

## NEW CONTRIBUTIONS TO THE KNOWLEDGE OF THE BUTTERFLY FAUNA OF MT VELEBIT AND THE NEIGHBOURING AREA OF LIKA (CROATIA)

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During the last eight years several surveys were undertaken to improve the knowledge of the butterfly distribution in Croatia. In this paper we provide additional data for Mt Velebit for some taxa with poorly known distributions like *Pieris (napi) balcana* Lorković, 1970 as well as the first records for *Carterocephalus palaemon*, *Gegenes pumilio*, *Lycaena tityrus*, *Polyommatus escheri*, *Neptis rivularis*, and *Charaxes jasius*. With the review of recently published data and our contribution, the number of species found on Mt Velebit has increased to 153 in all, which makes Velebit a mountain with a relatively great diversity of butterfly species. Additionally, we include records of some species of conservation concern for the neighbouring area of Lika, for *Polyommatus damon*, *P. ripartii*, *P. admetus*, *Lycaena dispar*, *Phengaris alcon* (humid meadow ecotype) and *Euphydryas maturna*.

**Key words:** Dinaric Alps, Croatia, butterflies, Lepidoptera, Papilionoidea, Hesperioidea

**Tvrtković, N., Verovnik, R., Lovrenčić, L., Vuković, M. & Šašić, M.: Novi prilozi fauni danjih leptira planine Velebita i susjednih područja Like (Hrvatska). Nat. Croat., Vol. 24, No. 2., 281–292, Zagreb, 2015.**

U Hrvatskoj su zadnjih desetak godina poduzeta dodatna istraživanja u svrhu poboljšanja znanja o rasprostranjenosti danjih leptira. U ovom radu su za planinu Velebit uz nove podatke za vrste slabije poznatog rasprostranjenja kao što je *Pieris (napi) balcana* Lorković, 1970 dati su i prvi podaci o nalazima vrsta *Carterocephalus palaemon*, *Gegenes pumilio*, *Lycaena tityrus*, *Polyommatus escheri*, *Neptis rivularis*, and *Charaxes jasius*. S novim nalazima i uz pregled podataka publiciranih u zadnjih osam godina, ukupni broj zabilježenih vrsta na planini Velebitu dosegao je 153 vrsta što čini Velebit jednom od planina s najraznolikijom faunom danjih leptira. Dodatno, u susjednoj Lici opisani su nalazi *Polyommatus damon*, *P. ripartii*, *Lycaena dispar*, *Phengaris alcon* 'ekotip vlažnih travnjaka' i *Euphydryas maturna*, redom vrsta od interesa za zaštitu.

**Ključne riječi:** Dinaridi, Hrvatska, leptiri, Lepidoptera, Papilionoidea, Hesperioidea

### INTRODUCTION

Despite the fact that the list of Croatian butterfly fauna is relatively well known (Šašić *et al.*, 2015), the distribution of some rare species is not completely known, including species of conservation interest. In the Croatian part of the European "Alpine biogeographical region" (EEA, 2012) Mt Velebit has one of the most fascinating ranges in the

Dinaric karst because it stretches over a length of 145 kilometres along the Adriatic coast. From 2003 Mt Velebit has been listed as one of the Prime Butterfly Areas in Europe (VAN SWAAY & WARREN, 2003). KUČINIĆ *et al.* (1995) made the first overview of published and collection data for Velebit Mountain listing 115 butterfly species. After additional field work MIHOČIĆ *et al.* (2007) upgraded the checklist with several new species records, which raised the number of species to 137. But KUČINIĆ *et al.*, (1995) did not include the data from published records for *Pieris balcana* Lorković, 1970 published in EITSCHBERGER (1983) under the name *P. pseudorapae balcana* Lorković, 1968 from a locality 4 km east of Senj, and also above Obrovac, 1000 m a.s.l. /= probably Mali Alan/, and also data from LORKOVIĆ (1989) for Trnovac and Senj.

Since the publication of the last list (MIHOČIĆ *et al.*, 2007) some additional species have been reported. MIHOČIĆ & ŠAŠIĆ (2007) found *Proterebia afra* on the main Gračac – Knin road after Sučevići (= Surčevac) viaduct and after Otrić village, both on the easternmost slopes of south-eastern Velebit. LORKOVIĆ (2009) in his manuscript from 1954 noted *Pyr-gus armoricanus* (Kosinj), *Spialia orbifer* (Oštarije /=Baške Oštarije/ and Metla peak), and *Callophrys rubi* (below Visočica peak). For south-eastern Velebit KOREN *et al.* (2011) reported *Lycaena thersamon* (Manastir Krupa), *Nymphalis antiopa* (Krupa spring) and provided additional localities of *Proterebia afra* (Golubići, Dobarnica, Manastir Krupa, Krupa spring). KUČINIĆ *et al.* (2013) added *Cacyreus marshalli* from Jablanac. The most recent contribution was made by ADŽIĆ (2015) identifying the butterfly photographs of Paklenica National Park rangers from the last three years. Among other species there were observations of *Favonius quercus* from June 2013, and *Thecla betulae* from June 2015 in the area of Paklenica National Park. These identifications were supervised by the first author.

