namen smo med letoma 2019 in 2022 opravili serijo usmerjenih popisov, zraven pa so vključeni še neobjavljeni podatki od leta 2014 naprej. Skupaj smo zabeležili 105 vrst metuljev, kar pomeni skoraj 60 % vseh vrst dnevnih metuljev, najdenih v Sloveniji. Med najdenimi vrstami so bile tudi take, ki so pomembne z naravovarstvenega vidika, npr. *Leptidea morsei*, *Euphydryas aurinia*, *Parnassius mnemosyne*, *Phengaris arion*, *Carcharodus floccifera*, *Lycaena dispar*. Lokacije z omenjenimi vrstami, kot tudi tiste z največjo pestrostjo, so pomembne za ohranitev velike pestrosti metuljev te regije.

Ključne besede: jugozahodno Posavsko hribovje, severna Suha krajina, favnistika, naravovarstvo, terenski popisi, vrstna pestrost

Introduction

Among the least studied parts of Slovenia in terms of butterflies are the southwestern Posavsko hills and northern Suha krajina between the Krka and Sava Rivers in Central Slovenia. No extensive surveys of butterflies were undertaken in the region, with only a few records included in the Atlas of Butterflies of Slovenia and its supplement (Verovnik et al. 2012; Čelik 2013). Most of the past surveys and data collection were carried out during the designation of Natura 2000 network in order to outline the distribution species under the Habitat Directive (OJ EC 1992; Ur. l. RS 2004a) or under the Regulation on protected wild animal species (Ur. l. RS 2004b). Based on these surveys, Suha krajina and Mirenščica were recognised as areas of conservational importance for butterflies (Čelik et al. 2005) due to the presence of two species listed in Annex II of the Habitat Directive, and in Annex I and II of the Regulation on protected wild animal species (OJ EC 1992, Ur. L. RS. 2004a, 2004b), *Leptidea morsei* and *Euphydryas aurinia*, while previous data also highlighted Moravška Gora, where both mentioned species were also found (Verovnik et al. 2012). Due to their presence, these localities are still regularly surveyed, and the results of these surveys are included in this report. However, since only two qualifying species were recognised, these areas were not included in Natura 2000 (Ur. L. RS 2004a). Consequently, only small parts of the studied area are covered by the network, mostly towards the south near the Krka River (Krka s pritoki, SI3000338), around Trebnje (Trebnje, SI3000382; Vejar, SI30000056; Vrhtrebnje – Sv. Ana, SI3000057) and around Mirna (Mirna, SI3000059) (Ur. L. RS 2004a). It must be additionally noted that none of the existing Natura 2000 areas were designated for butterflies' species listed in Annex II of the Habitat Directive. The past surveys indicated a potential high butterfly diversity of the studied region especially due to presence of several specialist species uncommon in central Slovenia, e.g. *Lycaena dispar*, *Polyommatus thersites*, *Polyommatus dorylas*, *Parnassius mnemosyne*, *Pyrgus armoricanus*, *Carcharodus floccifera*, etc. (Čelik et al. 2005; Verovnik et al. 2012; Čelik 2013), some of which are also included in the Regulation on protected wild animal species (Ur. L. RS 2004b). With this in mind, a more extensive survey of the area was needed, focusing on wide coverage of the surveyed region and targeted search for rare or threatened species.

Materials and methods

Geographical description of the studied region

The surveyed region cannot be described as a well-defined unit, and is composed from several geographical/regional units: Dolenjsko podolje, Suha krajina with Dobrepolje and southwestern part of Posavsko hills. According to Perko (1998) and its new regionalisation of Slovenia, the area lies at the boundary between the Dinaric and Alpine macro-regions. The first is represented mainly by Dinaric plains, valley systems and corrosion plains in the south, while the second is composed mainly of Alpine hills in the north. These parts of Slovenia are known for their typical temperate continental climate (Ogrin 1996), with 1300–1800 mm of annual rainfall, while the average year temperatures are around 7–10 °C, depending on altitude and other factors (Vrtačnik & Bertalanič 2017).

Topographically, the studied region is not diverse as it consists mainly of hilly terrain between two river valleys, with some small valleys and basins where bigger towns are situated. It is mostly covered with hills which rarely rise above 600 m, with the highest being Obolno at 776 m just north of the Stična village. The hills north of Ivančna Gorica-Trebnje (A2) highway are generally slightly higher, while the hills south of the highway rarely exceed 500 m, with Trebni vrh being the highest at 581 m (Požar 2005). The largest part of the region consists of limestone and dolomite bedrock, with a few deposits of clays and silts in some basins and valleys (e.g., Ivančna Gorica) (Perko 1998). The predominant vegetation consists of beech, chestnut, oak, fir, European hornbeam and partly birch, while south-facing slopes are locally dominated by red pine (parts of Moravška Gora). Cultivation, settlements and pastures are concentrated around larger towns like Ivančna Gorica, Trebnje, Mirna and along the Krka River (Perko 1998). The particularly important characteristic of the region, however, are its still relatively widely preserved dry, and partially humid extensive grasslands, which provide important habitats for many butterfly species.

The approximate surveying borders in this study were set between the Krka River (Krka-Žužemberk) in the south, the line connecting Žužemberk-Mirna Peč-Mokronog towns in the east, Mokronog-Velika Preska-Šmartno pri Litiji towns in the north, and Šmartno pri Litiji-Prežganje-Polica-Krka towns in the west (Fig. 1).

Field work

The surveys of the area took place from 2014–2022, with the majority of research performed during the summer of 2019, March–November of 2020 and summer of 2022. During each survey, the entire area of the chosen locality was thoroughly checked, with all found butterfly species recorded. Records made prior to 2014 are not included, since they were already published in the Atlas of Butterflies of Slovenia or in its supplement (Verovnik et al. 2012; Čelik 2013). In total, 70 localities were surveyed throughout the region, however, most localities are concentrated in the areas where extensive grasslands abound (Fig. 1). The surveying was performed using a butterfly net and identification was done in the field. Butterflies were not collected, therefore genital dissection needed for separation of *Leptidea sinapis/juvernica* species complex was not carried out. The butterflies were determined using the standard butterfly guide (Tolman and Lewington 2008), while localities were selected based on our past surveys (Moravška Gora, Debeče, Vodice pri Gabrovki, Pusti Javor, Leskovec, Metnaj, Osredek nad Stično, Tlaka, Primskovo and Lisec; all the previously surveyed localities are included in the Atlas of Butterflies of Slovenia or in its supplement (Verovnik et al. 2012; Čelik 2013)), knowledge of the region, and from the inspection of satellite photos/maps. All surveys were performed during appropriate weather conditions (sunny, relatively light wind, temperatures above 15 °C) between 9:00–18:00.