All those additional findings have increased the species number for Mt Velebit to 147, and established Mt Velebit as one of the true 'hot spots' for butterfly diversity in the Balkan region. In contrast, there are only scarce published records for the Lika area, a region in Croatia situated to the north and north-east of Mt Velebit towards Mt Mala Kapela peaks (to the north) and the Una River (to the east) (Fig. 1), and this area is generally understudied. Exceptions are the Plitvice lakes (LORKOVIĆ, 1970, 2009; ŠAŠIĆ KLJAJO, 2004) and Mt Poštak (KOREN *et al.*, 2015), both in marginal parts of this area.

The aim of our study is to review published records and present new data for the rare and locally distributed butterflies from Mt Velebit together with records for some butterflies of conservation interest for the neighbouring Lika area. The new records provide good examples of the complexity of the habitat mosaic inside the Croatian part of the European "Alpine biogeographical region" (EEA, 2012).

## MATERIAL AND METHODS

The field research was done in the Lika area (Krbavsko polje) and on Prezid pass on Mt Velebit from June to August 2007 and 2008 (N. Tvrčković and M. Vuković), in neighbouring Paklenica NP in May 2013 (N. Tvrčković, G. Lukač, I. Adžić), and from April to September 2015 (N. Tvrčković, L. Lovrenčić and M. Jagić) on Mt Velebit and in the Lika area (southern slopes of Mt Mala Kapela and Lisac peak, the southernmost part of Mt Lička Plješivica). Additional records were provided by R. Verovnik from occasional observations in the period from 2001 to 2015 for Veliki Alan pass, Mala Paklenica Valley, Mali Alan pass, Prezid pass and Krupa River valley.

Mt Velebit stretches from Vratnik pass (NW) to the Zrmanja River (SE), and is usually divided as follows: N Velebit (from Vratnik pass to Veliki Alan pass, middle Velebit (from



**Fig. 1.** Map with researched localities with butterflies from Mt Velebit and the Lika area. Numbers of localities correspond to those in Tab. 1.

Veliki Alan pass to Baške Oštarije), S Velebit (from Baške Oštarije to Prezid pass) and SE Velebit (from Prezid pass to Zrmanja River) (Fig. 1).

We also evaluated the photographs provided by Professor Jasenka Topić from the Una River canyon on the border with Bosnia and Herzegovina taken in 2014. Butterflies were identified in the field using LAFRANCHIS (2004) and TOLMAN & LEWINGTON (2008), and in the case of *Pieris balcana* using LORKOVIĆ (1970, 1989) and ZIEGLER (2013). Voucher specimens for some species are deposited in the Central Butterfly Collection in the Croatian Natural History Museum (CNHM) in Zagreb.

## RESULTS AND DISCUSSION

Material examined is given in the Appendix and surveyed locations are shown in Fig. 1. After the first historical localities for the Balkan Green-veined White *Pieris (napi) balcana* on the Velebit Mts. (EITSCHBERGER, 1983; LORKOVIĆ, 1989) we confirmed this taxon in all altitudinal belts of the mountain. *P. balcana* on Mt Velebit in 2015 started to fly as early as the end of March with other Pierinae. Findings were in all altitudinal belts; we documented specimens from the beginning of April to late September 2015 in two prolonged generations. We confirmed former findings near Trnovac (13) and near Senj in Senjska Draga (1). In Senjska Draga suitable habitats for females were also on the stony southern slopes of Mt Velika Kapela, in the part of the canyon together with the new locality Orlovo gnijezdo near Vratnik pass (2). New localities for this Balkan karst forest species on Mt Velebit are Donji Bileni: Sklop (3), Dundovića Podi (4), Kosinjski Bakovac (6) (all Northern Velebit), Vidovac (8), Ivanova Draga (9), Prpića duliba (10), Alaginac (11), Kalinovača (7) (all Middle Velebit), and Bristovac Milovci (16), Starigrad Paklenica (17a) (all Southern Velebit). In the Lika region we added to the list of known localities



**Fig. 2.** Variability of females of *Pieris (napi) balcana* Lorković, 1970, Mt Velebit; A) Senjska Draga, spring generation; B) Dundovića Podi, summer generation with thin *bryo*-streak; C) Kosinjski Bakovac, summer generation. Photo: N. Tvrković.