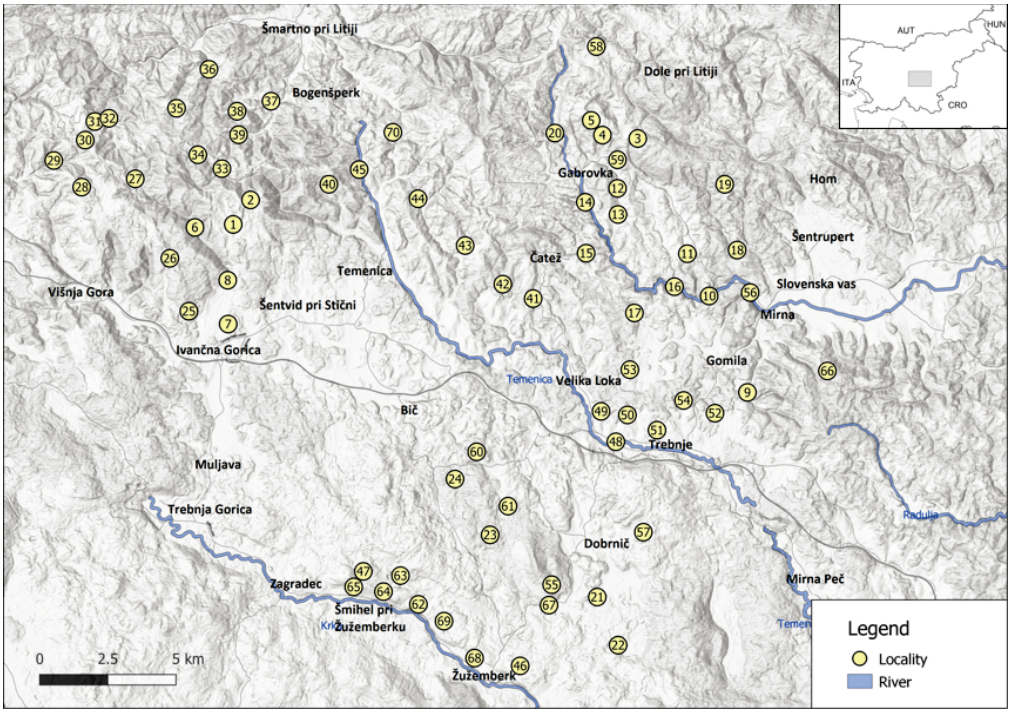

Figure 1. Map of the southwestern Posavsko hills and northern Suha krajina with the included localities surveyed between 2014 and 2022. Numbers refer to description of localities in Tab. 1. The position of the surveyed area within the country is shown with a grey square in the upper right corner.

Slika 1. Zemljevid severozahodnega dela Posavskega hribovja in severnega dela Suhe krajine z vključenimi lokacijami, pregledanimi med 2014 in 2022. Številke lokalitet so enake opisom lokalitet v Tab. 1. Položaj raziskovanega območja znotraj države je prikazan s sivim kvadratom zgoraj desno.

Results and discussion

General overview of localities and species

During the surveys, 44 localities were closely examined once, while 26 localities were surveyed at least twice. Most butterfly species were found at three localities at least, while nine species were found at two localities and eight species at a single one. During the surveying of the region, a total of 105 species or species complexes were found representing almost 60% of all species found in Slovenia (Verovnik 2019). Among these three species belonged to the family Papilionidae, 12 to Pieridae, 32 to Lycaenidae, a single one to Riodinidae, 45 to Nymphalidae, and 12 to Hesperiidae. Species found at more than half of the surveyed localities could be considered common in the region and include: *Colias crocea*, *Gonepteryx rhamni*, *Pieris rapae*, *L. sinapis/juvernica*, *Polyommatus icarus*, *Coenonympha pamphilus*, *Maniola jurtina*, *Melanargia galathea*, and *Ochlodes sylvanus*. Unsurprisingly, these species are also widespread in other parts of Central Slovenia (Verovnik et al. 2012).

With addition of eight species recorded only in previous surveys (*Colias hyale*, *Pieris ergane*, *Lysandra coridon*, *Nymphalis antiopa*, *Euphydryas maturna*, *Limenitis populi*, *Fabriciana (Argynnis) niobe* and *Pyrgus alveus*) (Verovnik et al. 2012; Čelik 2013), a total of 113 have been recorded from this part of central Slovenia so far. This puts the region among the most diverse in continental Slovenia, comparable with the Haloze and Goričko regions further eastwards – both with 109 species recorded (Verovnik 2000; Verovnik 2003; Verovnik et al. 2012). This is still somewhat less diverse compared to the two main centres of butterfly diversity at the junction with the sub-Mediterranean region in the Vipava Valley and at Kraški rob closer to the coast, with more than 130 species recorded (Verovnik et al. 2012).

Among the species observed, 22 are included in the red list of butterflies of Slovenia (Ur. l. RS 2002), 15 in the European red list of butterflies (Van Swaay et al. 2010), eight in the Regulation on protected wild animal species (Ur. l. RS 2004b), and five in the Directive on the conservation of natural habitats and of wild fauna and flora (OJ EC 1992) (Tab. 3).

Most species-rich localities are (in order of most species found): Moravška Gora, Žužemberk, Brezovo and Vrh pri Križu, and Vrhovo pri Žužemberku (Tab. 1). It is not surprising that the localities Moravška Gora and Brezovo are relatively close to one another, which is also true for localities Vrh pri Križu, Vrhovo pri Žužemberku and Žužemberk. In the case of the Moravška Gora and Brezovo localities, they are located near the northern border of the surveyed area at a relatively high altitude, both above 550 m. Characteristic of both localities are warm and dry extensive grasslands, and open deciduous woods on calcareous bedrock, which are sometimes replaced by pines. The entire area has a strong karst outlook, which is additionally increased by the abundance of large satyrids (e.g. *Hipparchia fagi*). In the case of Moravška Gora, especially near the village road, small gardens and orchards are also abundant, which additionally enrich the flora of the area. This abundance of habitat types, specific geographical location, as well as the presence of still relatively preserved areas of extensive grasslands are the main reasons for the vide variety of butterfly species.

The main habitat characteristics of the localities Vrh pri Križu, Vrhovo pri Žužemberku and Žužemberk, on the other hand, are the combination of humid and dry extensive grasslands, as well as woodlands with clearings in different stages of overgrowth. Thus, many different habitat specialists can be found in the area (e.g. *L. dispar*, *Lycaena hippothoe* and *C. floccifera* characteristic for humid, and *Melitaea aurelia*, *M. britomartis* and *Brenthis hecate* characteristic for dry extensive grasslands). All three localities are situated at the southern edge of the surveyed area, near the Krka River, at altitudes around 300 m, and have at least some karst characteristics including smaller valleys, exposed rocky terrain, etc. Combination of the mentioned characteristics, which include dry and humid extensive grasslands, riparian vegetation near the Krka River, rocky outcrops, as well as orchards, forest edges, etc., is reflected in high species richness, which is characteristic for low altitude, karst, habitat-rich areas in Slovenia, e.g., Vipava Valley, areas around Dragonja/Sečovlje villages, etc. (Verovnik et al. 2012; Čelik 2013).

Table 1. The list of localities surveyed during the study, including the description of locality and its habitat, coordinates, altitude, and date(s) of surveys. Coordinates are given in a WGS-84 decimal degrees, latitude (Lat.) followed by longitude (Long.). Abbreviations of names on the given surveying date refer to: AP – Andrej Peternel, LŠ – Luka Šturm, RV – Rudi Verovnik and JZ - Jure Zaman.

Tabela 1. Seznam lokalitet, vzorčenih med študijo, skupaj z opisom lokalitete in habitata, koordinat, nadmorske višine in datumom/ov vzorčenj(a). Koordinate so podane v WGS-84-decimalnih stopnjah kot zemljepisna širina (Lat.) in zemljepisna dolžina (Long.). Okrajšave imen ob datumih posamičnih vzorčenj pripadajo: AP – Andrej Peternel, LŠ – Luka Šturm, RV – Rudi Verovnik in JZ – Jure Zaman.