Ljubovo-Svračkovo selo (26), Donji Mekinjar (27) and Međugorje (29). *Arabis turrata* L. was documented as the oviposition plant in Senjska Draga (86 m a.s.l.) in Mediterranean colline *Quercus pubescens* and *Carpinus orientalis* forest, and below the Alaginac peak (1100 m a.s.l.) in subalpine *Fagus sylvatica* forest. Females of the summer brood show high variability in wing markings of the upper side from the typical *balcana* phenotype to one very similar to *P. (napi) bryoniae* with a thin *bryo*-streak but with a white ground (Fig. 2). A detailed study about the relationships among taxa in the *Pieris napi* aggregate group in the western Balkans is in preparation, and identification of all documented specimens of previously published findings of *Pieris napi* on Mt Velebit (KUČINIĆ *et al.*, 1995; MIHOČI *et al.*, 2007; KOREN *et al.*, 2011) should be re-evaluated because according to HIGGINS & RILEY (1993) and TOLMAN & LEWINGTON (1997, 2008) distinction between *P. napi* and *P. balcana* is nearly impossible.

Of the species with scarce records we should mention the Dalmatian Ringlet (*Proteberbia afra*) on the road to Prezid pass at the turn for Golubić (23) and near Kitnjasta glavica (20) E Starigrad-Paklenica, the westernmost locality of the species' distribution on the mainland of the Adriatic coast (MIHOČI & ŠAŠIĆ, 2007; KOREN *et al.*, 2011). We confirmed Grund's historical findings (GRUND, 1916) of the Balkan Marbled White (*Melanargia larissa*) below the Veliki Alan pass – this species was first observed in the beginning of July in 2013 at 990 m a.s.l. and was common in 2015 in late June and early July mostly between 750 and 1100 m a.s.l. on the karstic thermophilous slopes above Jablanac (4). Additionally we found several worn specimens of the species at Krupa spring (24) and a fresh specimen near Vidovec (8) above Karlobag, both in the end of June 2015. Our observation of the migratory Camberwell Beauty (*Nymphalis antiopa*) on Mali Alan pass (21) is the third finding of this species in Mt Velebit area (GRUND, 1916; MIHOČI *et al.*, 2007). Oberthur's Grizzled Skipper (*Pyrgus armoricanus*) was found in the first brood on the Prezid pass (22a) and in both generations from 2007 to 2015 in Krupa valley near the Krupa monastrey (25) and above the river spring (24) (all Southern Velebit) and in the second brood near Kalinovača (7) (Middle Velebit). Habitats in Kalinovača and Prezid are heaths, and probably this species is common in the same habitats in the Lika area where LORKOVIĆ (2009) noted this species for Divoselo in Ličko polje. We found it by Donji Mekinjar (26) too.

The Purple Hairstreak (*Favonius quercus*) is usually overlooked in faunistic surveys because it tends to perch in the oak tree canopies where it feeds on honeydew (SBN, 1994). We found it in Velika Paklenica Gorge (17b) feeding on a fig tree (*Ficus carica*) in mid August 2001 and above the village Kosinjski Bakovac (6) on a SW steep stony slope



between the houses of Ruja and Brneći vršak. In July, three females were resting on a *Quercus petraea* tree inside a mixed forest with *Ostrya carpinifolia*, *Sorbus torminalis* and *Fraxinus ornus*. Another species with limited records on Mt Velebit is the Green Hairstreak (*Callophrys rubi*) as it flies in spring when surveys are sparse. We found it in May in Krupa Gorge 2 km SE of the monastery (25), at the monastery, at Prezid pass (22b) on Libinje: Lički doci (19), 850 m a.s.l., all east from Paklenica NP, and at Stupačinovo village (12) above Baške Oštarije, 985 m a.s.l. LORKOVIĆ (2009) noted a finding of this species at a high altitude late in June on the southern slopes of Visočica peak, at 1450 m a.s.l. The Eros Blue (*Polyommatus eros*), a rare species in Croatia, known only from Southern Velebit from the peaks Sveto Brdo, Baba, Badanj and Visočica between 1500 and 1753 m a.s.l. (LORKOVIĆ, 2009) and Mt Dinara (TVRTKOVIĆ *et al.*, 2012; KOREN & LAUŠ, 2013), was found in 2014 on screes NW of Vaganski vrh peak (15), and much lower at 1330 m a.s.l. on the W slopes of Buljma peak below Veliki Alan pass (5b) in July 2013. According to botanist Professor Jasenka Topić its larval hostplant *Oxytropis campestris* subsp. *dinarica* Murb. grows in large quantities very near the observation site SE of Veliki Alan pass.