No.	Name	Description	Habitat type	Coordinates (Lat, Long)	Altitude (m)	Date	No. of species
1	Grasslands on slopes 200 m E of Metnaj; N of Ivančna Gorica		Dry grasslands; forest edge	45.979046, 14.810992	540	31.05.2014 (RV); 18.7.2019 (AP, JZ)	13
2	Grasslands 130 m W of Pristava nad Stično; N of Ivančna Gorica		Hay meadows; forest edge	45.987053, 14.819198	550	31.05.2014 (RV)	6
3	Grasslands 300 m E and S of Brezovo: NE of Gabrovka		Dry extensive and intensive grasslands; forest edge	46.007416, 14.997887	620	13.5.2018, 2.5.2020, 1.5.2021, 11.8.2022 (RV); 21.07.2019 (AP, LŠ, JZ), 9.8.2022 (AP, LŠ)	51
4	S slopes at Moravška Gora; N of Gabrovka		Dry grasslands; forest edge, road verges, open woods	46.008222, 14.985342	560	13.5.2018, 2.5.2020, 1.5. and 1.6. 2021, 11.8.2022 (RV); 21.07.2019 (AP, LŠ, JZ); 7.5.2020 (AP, JZ); 9. and 20.5.2021 (JZ), 9.8.2022 (AP, LŠ)	62
5	Grasslands 300 m SE of Zgornje Vodice; N of Gabrovka		Hay meadows; forest edge	46.013036, 14.980054	660	13.5.2018, 2.5.2020, 1.5. and 30.5.2021 (RV)	21
6	Meadows 800 m NW of Potok village, along Stiški potok stream; Gabrje pri Stični; N of Ivančna Gorica		Humid grasslands; forest edge	45.978070, 14.792910	420	16.6.2019 (AP, LŠ); 18.7.2019 (AP, JZ); 19.07.2019 (LŠ)	39
7	Grasslands at the elementary school, S of Stična; N of Ivančna Gorica		Intensive grasslands; forest edge	45.946490, 14.808600	350	18.7.2019 (AP, JZ)	10
8	Small river valley of Stiški potok, 50 m N of Gabrje pri Stični; N of Ivančna Gorica		Shrub and flowers along the stream; forest edge	45.960810, 14.808390	390	18.7.2019 (AP, JZ)	11
9	Grasslands 300 m SE of Lanšprež manor, near Gomilščica stream; Gomila; N of Trebnje		Humid grasslands; forest edge	45.924140, 15.053820	270	19.7.2019 (AP, JZ); 27.10.2019, 7.3. and 3.5.2020 (JZ);	21
10	Grasslands S, SE and E of Migolska Gora, around Mirenščica stream; N of Trebnje		Humid grasslands; forest edge	45.955660, 15.035740	290	19.7.2019 (AP, JZ); 6.8.2021, 3.7.2022 (JZ)	24
11	Grasslands 450 m SW of Selo pri Mirni, near Homščica stream; N of Trebnje		Humid grasslands; forest edge	45.969480, 15.025430	350	19.7.2019 (AP, JZ)	5

No.	Name Description	Habitat type	Coordinates (Lat, Long)	Altitude (m)	Date	No. of species
12	Overgrowing grasslands 450 m S of Pretržje, near Gabrovščica stream; SE of Gabrovka	Partially overgrowing humid meadows; forest edge	45.990830, 14.992470	350	19.7.2019 (AP, JZ)	5
13	Grasslands and shrubs 450 m NE of Tlaka; S of Gabrovka	Dry grasslands; forest edge	45.982300, 14.992700	340	19.7.2019 (AP, JZ)	17
14	Grasslands beneath the ruins of Turn castle, near Turnska Cerknica stream; Gabrska Gora; SW of Gabrovka	Humid grasslands; forest edge	45.986280, 14.977260	330	19.7.2019 (AP, JZ)	7
15	Grasslands 50 m S of Okrog (Dule), near Dušica stream; S of Gabrovka	Humid grasslands; forest edge	45.969640, 14.977640	330	19.7.2019 (AP, JZ)	9
16	Grasslands 250 m S of Selska Gora, near Mirenščica stream; N of Trebnje	Humid grasslands; forest edge	45.958710, 15.019350	300	19.7.2019 (AP, JZ)	10
17	Forest clearing and grasslands 450 m NW of Mala Ševnica, near Cedilnica stream; N of Trebnje	Partially overgrown humid grasslands; forest edge	45.950120, 15.000450	300	19.7.2019 (AP, JZ)	11
18	Grasslands NW of Trstenik, 250 S of Srasle, along the Trstenik-Zabukovje road; Srasle; NE of Mirna	Humid grasslands; forest edge	45.970665, 15.048959	280	21.07.2019 (AP, LŠ, JZ)	11
19	Grasslands 350 m N of quarry at Gorenje Zabukovje, near stream Ločica; Zabukovje; NW of Mirna	Humid grasslands, forest edge	45.992150, 15.043090	360	21.07.2019 (AP, LŠ, JZ); 24.6.2020, 14.6.2021 (JZ)	24
20	Grasslands in a small valley 50 m E of Hohovica; NW of Gabrovka	Humid grasslands; shrubs	46.008900, 14.962910	360	21.07.2019 (AP, LŠ, JZ)	18
21	Grasslands 600 m S and SE of Korita; S of Trebnje	Intensive grasslands; forest edge	45.857172, 14.982919	250	22.07.2019 (LŠ)	8
22	Grasslands 400 m W of Podlipa; NE of Žužemberk	Humid grasslands; forest edge	45.841410, 14.992745	250	22.07.2019 (LŠ)	19
23	Grasslands and forest clearings 700 m N and NE of Volčja Jama; N of Žužemberk	Dry grasslands; forest edge and clearings	45.877523, 14.932309	340	22.07.2019 (LŠ)	19
24	Grasslands 600 m S of Babna Gora; W of Trebnje	Intensive grasslands; forest edge	45.895795, 14.915733	320	22.07.2019 (LŠ)	10
25	Grasslands and shrubs on slopes SW of Stična; N of Ivančna Gorica	Dry grasslands; forest edge, shrubs	45.950694, 14.790047	420	23.07.2019 (LŠ, JZ)	13
26	Grasslands 900 m NE of Velika Dobrava; NW of Ivančna Gorica	Intensive grasslands; forest edge	45.967970, 14.781077	540	23.07.2019 (LŠ, JZ)	21

No.	Name Description	Habitat type	Coordinates (Lat, Long)	Altitude (m)	Date	No. of species
27	Grasslands 1100 m E of Leskovec, near Stiški potok stream; NW of Ivančna Gorica	Dry grasslands; forest edge	45.993935, 14.764731	540	23.07.2019 (LŠ, JZ)	18
28	Grasslands and slopes 850 m W of Leskovec; NW of Ivančna Gorica	Dry grasslands; forest edge	45.991234, 14.739448	740	23.07.2019 (LŠ, JZ)	14
29	Grasslands on slopes 700 m SW of Mali Vrh pri Prežganju, near Veliki potok stream; NE of Grosuplje	Dry and humid grasslands; forest edge	45.999935, 14.726270	480	23.07.2019 (LŠ, JZ)	15
30	Gasslands and clearing 200 m S of Veliko Trebeljevo; SW of Litija	Intensive grasslands; forest edge	46.006583, 14.741094	540	23.07.2019 (LŠ, JZ)	10
31	Grasslands on slopes 400 m E of Veliko Trebeljevo; SW of Litija	Dry grasslands; forest edge	46.012669, 14.745662	500	23.07.2019 (LŠ, JZ)	21
32	Grasslands near Reka stream, 850 m E of Veliko Trebeljevo; SW of Litija	Intensive grasslands; forest edge	46.013711, 14.752331	380	23.07.2019 (LŠ, JZ)	16
33	Grasslands and slopes 250 m W and SW of Debeče, near Bukovica stream; S of Litija	Humid and dry grasslands; forest edge	45.997272, 14.805665	530	23. and 24.07.2019 (LŠ, JZ)	14
34	Grasslands and slopes at Osredek nad Stično; SW of Litija	Dry grasslands; forest edge	46.001805, 14.794284	620	24.07.2019 (LŠ, JZ)	17
35	Grasslands and slopes in a small valley 400 m W of Jastrebnik; SW of Litija	Humid and dry grasslands; forest edge	46.016975, 14.784236	420	24.07.2019 (LŠ, JZ)	14
36	Grasslands and slopes 200 m S of Volčja Jama; SW of Litija	Dry grasslands; forest edge	46.029719, 14.799543	340	24.07.2019 (LŠ, JZ)	13
37	Grasslands and slopes at Podroje, near Koški potok stream; S of Litija	Humid and dry grasslands; forest edge	46.019302, 14.828849	300	24.07.2019 (LŠ, JZ)	30
38	Grasslands and slopes 350 m S of Kot, near Koški potok stream; S of Litija	Humid and dry grasslands; forest edge	46.016018, 14.812797	330	24.07.2019 (LŠ, JZ)	22
39	Clearings 1250 m SW of Vintarjevec, near Vintarjevški potok stream; S of Litija	Partially overgrowing clearings; forest edge	46.008348, 14.813535	340	24.07.2019 (LŠ, JZ)	11
40	Grasslands on slopes 100 m NE of Bukovica (Cerovec); S of Litija	Dry grasslands; forest edge	45.992163, 14.856168	480	24.07.2019 (LŠ, JZ)	13
41	Grasslands 900 m NW of Mačkovec; NW of Trebnje	Partially overgrowin humid grasslands; forest edge	45.954820, 14.952630	320	25.7.2019 (AP, JZ)	14
42	Grasslands 750 m N of Dolga Njiva pri Šentlovrencu; NW of Trebnje	Humid extensive and intensive grasslands; forest edge	45.959520, 14.938300	330	25.7.2019 (AP, JZ)	14

No.	Name Description	Habitat type	Coordinates (Lat, Long)	Altitude (m)	Date	No. of species
43	Grasslands 150 m N of Primskovo, near Laniški potok stream; NW of Trebnje	Humid grasslands; forest edge	45.972150, 14.920530	340	25.7.2019 (AP, JZ)	20
44	Grasslands on slopes W of Mišji dol; NE of Ivančna Gorica	Dry grasslands; forest edge	45.987440, 14.898270	380	25.7.2019 (AP, JZ)	14
45	Grasslands at Pusti Javor, along Temenica-Prečna stream; S of Litija	Humid grasslands; forest edge	45.996970, 14.870488	380	25.7.2019 (AP, JZ)	29
46	Grasslands on slopes 250 m E of Zafara; E of Žužemberk	Dry grasslands; forest edge	45.834630, 14.946490	310	26.7.2019 (AP, JZ)	12
47	Grasslands on slopes 350 m N of Valična vas; NW of Žužemberk	Dry grasslands; forest edge	45.865560, 14.872430	400	26.7.2019 (AP, JZ)	15
48	Grasslands around Štefan pri Trebnjem, also near Temenica-Prečna stream; W of Trebnje	Humid grasslands; shrub	45.907994, 14.991682	280	Mar.-Jun., Avg. 2020 (JZ)	22
49	Grasslands between and N of Kamni Potok and Gorenja Nemška vas; W of Trebnje	Dry grasslands; forest edge	45.917945, 14.984703	300	Mar.-May 2020 (JZ)	31
50	Grasslands around both Pekel/Studenec, mainly to the N; NW of Trebnje	Humid grasslands; forest edge	45.916776, 14.997149	300	Mar.-Jul., Nov. 2020, 8.5.2021 (JZ)	39
51	Grasslands around both Trebnje/Praproče settlements	Humid grasslands; forest edge	45.911781, 15.011120	290	Mar.-Jun. 2020 (JZ)	27
52	Grasslands 200 m E of Primštal; NE of Trebnje	Intensive grasslands; forest edge	45.917342, 15.038491	310	3.4. and 14.5.2020 (JZ)	7
53	Grasslands at Blato, and near Blato pond; N of Trebnje	Intensive grasslands; forest edge and shrubs	45.931561, 14.998300	320	Apr., Nov. 2020 (JZ)	12
54	Grasslands at Gorenje Medvedje selo, mostly to the N; N of Trebnje	Dry grasslands; forest edge	45.921505, 15.023672	310	Apr.-Jun. 2020 (JZ)	32
55	Grasslands at the SE of Lisec; SW of Trebnje	Dry grasslands; forest edge and shrubs	45.861220, 14.961370	380	7.5.2020 (AP, JZ); 8.8.2021, 18.4., 16.10.2022 (JZ)	30
56	Partially overgrown grasslands at Mirna pond; Mirna; NE of Trebnje	Intensive grasslands; riparian vegetation	45.956794, 15.055127	260	25.6.2020, 3.7.2022 (JZ)	3
57	Grasslands 250 m W and N of Dolenji Vrh; S of Trebnje	Dry grasslands; forest edge	45.878407, 15.004673	450	12.7.2020 (JZ)	4
58	Grasslands 170 m SE of Mala Goba; N of Gabrovka	Dry grasslands; forest edge	46.037143, 14.982466	700	1.5.2021 (RV)	5
59	Grasslands at Gabrovka, E of the school	Intensive grasslands; forest edge	46.000162, 14.992439	420	1.5. and 21.6.2021 (RV)	28

No.	Name	Description	Habitat type	Coordinates (Lat, Long)	Altitude (m)	Date	No. of species
60	Grasslands 600 m NW of Gorenje Selce; W of Trebnje		Humid grasslands; forest edge	45.904710, 14.925960	380	5.6.2022 (JZ)	27
61	Grasslands 100 m NE of Dolenje Kamenje pri Dobrniču; SW of Trebnje		Dry grasslands; forest edge	45.886930, 14.940770	320	5.6.2022 (JZ)	19
62	Grasslands 350 m SE of Vrh pri Križu; NW of Žužemberk		Humid grasslands; forest edge	45.854780, 14.898450	270	16.5. and 11.8. 2022 (RV), 5.6.2022 (JZ), 12.6.2022 (LŠ, JZ), 9.8.2022 (AP, LŠ)	51
63	Grasslands 650 m NW of Vrh pri Križu; NW of Žužemberk		Dry grasslands; forest edge	45.864190, 14.889990	350	16.5. and 11.8.2022 (RV), 5.6.2022 (JZ)	31
64	Small lake in an abandoned quarry 600 m E of Valična vas; NW of Žužemberk		Ruderal sandy areas; shrubland;	45.858940, 14.881950	300	20.5. and 11.8.2022 (RV), 5.6.2022 (JZ)	25
65	Abandoned quarry 300 m W of Valična vas; NW of Žužemberk		Rocky and sandy slopes; open woods	45.860490, 14.867890	360	16.5.2022 (RV), 5.6.2022 (JZ)	11
66	Grasslands 100 m N of Debenec; NE of Trebnje		Dry grasslands; forest clearings	45.931158, 15.091570	440	11.6. and 3.7.2022 (JZ)	20
67	Grasslands 150 m W of Dobrava; NE of Žužemberk		Dry and humid grasslands; forest edge	45.854510, 14.960126	260	12.6.2022 (LŠ, JZ)	29
68	Grasslands 250 m NW of Žužemberk		Dry and humid grasslands; forest edge	45.837185, 14.924976	270	12.6.2022 (LŠ, JZ), 9.8.2022 (AP, LŠ), 16., 31.10.2022 (JZ)	54
69	Grasslands and forest clearings 600 m E of Vrhovo pri Žužemberku; NW of Žužemberk		Dry and humid grasslands; forest edge	45.849283, 14.910535	260	12.6.2022 (LŠ, JZ), 9.8.2022 (AP, LŠ)	46
70	Grasslands at the E edge of Višnji Grm, near the main road; SE of Litija		Dry grasslands; forest edge	46.009140, 14.886415	460	1.6.2021 (RV)	6

Table 2. The list and occurrence of butterfly species found during the 2014–2022 surveys in southwestern Posavsko hills and northern Suha krajina in Central Slovenia. The localities are indicated by numbers from 1 to 70 as in the list and description of localities.

Tabela 2. Seznam in pojavljanje vrst dnevnih metuljev, opaženih med popisi , opravljenimi v obdobju 2014–2022 na območju jugozahodnega dela Posavskega hribovja in severnega dela Suhe krajine v centralni Sloveniji. Lokacije so označene s številkami od 1 do 70 kot v seznamu in opisu lokacij.