Six species were found for the first time on Mt Velebit: *Carterocephalus palaemon*, *Gegenes pumilio*, *Lycaena tityrus*, *Polyommatus escheri*, *Neptis rivularis* and *Charaxes jasius*. The first unexpected species was the Chequered Skipper (*Carterocephalus palaemon*); we documented the species in 2010 at the beginning of June also at Prezid pass (22b), 750 m a.s.l., near Kosinjski Bakovac (6) along the road on the SW slope of Ruja – Brneći vršak, 660 m a.s.l., and then above Baške Oštarije in Prpića duliba (10), 965 m a.s.l., on the edge of a beech forest. Our records on Mt Velebit are at the southern border of the species' distribution in Croatia, between Krk Island (HABELER, 2003) and our additional finding in the Lika region, near the border with Bosnia and Herzegovina, on the karst plateau Međugorje (29), 990 m a.s.l., north of Kremen peak (Mt Lička Plješivica).

The typical Mediterranean coastal species the Pigmy Skipper (*Gegenes pumilio*) was observed in August 2007 in Mala Paklenica Gorge (18) typically settling on a path in an abandoned dry grassland overgrown with juniper bushes. This is the northernmost locality for the species along the eastern Adriatic coast, although it is likely that the record of a similar *G. nostradamus* (Fabricius, 1793) from Pag Island (MLADINOV, 1965) further north was probably really that of *G. pumilio* (LORKOVIĆ, 1971).

The Sooty Copper (*Lycaena tityrus*) was found near Kalinovača (7), 580 m a.s.l., a village on the foot of the northern slopes of Mt Velebit. LORKOVIĆ (2009) noted this species for Smiljan village before 1954 (leg. Gušić) in Lika karst polje, about 10 km away from our site near Kalinovača. Habitats of both sites are very similar: wet grasslands on acid and very poor soil in the vicinity of heath.

Another lycaenid the Escher's Blue (*Polyommatus escheri*) was found only once in the Krupa valley about 2 km SE of Krupa Monastery (25) at the southwestern foothills of Mt Velebit. It is a habitat specialist with a usually tightly localised distribution linked to its larval host plant *Astragalus monspesullanus* (Bernh.) (VEROVNIK, 2004). The species is known from neighbouring regions, from Mt Poštak (KOREN *et al.*, 2015) and Pag Island (MLADINOV, 1965).

The most unexpected were two findings of the Hungarian Glider (*Neptis rivularis*), the first recently near Baške Oštarije in Prpića duliba (10) (N exposure, 955 m a.s.l.), and next in the last century (leg. Z. Lorković) from Medačka staza trail (14) between Medak village in Lika and Buljma pass (Southern Velebit), both on the N slopes of the mountain and at similar altitude (900 m a.s.l.). These findings are still more plausible than the

finding of the lowland and colline species *N. sappho* near Baške Oštarije (MIHOČI *et al.*, 2007). The Hungarian Glider as a forest species (SBN, 1994; VEROVNIK *et al.*, 2012) was observed in July 2015 in a group of five specimens in a beech forest clearing, on shrubs of *Rubus idaeus*, *Sambucus ebulus*, *Rosa* sp. and on leaves of the lower branches of *Fagus sylvatica*. According to our observations in the Dinaric Alps this species is common in beech, fir and pine forests on the northern slopes of Mt Dinara (Bosnia and Herzegovina: between Grahovo and Risovac, 800 – 1050 m a.s.l., Croatia: Ledenica et Veliki Lad, 1500 – 1550 m a.s.l., N of the Sinjal peak area of Mt Dinara), but is rare on mostly open southern slopes. On the southern side only one finding is known from KOREN & LAUŠ (2013) at the beech-forest edge S of Troglav peak (Katića torine, about 1370 m a.s.l.), and one isolated population in a typical Submediterranean *Quercus pubescens* wood with *Ostrya carpinifolia* and *Carpinus orientalis* at Velika greda (810 m a.s.l.) above Bitelić (unpublished data). New localities on the Mt Velebit form a link between the sites in Mt Dinara and localities on the border of Slovenia and Croatia between Mt Snežnik and Mt Risnjak (MLADINOV, 1973; VEROVNIK *et al.*, 2012). For this species TOLMAN & LEWINGTON (2008) noted very fragmented and local distribution in the S Balkan area, but the situation seems to be similar in the western Dinaric Alps close to the Adriatic Sea.

Additionally, there is an interesting finding of a vagrant specimen of the Two-tailed Pasha *Charaxes jasius* photographed by M. Vuković near the Veliki Alan pass (5a) close to the Alan hikers hut (1340 m a.s.l.) in June 2015. The year 2015 was extremely good for this species as it was found in many new sites in Croatia (our unpublished data) probably because of the favourable weather in the late spring. TOLMAN & LEWINGTON (2008) cited “hill-topping” behaviour for this species: the specimen from Veliki Alan pass probably originated from the known population on Rab Island. During our survey of the coastal slopes in 2015 we did not find two other Mediterranean species, Cleopatra (*Gonepteryx cleopatra*) and Long-tailed Blue (*Lampides boeticus*), both documented in the past (KUČINIĆ *et al.*, 1995; our unpublished findings). Probably these findings refer to occasional vagrants, too.