Family/Species	**Locality number(s)**
Papilionidae	
Iphiclides podalirius (Linnaeus, 1758)	3, 4, 6, 10, 13, 19, 22, 25, 26, 27, 28, 30, 31, 32, 36, 37, 41, 44, 45, 48, 50, 53, 54, 55, 63, 66, 68
Papilio machaon Linnaeus, 1758	3, 4, 23, 26, 28, 31, 33, 35, 43, 48, 49, 50, 51, 52, 53, 54, 55, 61, 62, 66, 68
Parnassius mnemosyne (Linnaeus, 1758)	3, 49
Pieridae	
Leptidea morsei (Fenton, 1881)	3, 4, 23
Leptidea sinapis (Linnaeus, 1758) / *Leptidea juvernica* Williams, 1946	3, 4, 5, 6, 7, 9, 10, 19, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 34, 35, 37, 38, 41, 42, 43, 44, 45, 47, 55, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69
Colias alfacariensis Ribbe, 1905	3, 4, 26, 37, 44, 45, 49, 53, 59, 62
Colias crocea (Fourcroy, 1785)	3, 4, 6, 9, 10, 11, 13, 15, 18, 21, 22, 24, 25, 27, 36, 37, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 54, 55, 59, 60, 61, 62, 63, 67, 68, 69
Gonepteryx rhamni (Linnaeus, 1758)	3, 4, 5, 6, 8, 9, 12, 13, 17, 20, 23, 24, 26, 27, 28, 30, 31, 32, 33, 35, 37, 38, 39, 40, 43, 45, 55, 58, 59, 60, 61, 62, 63, 66, 67, 68, 69
Anthocharis cardamines (Linnaeus, 1758)	3, 4, 9, 48, 49, 50, 51, 54, 59
Aporia crataegi (Linnaeus, 1758)	50, 68, 69
Pieris brassicae (Linnaeus, 1758)	3, 6, 19, 45, 49, 50, 51, 54, 62, 64, 68
Pieris mannii (Mayer, 1851)	4, 10, 48, 55, 64, 65, 66, 68
Pieris napi (Linnaeus, 1758)	4, 7, 14, 16, 18, 20, 21, 25, 27, 36, 38, 45, 64
Pieris rapae (Linnaeus, 1758)	3, 4, 5, 6, 10, 11, 13, 14, 16, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 34, 36, 37, 38, 39, 41, 42, 44, 45, 55, 59, 60, 67, 68, 69
Pontia edusa (Fabricius, 1777)	48, 68
Lycaenidae	
Lycaena alciphron (Rottemburg, 1775)	61
Lycaena dispar (Haworth, 1802)	9, 37, 49, 50, 51, 54, 60, 68
Lycaena hippothoe (Linnaeus, 1761)	6, 13, 15, 20, 37, 45, 48, 49, 51, 54, 60, 63, 68, 69
Lycaena phlaeas (Linnaeus, 1761)	3, 4, 9, 19, 37, 48, 49, 50, 51, 52, 54, 55, 59, 62, 64, 67, 68, 69
Lycaena tityrus (Poda, 1761)	1, 3, 4, 5, 6, 9, 13, 19, 22, 23, 25, 26, 27, 30, 34, 35, 36, 37, 38, 40, 49, 51, 54, 55, 59, 61, 62, 63, 64, 65, 68, 69
Lycaena virgaureae (Linnaeus, 1758)	19
Callophrys rubi (Linnaeus, 1758)	3, 4, 50, 51, 54, 55
Favonius quercus (Linnaeus, 1758)	66
Thecla betulae (Linnaeus, 1758)	50, 53, 55
Satyrium acaciae (Fabricius, 1787)	4, 10, 68, 69
Satyrium ilicis (Esper, 1779)	67, 68, 69
Satyrium spini (Denis & Schiffermüeller, 1775)	3, 62
Satyrium w-album (Knoch, 1782)	20, 38, 39, 45

Family/Species	Locality number(s)
Aricia agestis (Denis & Schiffermüeller, 1775)	2, 3, 4, 6, 20, 22, 23, 26, 27, 28, 31, 32, 33, 34, 40, 48, 51, 54, 62, 63, 67, 68, 69
Aricia artaxerxes (Fabricius, 1793)	4, 6, 22, 29, 33, 34, 62, 69
Celastrina argiolus (Linnaeus, 1758)	3, 4, 10, 48, 49, 50, 51, 53, 54, 55, 60, 61, 62, 63, 66, 67, 68, 69
Cupido argiades (Pallas, 1771)	3, 4, 5, 9, 10, 20, 23, 36, 37, 42, 43, 45, 46, 48, 49, 50, 53, 59, 62, 63, 64, 67, 68, 69
Cupido minimus (Fuessly, 1775)	2, 3, 4, 5, 10, 34, 59, 62, 64, 70
Cyaniris semiargus (Rottemburg, 1775)	4
Glaucopsyche alexis (Poda, 1761)	4, 50
Leptotes pirithous (Linnaeus, 1767)	9
Cacyreus marshalli Butler, 1898	68
Lysandra bellargus (Rottemburg, 1775)	2, 3, 4, 23, 29, 45, 47, 55, 59, 62, 63, 64, 68, 69
Phengaris arion (Linnaeus, 1758)	4, 6, 15, 19, 20, 29, 31, 37, 40, 43
Plebejus argyrognomon (Bergsträsser, 1779)	6, 46, 49, 55, 62, 69
Plebejus argus (Linnaeus, 1758)	1, 3, 4, 13, 14, 19, 20, 26, 31, 33, 34, 35, 36, 37, 40, 57, 59, 62, 63, 68, 69
Plebejus idas (Linnaeus, 1761)	5, 6, 43, 46, 60, 62, 63
Polyommatus dorylas (Denis & Schiffermüeller, 1775)	34, 37, 59, 62, 63, 64, 69
Polyommatus icarus (Rottemburg, 1775)	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44, 46, 47, 48, 55, 59, 60, 61, 62, 63, 64, 66, 67, 68, 69
Polyommatus thersites (Cantener, 1835)	3, 5, 59
Pseudophilotes vicrama (Moore, 1865)	10, 51
Scolitantides orion (Pallas, 1771)	4, 55
Riodinidae	
Hamearis lucina (Linnaeus, 1758)	4, 10, 19, 31, 38, 43, 45, 59
Nymphalidae	
Apatura ilia (Denis and Schiffermüeller, 1775)	24, 48, 56
Apatura iris (Linnaeus, 1758)	1, 4, 28, 57, 67
Limenitis camilla (Linnaeus, 1764)	6, 39
Limenitis reducta Staudinger, 1901	4, 6, 19, 42, 50, 54, 62, 64, 65
Neptis rivularis (Scopoli, 1763)	4, 37, 38, 54, 56
Neptis sappho (Pallas, 1771)	19, 50, 54
Argynnis paphia (Linnaeus, 1758)	1, 3, 4, 6, 8, 11, 16, 18, 19, 24, 26, 27, 30, 31, 33, 37, 38, 41, 43, 45, 46, 50, 60, 62, 64, 66, 67, 68, 69
Boloria dia (Linnaeus, 1767)	3, 4, 5, 6, 10, 13, 22, 24, 29, 31, 34, 36, 37, 44, 45, 47, 48, 49, 50, 51, 52, 54, 55, 58, 59, 60, 61, 62, 63, 65, 66, 67, 68, 69
Boloria euphrosyne (Linnaeus, 1758)	3, 4, 5, 55
Brenthis daphne (Bergsträsser, 1780)	4, 6, 8, 10, 17, 22, 39, 42, 43, 50, 51, 60, 63, 67, 68, 69
Brenthis hecate (Denis and Schiffermüeller, 1775)	3, 62, 63, 68, 69
Brenthis ino (Rottemburg, 1775)	16, 29, 46, 47, 68, 69
Speyeria aglaja (Linnaeus, 1758)	3, 41, 45
Issoria lathonia (Linnaeus, 1758)	9, 17, 41, 42, 44, 48, 49, 50, 51, 53, 54, 60, 61, 62, 66, 67, 68, 69

Family/Species	Locality number(s)
Fabriciana adippe (Denis & Schiffermüeller, 1775)	9, 16, 20, 23, 38, 45, 50, 62, 69
Aglais io (Linnaeus, 1758)	4, 6, 9, 17, 19, 23, 37, 46, 48, 49, 50, 51, 52
Aglais urticae (Linnaeus, 1758)	1, 4, 48, 49, 50, 52, 54, 55, 62, 69
Arachnia levana (Linnaeus, 1758)	6, 8, 9, 12, 13, 16, 17, 18, 32, 35, 37, 38, 39, 42, 43, 44, 45, 46, 49, 50, 51, 52, 54, 59, 62, 64
Vanessa atalanta (Linnaeus, 1758)	4, 5, 6, 9, 12, 25, 26, 27, 28, 39, 42, 43, 48, 49, 50, 53, 55, 64, 66, 68, 69
Vanessa cardui (Linnaeus, 1758)	3, 4, 6, 7, 9, 10, 17, 18, 20, 22, 23, 33, 34, 35, 37, 38, 40, 41, 44, 47, 49, 52, 54, 59, 60, 61, 62, 66, 67, 68, 69, 70
Polygonia c-album (Linnaeus, 1758)	1, 3, 5, 6, 33, 38, 39, 42, 45, 48, 49, 50, 54, 56, 60, 64, 68, 69
Euphydryas aurinia (Rottemburg, 1775)	3, 4, 62, 63, 69
Nymphalis polychloros (Linnaeus, 1758)	9, 49
Melitaea athalia (Rottemburg, 1775)	3, 4, 5, 6, 9, 21, 23, 25, 26, 31, 32, 36, 37, 38, 39, 40, 43, 44, 45, 47, 50, 51, 53, 55, 59, 60, 61, 62, 63, 64, 65, 67, 68, 69, 70
Melitaea aurelia Nickerl, 1850	22, 43, 62, 68
Melitaea britomartis Assmann, 1847	62, 63, 68
Melitaea cinxia (Linnaeus, 1758)	2, 3, 4, 5, 6, 62, 63
Melitaea diamina (Lang, 1789)	6
Melitaea didyma (Esper, 1778)	3, 4, 7, 10, 18, 35, 36, 37, 50, 51, 55, 59, 60, 61, 62, 63, 64, 67, 68, 69
Melitaea phoebe (Denis & Schiffermüeller, 1775)	2, 3, 5, 49, 51, 53, 55, 59, 60, 62, 63, 65
Melitaea trivia (Denis & Schiffermüeller, 1775)	49, 50, 51, 54, 60, 67, 68
Aphantopus hyperantus (Linnaeus, 1758)	1, 3, 4, 6, 8, 10, 11, 13, 19, 20, 21, 22, 26, 27, 30, 31, 32, 35, 37, 38, 41, 42, 43, 45, 57
Brintesia circe (Fabricius, 1775)	26, 65, 67, 68
Coenonympha arcania (Linnaeus, 1761)	3, 4, 6, 51, 54, 59, 60, 61, 62, 63, 64, 65, 67, 68, 69
Coenonympha glycerion (Borkhausen, 1788)	1, 3, 4, 6, 50, 54, 59, 60, 61, 62, 63, 67, 68, 69, 70
Coenonympha pamphilus (Linnaeus, 1758)	1, 3, 4, 5, 6, 7, 9, 10, 15, 16, 18, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 37, 38, 41, 42, 43, 45, 47, 48, 49, 50, 55, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70
Erebia aethiops (Esper, 1777)	3, 4, 6, 10, 19, 27, 29, 34, 38, 45
Hipparchia fagi (Scopoli, 1763)	3, 4, 43, 47, 55
Lasiommata maera (Linnaeus, 1758)	4
Lasiommata megera (Linnaeus, 1767)	4, 25, 48, 49, 50, 51, 53, 54, 55, 66, 68
Lopinga achine (Scopoli, 1763)	3, 19, 68, 69
Maniola jurtina (Linnaeus, 1758)	1, 2, 3, 4, 5, 6, 7, 9, 10, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 43, 44, 45, 46, 47, 51, 54, 59, 60, 61, 62, 63, 65, 66, 67, 68, 69, 70
Melanargia galathea (Linnaeus, 1758)	3, 4, 6, 7, 8, 10, 13, 14, 15, 19, 20, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 34, 35, 38, 40, 46, 47, 50, 60, 61, 62, 63, 66, 67, 68, 69
Minois dryas (Scopoli, 1763)	3, 4, 19, 29, 31, 45, 46, 47, 57, 62, 64, 68, 69
Pararge aegeria (Linnaeus, 1758)	3, 4, 5, 6, 8, 19, 45, 49, 50, 51, 54, 55, 68

Family/Species	Locality number(s)
Hesperiidae	
Heteropterus morpheus (Pallas, 1771)	1, 3, 4, 6, 7, 8, 10, 13, 14, 15, 17, 19, 20, 22, 23, 26, 27, 28, 30, 31, 32, 33, 34, 37, 38, 39, 40, 41, 43, 44, 45, 47, 50
Carterocephalus palaemon (Pallas, 1771)	54, 63
Hesperia comma (Linnaeus, 1758)	3, 4, 33, 36, 55, 62, 63, 64, 68, 69
Ochlodes sylvanus (Esper, 1777)	1, 3, 4, 6, 8, 9, 10, 13, 16, 17, 18, 22, 23, 26, 27, 28, 29, 30, 31, 32, 32, 33, 34, 35, 37, 38, 39, 40, 41, 42, 43, 45, 47, 50, 62, 66, 67, 68, 69
Thymelicus lineola (Ochsenheimer, 1808)	3, 4, 10, 17, 19, 60, 62, 64, 67, 68, 69
Thymelicus sylvestris (Poda, 1761)	6, 7, 13, 17, 20, 22, 50, 62, 66, 67, 68, 69
Carcharodus alceae (Esper, 1780)	50, 51, 55, 60, 64, 66, 68
Carcharodus floccifera (Zeller, 1847)	49, 54, 62, 68, 69
Erynnis tages (Linnaeus, 1758)	3, 4, 5, 6, 8, 13, 15, 19, 22, 26, 29, 31, 37, 40, 44, 45, 49, 50, 53, 54, 55, 58, 59, 62, 63
Pyrgus armoricanus (Oberthür, 1910)	5, 37, 49, 59, 60, 61, 62, 64, 68, 69
Pyrgus malvae (Linnaeus, 1758)	32, 48, 49, 50, 51, 54, 67
Spialia sertorius (Hoffmannsegg, 1804)	4, 54, 62

Table 3. The list of butterfly species included in the Red list of butterflies of Slovenia (Ur. l. RS 2002), European red list of butterflies (Van Swaay et al. 2010), Regulation on protected wild animal species (Ur. l. RS 2004b) and/or Council directive on the conservation of natural habitats and of wild fauna and flora (Council Directive 92/43/EEC 1992).
Tabela 3. Seznam vrst dnevnih metuljev, vključenih na Rdeči seznam metuljev Slovenije (Ur. l. RS 2002), Evropski rdeči seznam metuljev (Van Swaay et al. 2010), Uredbo o zavarovanih prostoživečih živalskih vrstah (Ur. l. RS 2004b) in/ali na Direktivo Sveta o ohranjanju naravnih habitatov ter prostoživečih živalskih in rastlinskih vrst (Council Directive 92/43/EEC 1992).

Species	Inclusion in the Red list of butterflies of Slovenia (Ur. l. RS 2002)	Inclusion in the European red list of butterflies (Van Swaay et al. 2010):	Inclusion in the Regulation on protected wild animal species (Ur. l. RS 2004b)
*Parnassius mnemosyne**	Vulnerable	Near threatened	×
Pieris mannii	Vulnerable	Least concerned	
Lycaena alciphron	Vulnerable	Near threatened	
Lycaena hippothoe	Vulnerable	Near threatened	
*Lycaena dispar**	Vulnerable	Least concerned	×
Leptidea morsei	Vulnerable	Endangered	×
Plebejus argyrognomon	Vulnerable	Least concerned	
Plebejus idas	Vulnerable	Least concerned	
Pseudophilotes vicrama	Vulnerable	Near threatened	
Scolitantides orion	Vulnerable	Near threatened	
Apatura ilia	Vulnerable	Least concerned	
*Euphydryas aurinia**	Vulnerable	Least concerned	×
Melitaea aurelia	Vulnerable	Near threatened	
Melitaea britomartis	Vulnerable	Near threatened	
Melitaea diamina	Vulnerable	Near threatened	
Melitaea trivia	Vulnerable	Near threatened	
Carcharodus alceae	Vulnerable	Least concerned	
Pyrgus armoricanus	Vulnerable	Least concerned	
*Phengaris arion**	Vulnerable	Endangered	×
Spialia sertorius	Vulnerable	Least concerned	
Carcharodus floccifera	Endangered	Near threatened	×
Polyommatus thersites	Endangered	Least concerned	×
Polyommatus dorylas	Least concerned	Near threatened	
Hipparchia fagi	Least concerned	Near threatened	
*Lopinga achine**	Least concerned	Vulnerable	×

* Species included in the Council Directive on the conservation of natural habitats and of wild fauna and flora (Council Directive 92/43/EEC 1992).
* Vrsta vključena na Direktivo Sveta o ohranjanju naravnih habitatov ter prostoživečih živalskih in rastlinskih vrst (Council Directive 92/43/EEC 1992).