The number of species on the check-list for Mt Velebit, the longest mountain chain in Croatia, including previous contributions by KUČINIĆ *et al.* (1995), MIHOČI *et al.* (2007), MIHOČI & ŠAŠIĆ (2007), LORKOVIĆ (2009), KOREN *et al.* (2011), KUČINIĆ *et al.* (2013) and ADŽIĆ (2015) increased to 153 species with our new records. Nevertheless the number of species on the list will probably be higher after additional analysis of voucher specimens in collections. The first candidate is one species from the morphologically indistinguishable pair *Colias hyale* and *C. alfacariensis* (DINCA *et al.*, 2011). GRUND (1916) noted only *C. hyale* for Mt Velebit, but KOREN *et al.* (2011) cited both taxa for the southern slopes of the south-eastern part of Mt Velebit. Velebit is probably inhabited by both species, but the presence of northern *C. hyale* should be evaluated with MT COI barcodes, as wing and genital morphology are not reliable enough for separation of the two taxa (DINCA *et al.*, 2011: Annex 3). The presence of *Euchloe ausonia* from KOREN *et al.* (2011) should be re-evaluated as data from the table do not match the findings mentioned in the text, so data for Manastir Krupa (SW slopes of Velebit Mt) are dubious. Additionally the listing of the western taxon *Pontia daplidice* (Linnaeus, 1758) by KUČINIĆ *et al.* (1995) and MIHOČI *et al.* (2007) should be changed to *Pontia edusa* Fabricius, 1777 as the former does not fly further eastwards from the Po River in Italy (GEIGER *et al.*, 1988; PORTER *et al.*, 1997).

The most unexpected finding in Lika area is the presence of the Damon Blue (*Polymmatius damon*) near Krbava karst polje at Donji Mekinjar (27), 650 m a.s.l. During fieldwork in August 2007 and July 2008 we documented several males near Suvaja

**Tab. 1.** List of researched localities (signed by numbers) from Mt Velebit and Lika area with incorporated sites without published coordinates from EITSCHBERGER (1983), LORKOVIĆ (1989, 2009) and МИНОСИ & ŠAŠIĆ (2007) pointed with sign \*.

Area	No.	Locality	Altitudem a.s.l.	X	Y
Velebit / V. Kapela	1	Senjska Draga*	70–340	44°59'6,45"N	14°56'6,57"E
Velika Kapela Mt	2	Vratnik (Orlovo gnijezdo)	600	44°59'11,16"N	14°57'36,29"E
<b>Velebit Mt</b>	3	Donji Bileni (Sklop)	400	44°41'44,30"N	14°56'22,54"E
	4	Dundovića Podi-Balenske brižine	750–1010	44°43'20,87"N	14°56'31,44"E
	5a	Veliki Alan (hut below the pass)	1340	44°43'17,36"N	14°58'6,69"E
	5b	Veliki Alan (W slopes of Buljma)	1330	44°43'5,45"N	14°57'54,46"E
		Kosinj*	590	44°44'9,49"N	15°16'22,18"E
	6	Kosinjski Bakovac	660	44°42'50,80"N	15°11'6,73"E
	7	Kalinovača (Široke bare)	580	44°37'48"N	15°12'38,29"E
	8	Vidovac	160	44°31'19,52"N	15°5'56,15"E
	9	Ivanova draga	650	44°32'2,66"N	15°7'14,29"E
	10	Prpića duliba	965	44°32'51,61"N	15°9'4,77"E
	11	Alaginac (S slope)	1100	44°32'43,24"N	15°9'53,26"E
	12	Stupačinovo	985	44°32'31,54"N	15°9'22,54"E
	13	Trnovac*	580	44°31'38,32"N	15°16'22,19"E
	14	Medačka staza trail	900	44°24'42,44"N	15°29'3,96"E
	15	Vaganski vrh peak (NW slopes)	1680	44°22'2,10"N	15°30'2,70"E
	16	Bristovac Milovci	450	44°18'51,49"N	15°27'10,44"E
	17a	Velika Paklenica gorge (entrance)	30	44°17'36,53"N	15°27'26,44"E
	17b	V. Paklenica gorge (lower part)	65	44°17'54,84"N	15°28'12,50"E
	18	Mala Paklenica gorge (lower part)	60	44°17'9,44"N	15°30'4,50"E
	19	Lički doci	825	44°18'6,88"N	15°33'47,58"E
	20	Kitnjasta glavica	155	44°15'35,10"N	15°33'29,79"E
	21	Mali Alan (= Halan) pass*	1040	44°17'24,15"N	15°39'9,61"E
	22a	Prezid pass	780	44°15'7,03"N	15°48'38,21"E
	22b	Prezid pass (S of tunnel)	740	44°14'38,21"N	15°48'27,87"E
	23	Prezid-Obrovac (turn to Golubić)	600	44°13'50,36"N	15°47'57,00"E
	24	Krupa River spring (slopes above)	190	44°11'50,55"N	15°54'41,60"E
	25	Krupa valley 2 km SE monastery	140	44°11'25,62"N	15°52'28,34"E
		Otrič* and Sučevići viaduct*	640	44°15'7,91"N	16°3,3'3,97"E
<b>Lika area</b>					
Mala Kapela Mt	26	Ljubovo – Svrčakovo selo	920	44°38'37,69"N	15°34'26,46"E
Mala Kapela Mt	27	Donji Mekinjar (Suvaja)	650	44°33'59,64"N	15°40'47,05"E
	28	Krbavsko polje (Močila-Zaklopača)	628	44°36'16,70"N	15°41'39,74"E
Lička Plješivica Mt	29	Međugorje (Magarčev do)	990	44°30'47,88"N	15°52'44,68"E
	30	Kanjon Une (Oreljov krš)	374	44°28'48,22"N	16°8'26,99"E
Lička Plješivica Mt	31	Lisac (Strmica)	1100	44°19'30,64"N	15°58'59,20"E