Comments to selected species

Leptidea morsei (Fenton, 1881) (fam. Pieridae)

The isolated occurrence of the species at Gabrovka has been discovered during surveys carried out for the designation of Natura 2000 sites (Čelik et al. 2005) and the species has been monitored regularly at this location in the past years, with the results published in this article. The butterfly has been observed regularly, although in fluctuating numbers on Moravška Gora and its vicinity, where the distribution of its hostplant *Lathyrus niger* (L., 1753) Bernh., 1800 remains stable as well. We found *L. morsei* at a new locality at Volčja Jama village north of Žužemberk, where a single male of the second generation was observed in a clearing north of the village on 22.7.2019. The hostplant was also found at the location, occurring on south-facing slopes with sparse oak woods near the village. This suggests that the species is more common in the region than previously thought, as it was now also confirmed in northern Suha krajina, and not only in the vicinity of Moravška Gora in the southwestern parts of Posavsko hills. Consequently, additional surveys should be performed in these parts to consolidate the finding.

Cacyreus marshalli Butler, 1898 (fam. Lycaenidae)

This known allochthonous butterfly species occurs throughout the Mediterranean and was first discovered in Slovenia in 2008 (Verovnik et al. 2011). Despite its known dispersal potential, the only noteworthy range extension in the past few years in Slovenia was in the Soča Valley where it reached Bovec town (Verovnik et al. 2012; Verovnik, pers. obs.). There are only two records from central Slovenia, first from Kranj in 2010, where adults were observed inside a house where pelargoniums were kept over winter (Verovnik et al. 2011), and the second from Žirovski Vrh in the Poljanska Valley, where the butterfly was spotted sitting on a pelargonium plant in September 2020 (Tina Belej, pers. obs.). Its presence on a dry grassland near Žužemberk on 31.10.2022 was therefore unexpected. Given that it was observed also near Ljubljana at Pijava Gorica on 1.11.2022 (Šturm, pers. obs.) it is possible that the species had spread from the Primorska region during the late October heatwave (ARSO 2022). It is, however, unlikely that larvae or adults would have survived the harsh winters outdoors in Central Slovenia, for otherwise it would have been observed more regularly here in the past decade. It would be worth surveying the urban areas in the vicinity of the finds in the next autumn to check whether local populations have been established.

Aricia artaxerxes (Fabricius, 1793) (fam. Lycaenidae)

This species has been considered an exclusively Alpine species in Slovenia in the past (Carnelutti 1992). However, the surveys carried out in the last few decades have confirmed its much wider distribution including the Dinaric Mts in the south and even the sub-Pannonian region in the north east (Verovnik et al. 2012). It is, however, sparsely recorded from Central Slovenia with notable concentrations of records southwest of Mt Kum in northern Posavje (Verovnik, pers. obs.) and on the Sava River gravels north of Ljubljana (Verovnik, pers. obs.). We found the species at eight new localities from different parts of the surveyed areas, indicating its wider distribution in the region (Fig. 2). It is linked to unfertilized, flower-rich, dry, calcareous grasslands with abundance of sunrose (*Helianthemum* sp.), a likely hostplant of the species. Such grasslands are becoming increasingly rare and fragmented in Slovenia, and the species should therefore be considered threatened in lowlands, including the studied region.

Phengaris arion (Linnaeus, 1758) (fam. Lycaenidae)

This emblematic species is one of the most threatened butterflies in Europe (van Swaay et al. 2010) and is considered vulnerable in Slovenia (Ur. l. RS 2002). From the studied region it is only known from a historical record from Trebnje but was/is also present in the neighbouring regions to the north in the Posavje and Zasavje regions (Verovnik et al. 2012). We recorded the species at 10 localities, mostly in the northern part of the surveyed region (Fig. 2). This is somewhat surprising given the past survey efforts, however, most of the previous surveys of Natura 2000 species were done in late spring/early summer, thus outside the main flight period of the species (Verovnik et al. 2012). In the surveyed region *P. arion* utilizes different types of dry grasslands, also in the early stages of abandonment and overgrowing, and is highly sensitive to excessive fertilization and multiple mowing regimes (Van Swaay et al 2012). Abandonment of mowing on steep south-facing slopes is possibly the main feature of most of the localities populated by the species in the region, therefore some sort of management will be required in the near future to sustain the existing habitat network.

Melitaea diamina (Lang, 1798) (fam. Nymphalidae)

This is a predominantly humid grassland species, although found also in dry, calcareous grasslands in western Slovenia (Verovnik et al. 2012). The species is listed as vulnerable in Slovenia (Ur. l. RS 2002) due to decline in suitable habitat, in particularly humid meadows and mires, which have mostly been turned into intensive grasslands with drainage, seeding and fertilization. The same trend is evident in the studied region where the species was found at several localities in the northern part during surveys at the beginning of the century (Verovnik et al. 2012). Many of these localities were revisited during our field work, but only a single population was reconfirmed in a small valley north of Ivančna Gorica at Potok settlement. Targeted surveys during first generation maximum might confirm a survivor of some additional populations, but in general, the humid grasslands deteriorated most severely in the studied region over the last two decades. They may still provide suitable habitat for some less sensitive hygrophilous specialist such as *Brenthis ino*, *L. dispar* and *L. hippothoe*, which are still widespread in the region, but further intensification could eliminate these species as well.

Hipparchia fagi (Scopoli, 1763) (fam. Nymphalidae)

This is a typical thermophilous shrubland and woodland species with sparse records from central Slovenia (Verovnik et al. 2012). From the studied region it was historically known only from Šentlovrenc near Trebnje (collection in the Slovenian Museum of Natural History). We recorded the species commonly on Moravška Gora above Gabrovka town along woodland edges, as well as in orchards and vineyards. Elsewhere, only single specimens were observed at Primskovo, which is quite near the historical record, on southern slopes of Mt Lisec, and north of Valična vas in a complex of dry grasslands. These new finds are likely a result of recent late summer surveys that were absent in the past, as the species is known from neighbouring regions (Verovnik et al. 2012), being particularly widespread in the Haloze region further northeast (Verovnik 2003).

Carcharodus alceae (Esper, 1780) (Hesperiidae)

Despite utilizing severely modified ruderal habitats including urban areas and intensive farmlands, the species is surprisingly rare in Central Slovenia, its strongholds being the sub-Pannonian eastern part of the country and the Primorska region in the west (Verovnik et al. 2012). In the studied region it was recorded only from a single locality near Gabrovka (Verovnik, pers. obs.), so addition of six new localities is significant. These are mainly concentrated in southern and eastern parts of the region (Fig. 2). It has been found in different habitats including a ruderal area near Valična vas in the south.