periodical karst spring. The potential host plant *Onobrychis arenaria* was found on dry grasslands only at localities more than 800 m distant from male butterfly findings. By 2015 these grasslands have become overgrown and we could not confirm our previous finding of host plants and the butterflies. Fortunately an additional population was found 30 km NW from Mekinjar in July 2015 on dry meadows near the Ljubovo-Svračkovo selo road (26). Two males and two females of *P. damon* were observed together with one male of Ripart's Anomalous Blue (*Polyommatus ripartii*). Both localities are on the southern slopes of Mt Mala Kapela where Mediterranean plants and insects (e.g. plants *Eryngium amethystinum*, *Plantago holosteum*, *Satureja subspicata* and *S. montana*, cricket *Ephippiger discoidalis*, moth *Perisonema caecigena*) were observed deep in the Alpine region. Additionally, one male and two females of *P. ripartii* together with 10 specimens *P. admetus* were found in July 2015 on dry grasslands of the thermophilous southern slopes of Strmica (31), 1100 m a.s.l., south of Lisac peak (the southernmost part of Mt Lička Plješivica). These dry grasslands are extremely rich in *Onobrychis arenaria*, and we are expecting more species sharing the same host plants, like *Cupido osiris* and *Polyommatus thersites*, to be found at this site eventually. After the first published papers on findings of *P. damon* and *P. ripartii* on Mt Dinara (Troglav and Kamešnica) and Mt Poštak (MIHOČI *et al.*, 2006; KOREN, 2010; KOREN *et al.*, 2015) our findings of these species in Lika area are the most northwesterly points of their distribution on the Balkan Peninsula. In June 2014 botanist Professor Jasenka Topić took a photo of an endangered species in Europe, the Scarce Fritillary (*Euphydryas maturna*), in the canyon of the Una River (30) on the state border between Croatia and Bosnia and Herzegovina. This locality is isolated from the known area of distribution of this species in Croatia (ŠAŠIĆ *et al.*, 2015).

In the central part of the karstic Krbava polje on 01.–02. 08. 2007 in a site more than three kilometres in area (28) with marshes and dinaric karst poljes wet grasslands (Močila – Ribnjak – Čorkovo jezero – Kotao – Zaklopača: 628 m a.s.l.) between the settlements of Krbava and Jošani we documented more than ten individuals of the Large Copper (*Lycaena dispar*) and a strong population of the humid meadow ecotype of the Alcon Blue (*Phengaris alcon*) on *Gentiana pneumonanthe* as host plant. A detailed study of the habitat and the population size is needed as this could be the largest population in Croatia. Possible future monitoring would be recommended to fulfil the gaps in the knowledge of the life cycle and of the habitat requirements of this species of conservation interest in a typical Dinaric karst polje habitat with seasonal flooding.

At the first glance Mt Velebit acts like a big barrier for Mediterranean fauna from the coastal area, and for continental fauna from the north-eastern side. But because of the great variations in climate during Pleistocene, Lika with its lower mountains and large karst poljes contains pockets of different faunistic elements, Mediterranean and continental. From the Zrmanja River source area along the western slopes of Mt Poštak, Mediterranean elements penetrate further to the north. The "Alpine biogeographical region" (EEA, 2012) in the Lika area is therefore a broad transitional zone of continental (Eurosiberian) and Mediterranean faunal elements. True alpine elements are restricted only to the highest isolated peaks of Mt Velebit and Mt Lička Plješivica (MLADINOV & LORKOVIĆ, 1985). A high species number, as in the case of Velebit's butterfly fauna, is expected in all high mountain chains in Dinaric region with a transitional belt of vegetation regions on southern slopes between Mediterranean and continental belt, together with a higher subalpine belt, as is the case across Mt Dinara (TVRTKOVIĆ *et al.*, 2012;



KOREN & LAUŠ, 2013) and the high mountains of Bosnia and Herzegovina (SIJARIĆ, 1974), to Montenegro and the Prokletije Mts in the Albanian Alps in the south.

Completing the list of butterfly fauna of Mt Velebit and neighbouring Lika region followed by mapping is of great importance as it will encourage initiatives regarding butterfly conservation, especially as urgent measures for habitat management and conservation in some areas are needed.

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## APPENDIX

**Material examined:*****Carterocephalus palaemon* (Pallas, 1771)**

Prezid pass: along road on the S side before tunnel, 740 m a.s.l., 06.06.2010, obs. R. Verovnik; Kosinjski Bakovac: Ruja – Brneći vršak, 660 m a.s.l., 29.05.2015, leg. L. Lovrenčić; Baške Oštarije: Prpića duliba, 965 m a.s.l., 29.05.2015, leg. L. Lovrenčić; Međugorje: Magarčev dol, 990 m a.s.l., 04.06.2015, leg. N. Tvrtković;

***Gegenes pumilio* (Hoffmannsegg, 1804)**

Mala Paklenica gorge: first part, 60 a.s.l., 19.08.2007, obs. R. Verovnik;

***Pyrgus armoricanus* (Oberthür, 1910)**

Donji Mekinjar, 650 m a.s.l., 02.08.2007, leg. N. Tvrtković et M. Vuković; Krupa stream valley: 2 km SE of the Krupa monastery, 140 m a.s.l., 08.08.2007, 6.06.2010, obs. R. Verovnik; Prezid, 850 m a.s.l., 25.06.2008, leg. N. Tvrtković; Krupa monastery: SE grasslands, 140 m a.s.l., 06.06.2010, 08.08.2014, obs. R. Verovnik; Krupa stream sprig: slopes above, 190 m a.s.l., 08.08.2014, 27.06.2015, obs. R. Verovnik; Kalinovača: Široke bare, 580 m a.s.l., 18.09.2015, leg. M. Jagić;

***Pieris (napi) balcana* Lorković, 1970**

Senjska Draga, 86 m a.s.l., 13.04.2015, 1♀, leg. N. Tvrtković; Vratnik: Orlovo gnijezdo, 600 m a.s.l., 20.04.2015, 2♂♂+1♀, leg/obs. N. Tvrtković; D. Bileni: Sklop, 400 m a.s.l., 10.04.2015, 1♀ leg. N. Tvrtković; Dundovića Podi, 750 m a.s.l., 03.07.2015, 2♀♀ leg. +13♂♂ obs.; 22.09.2015 1♂ leg. L. Lovrenčić; Bakovac Kosinjski, 660 m a.s.l., 28.05.2015, 3♂♂; 16.07.2015, 8♂♂ leg. N. Tvrtković; Vidovac, 160 m a.s.l., 10.04.2015, 2♂♂ leg. N. Tvrtković; Ivanova Draga, 650 m a.s.l., 10.04.2015, 3♂♂; 25.06.2015, 3♂♂ leg. N. Tvrtković; Prpića duliba, 965 m a.s.l., 07.06.2015, 2♂♂; 15.07.2015, 7♂♂ leg. N. Tvrtković; Alaginac, 1100 m a.s.l., 29.04.2015, 2♀♀ obs.; 08.08.2015, 1♀ obs. N. Tvrtković; Kalinovača, 580 m a.s.l., 03.07.2015, 5♂♂ leg. N. Tvrtković; Trnovac, 580 m a.s.l., 25.06.2015, 1♂ leg. N. Tvrtković; Bristovac Milovci, 450 m a.s.l., 02.04.2015, 2♂♂ leg. N. Tvrtković; Starigrad Paklenica (before entrance of NP), 30 m a.s.l., 02.04.2015, 2♂♂ leg. N. Tvrtković; Ljubovo-Svračkovo selo, 920 m a.s.l., 28.07.2015, 9♂♂ leg. N. Tvrtković; Donji Mekinjar, 650 m a.s.l., 05.08.2015, 1♂ leg. N. Tvrtković;