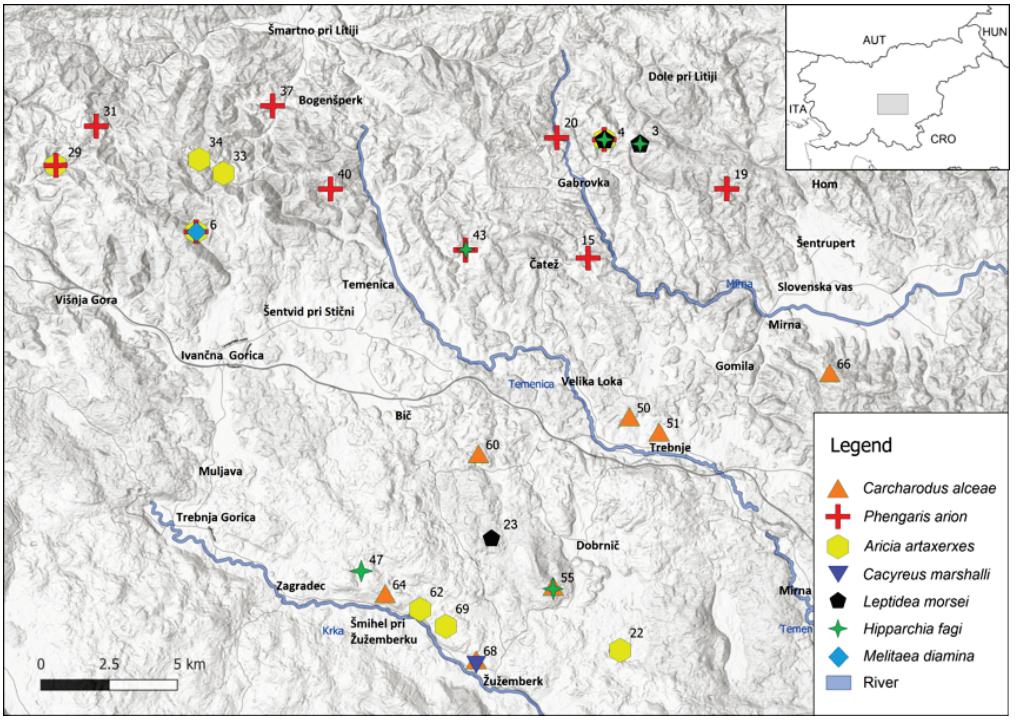

Figure 2. Distribution of *Leptidea morsei*, *Hipparchia fagi*, *Cacyreus marshalli*, *Melitaea diamina*, *Carcharodus alceae*, *Phengaris arion* and *Aricia artaxerxes* in the surveyed area of the southwestern Posavsko hills and northern Suha krajina. Numbers refer to localities listed in Tab. 1. The position of the surveyed area within the country is shown with a grey square in the upper right corner.

Slika 2. Razširjenost vrst *Leptidea morsei*, *Hipparchia fagi*, *Cacyreus marshalli*, *Melitaea diamina*, *Carcharodus alceae*, *Phengaris arion* in *Aricia artaxerxes* na območju jugozahodnega Posavskega hribovja in severne Suhe krajine. Številke označujejo lokacije, ki so navedene v Tab. 1. Položaj raziskovanega območja znotraj države je prikazan s črnim/sivim kvadratom zgoraj desno.

Concluding remarks

Several additional rare or rarely observed species include those with more sparsely seen adults such as *Thecla betulae*, *Favonious quercus*, *Satyrium ilicis*, *Satyrium acaciae*, *Satyrium w-album*, and thermophilous species *Scolitantides orion*, *Pseudophilotes vicrama*, *P. thersites*, *Limenitis reducta*, and *Melitaea trivia*. Also noteworthy is the widespread occurrence of *Aphantopus hyperantus* and *Heteropterus morpheus*, both being only rarely recorded in the region in the past, as well as the observation of *B. hecate* on five localities, despite being thought to have almost disappeared from Central Slovenia (Verovnik et al. 2012). *Leptotes pirithous*, a known migratory species, has been observed once during the surveys.

Given the long list of butterfly species, the abundance of records of species of conservation concern, as well as local hot spots of butterfly diversity, the central Slovenia or, to be more precise, the southwestern Posavsko hills and northern Suha krajina, is grossly underrepresented within Natura 2000 network of Slovenia, or any other form of legally protected area. As this is unlikely to change, local initiatives are needed to preserve the most important localities, which would provide core areas for threatened species to survive. Although flower-rich, dry, calcareous grasslands still abound, in particular around Gabrovka and just north of the Krka Valley, both abandonment with overgrowing as well as intensification through pasturing and fertilisation in these areas are evident. These processes will inevitably lead to the decline of habitat specialist butterfly species that we were still able to record during our surveys. The situation is even worse for humid grasslands, as only small fragments are left, scattered mostly along small tributaries of major streams. Whether these are sufficient for maintaining local populations of threatened species remains to be studied through additional surveys. Land owners and local communities should be targeted to ensure maintaining or even enlarging the existing humid grassland areas, while the preservation of such habitats should be one of the ecological priorities of the country.

Povzetek

V članku predstavljamo popise dnevnih metuljev na območju centralne Slovenije (jugozahodni del Posavskega hribovja in severni del Suhe krajine), ki so potekali med letoma 2014 in 2022. Območje je bilo izbrano zaradi majhnega števila predhodnih terenskih podatkov, kjer znaten delež zajemajo pomembnejše najdbe pred letom 1990 (Verovnik et al. 2012). Metulje smo lovili z metuljnico in jih določevali na terenu s pomočjo ustrezne literature (Tolman & Lewington 2008). Posamezne lokacije vzorčenja smo izbrali na podlagi ohranjenosti habitatov, dostopnosti in predhodnih raziskav (Verovnik et al. 2012; Čelik 2013).

Na izbranem območju nam je v tem času uspelo zabeležiti 105 vrst metuljev, kar pomeni 60 % vseh najdenih vrst v Sloveniji (Verovnik et al. 2012). Večina vrst je bila najdena na vsaj treh lokacijah, medtem ko je bilo devet vrst najdenih na dveh in osem vrst na eni sami lokaciji. Vrste, ki smo jih našli na vsaj polovici lokacij, lahko štejemo med pogoste, med njimi pa so: *Colias crocea*, *Gonepteryx rhamni*, *Pieris rapae*, *Leptidea sinapis/juvernica*, *Polyommatus icarus*, *Coenonympha pamphilus*, *Maniola jurtina*, *Melanargia galathea*, in *Ochlodes sylvanus*. Te vrste so sicer pogoste tudi drugod v osrednji Sloveniji (Verovnik et al. 2012). Med najdenimi vrstami je bilo 22 takih, ki so vključene na rdeči seznam metuljev Slovenije (Ur. l. RS 2002), 15 takih, ki so vključene na seznam ogroženih metuljev v Evropi (Van Swaay et al. 2010), osem, ki so vključene v Uredbo o zavarovanih prosto živečih živalskih vrstah (Ur. l. RS 2004b), in pet takih, ki so vključene v Direktivo o ohranjanju naravnih habitatov ter prosto živečih živalskih in rastlinskih vrst (OJ EC 1992) (Tab. 3).

Največ vrst smo našli na lokacijah Moravška Gora, Žužemberk, Brezovo in Vrh pri Križu ter na lokaciji Vrhovo pri Žužemberku (Tab. 1). Lokaciji Brezovo in Moravška Gora sta blizu druga drugi na severnem delu območja, lokacije Vrh pri Križu, Vrhovo pri Žužemberku in Žužemberk pa ležijo na južnem robu območja prav tako blizu druga drugi. Med popisi nismo zabeležili osmih vrst, ki so bile predhodno na območju že najdene, smo pa nekaj vrst na območju zabeležili prvič (npr. *Cacyreus marshalli* in *Leptotes pirithous*). Za območje so precej pomembne tudi najdbe vrst *Leptidea morsei*, *Hipparchia fagi*, *Cacyreus marshalli* in *Melitaea diamina*ter še posebej vrste *Phengaris arion*, *Carcharodus alcea* in *Aricia artaxerxes*, ki smo jih našli na vsaj sedmih lokacijah (Sl. 2). Območje je glede na število najdenih vrst med najbolj pestrimi v Sloveniji, a ga podobno kot drugje v državi ogrožata zaraščanje ekstenzivnih travnikov in intenzivno pašništvo predvsem na suhih travnikih. Najbolj ogrožene so vrste, vezane na vlažne travnike, ki se fragmentirano pojavljajo le še ob manjših potokih v stranskih dolinah. Ker je celotno območje izredno slabo pokrito z območji, vključenimi v Natura 2000 (Ur. l. RS 2004a), velikemu številu bolj specializiranih vrst grozi izumrtje. Če želimo ohraniti pestrost tega dela države, bo zato treba opravljati tarčno usmerjene popise izbranih lokacij, predvsem pa k ohranjanju določenih habitatov (npr. vlažnih travnikov) spodbujati lokalno prebivalstvo in državo.

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