***Callophrys rubi* (Linnaeus, 1758)**

Krupa stream valley: 2 km SE of the Krupa monastery, 140 m a.s.l., 03.05.2008, obs. R. Verovnik; Krupa monastery: grasslands SE, 140 m a.s.l., 06.06.2010, obs. R. Verovnik; Prezid pass: along road on the S side before tunnel, 740 m a.s.l., 03.05.2013, obs. R. Verovnik; Libinje: Lički doci, 850 m a.s.l., 08.05.2013, 1♂ obs. N. Tvrtković; Baške Oštarije: Stupačinovo, 985 m a.s.l., 29.05.2015, 1♂ leg. L. Lovrenčić;

***Favonius quercus* (Linnaeus, 1758)**

Velika Paklenica gorge: lower part, 65 m a.s.l., 15.08.2001, obs. R. Verovnik; Bakovac Kosinjski (600 m a.s.l.), 16.07.2015, 1♀ leg. L. Lovrenčić;

***Lycaena dispar* Haworth, 1803**

Krbavsko polje: Močila – Zaklopača, 628 m a.s.l., 02.08.2007, 5♂♂ photo M. Vuković and N. Tvrtković;

***Lycaena tityrus* (Poda, 1761)**

Kalinovača: Široke bare, 580 m a.s.l., 28.05.2015, 1♂ leg. L. Lovrenčić;

***Phengaris alcon* Denis et Schiffermüller, 1775**

Krbavsko polje: Močila – Zaklopača, 628 m a.s.l., 01.08.2007, eggs on *Gentiana pneumonanthe* and ♀♀ at oviposition, 02.08.2007, several photos M. Vuković and N. Tvrčković;

***Polyommatus admetus* Esper, 1785**

Lisac: Strmica, 1100 m a.s.l., 29.07.2015, 1♂+1♀ leg. N. Tvrčković and L. Lovrenčić;

***Polyommatus damon* (Denis et Schiffermüller, 1775)**

Donji Mekinjar, 650 m a.s.l., 02.08.2007, 2♂♂ photo M. Vuković; 10.07.2008, 1♂ photo M. Vuković; Ljubovo – Svračkovo selo, 920 m a.s.l., 22.07.2015, 1♂+1♀ leg. N. Tvrčković;

***Polyommatus eros* (Ochsenheimer, 1808)**

Veliki Alan pass: W slopes of Buljma peak, 1330 m a.s.l., 05.07.2013, obs. R. Verovnik; Vaganski vrh peak, 1680 m a.s.l., 12.08.2014, obs. R. Verovnik;

***Polyommatus escheri* (Hübner, 1823)**

Krupa stream valley: 2 km SE of the Krupa monastery, 140 m a.s.l., 06.06.2010, obs. R. Verovnik;

***Polyommatus ripartii* (Freyer, 1830)**

Ljubovo – Svračkovo selo, 920 m a.s.l., 22.07.2015, 1♂ leg. and released N. Tvrčković; Lisac: Strmica, 1100 m a.s.l., 29.07.2015, 1♂+1♀ leg. N. Tvrčković and L. Lovrenčić;

***Charaxes jasius* (Linnaeus, 1767)**

Velebit Mt: Veliki Alan pass, 'Alan' hut, 1340 m a.s.l., 11.06.2015, photo M. Vuković;

***Neptis rivularis* (Scopoli, 1763)**

Medačka staza trail, 900 m a.s.l., 11.08.1940, leg. Z. Lorković, Coll. Lorković, CNHM Zagreb; Baške Oštarije: Prpića duliba, 955 m a.s.l., 14.07.2015, 1♀ photo and 5 specimens obs. N. Tvrčković and L. Lovrenčić;

***Nymphalis antiopa* (Linnaeus, 1758)**

Mali Alan (= Halan) pass: along the roads, 1040 m a.s.l., 04.07.2013, obs. R. Verovnik;

***Euphydryas maturna* (Linnaeus, 1758)**

Una River canyon: Oreljov krš, 374 m a.s.l., 08.06.2012, photo J. Topić;

***Melanargia larissa* (Geyer, 1828)**

Jablanac-Veliki Alan pass: turn the road at Balenske brižine, 990 m a.s.l., 03.07.2013, obs. R. Verovnik; Krupa stream spring: slopes above, 27.06.2011, obs. R. Verovnik; Vidovac, 160 m a.s.l., 25.06.2015, leg. N. Tvrčković; Dundovića Podi – Balenske brižine, 750 – 1010 m a.s.l., 03.07.2015, more than 10 specimens obs. N. Tvrčković and L. Lovrenčić;

***Proterebia afra* (Fabricius, 1787)**

Prezid pass-Obrovac: turn to Golubić, 600 m a.s.l., 03.05.2013, obs. R. Verovnik; Kitnjasta glavica, 155 m a.s.l., 08.05.2013, 1♀ leg. N. Tvrčković and G. Lukač;