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Surveys of butterfly and skipper fauna in the southwestern part of the Republic of Macedonia (Lepidoptera: Papilionoidea & Hesperioidea)

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Abstract. Data from four surveys within the last six years were combined in order to improve the knowledge of the butterfly distribution in the Republic of Macedonia. These surveys covered a total of 40 localities, with special emphasis on less sampled areas of the south-western part of the country. The study yielded recording of 131 species, including several habitat specialist and potentially threatened butterflies. Interesting records for the following species are discussed in detail: *Muschampia tessellum*, *Anthocharis gruneri*, *Euchloe penia*, *Tarucus balkanicus*, *Cupido alcetas*, *Pseudophilotes bavius*, *Polyommatus aroaniensis*, *Polyommatus escheri*, *Araschnia levana* and *Melitaea ornata*. Ten species observed are considered threatened at the European level and 18 of them at the country level. This proves high conservation value of the studied region with many butterfly rich habitats still preserved. The lack of concerted effort for mapping of butterfly fauna in Macedonia is discussed and priorities for future surveys given.

Key words: distribution, habitat specialists, threatened species, Grypocera

Izvleček. Raziskave favne dnevnih metuljev v jugozahodnem delu Republike Makedonije (Lepidoptera: Papilionoidea & Hesperioidea) – Predstavljeni so podatki iz štirih raziskav v zadnjih šestih letih, s katerimi želimo prispevati k boljšemu poznavanju razširjenosti dnevnih metuljev v Republiki Makedoniji. Vzorčili smo na 40 lokacijah, s posebnim poudarkom na popisovanju v manj raziskanih predelih jugozahodnega dela države. Skupno smo zabeležili 131 vrst, med njimi več habitatnih specialistov in potencialno ogroženih metuljev. Podrobneje so predstavljene zanimive najdbe naslednjih vrst: *Muschampia tesellum*, *Anthocharis gruneri*, *Euchloe penia*, *Tarucus balkanicus*, *Cupido alcetas*, *Pseudophilotes bavius*, *Polyommatus aroaniensis*, *Polyommatus escheri*, *Araschnia levana* in *Melitaea ornata*. Deset opaženih vrst je navedenih kot ogrožene na evropski ravni, 18 vrst pa je vključenih v rdeči seznam na državni ravni. Prisotnost teh vrst dokazuje, da je na območju raziskave še vedno mogoče najti ohranjena življenjska okolja z visoko naravovarstveno vrednostjo in veliko vrstno pestrostjo metuljev. V zaključku razpravljamo o pomanjkanju usklajenih prizadevanj za kartiranje favne dnevnih metuljev v Makedoniji ter postavljamo prednostne naloge za prihodnje raziskave.

Ključne besede: razširjenost, habitatni specialisti, ogrožene vrste, Grypocera

Introduction

The Republic of Macedonia is situated in southeastern Europe, in the region where continental and Mediterranean climate influences intersect. The country possesses some of the most stunning mountain ranges of up to about 2700 meters, with typical mountain climate, and deep river gorges which provide great microclimatic variation and serve as refugia for a number of relict taxa. This wide range of climatic types resulted in extremely diverse invertebrate fauna in the country with a relatively small total area (Hristovski et al. 2015). With 205 butterfly species recorded up to date (Melovski & Bozhinovsk 2014), it is definitively one of the hotspots of butterfly diversity in Europe.

Comprehensive faunistic surveys from the previous century by Rebel (1913), Alberti (1922) and Thurner (1964) provided valuable outlines of the butterfly species distribution in the country. In 1989, a distribution atlas of the butterflies of Yugoslav Macedonia followed (Schaider & Jakšić 1989), but its reliability is questionable due to lack of record traceability and inclusion of doubtful and imprecise data. In the last two decades, the butterfly surveys intensified resulting in a number of new species records for the country (Kolev & van der Poorten 1997, Krpač & Mihajlova 1997, Melovski 2004, Verovnik & Micevski 2008, Micevski et al. 2009a, 2009b, Verovnik et al. 2010, Micevski 2013, Melovski & Bozhinovsk 2014). Additionally, several faunistic and species targeted surveys were published providing valuable new information on the distribution of several rare species in the country (Dincă et al. 2010, Franeta et al. 2012, Verovnik 2012, Verovnik et al. 2013, Melovski & Bozhinovsk 2014). Although the published surveys vastly improved the knowledge regarding the distribution of butterflies in Macedonia, most of the recent studies focused on already well surveyed areas like Mt. Galičica (Krpač et al. 2011), Mt. Baba (Micevski & Micevski 2002/2003) or Mt. Shar (Melovski 2003, Huemer et al. 2011, Abdija et al. 2013a, 2013b, 2013c, 2013d). Therefore large portions of the country, particularly its central and eastern parts, remain understudied.

Here we combined unpublished data from several visits to the Republic of Macedonia between 2010 and 2016. This study could thus be considered as a continuation of the previously published surveys (Verovnik et al. 2010, Verovnik 2012). Once more, the clear focus was on spring aspect of the fauna which is generally neglected. The study specifically targets the under surveyed regions in the south-western part of the country and the most important habitats for butterfly diversity (e.g. rocky slopes, gorges and gullies, dry grasslands). This enabled us to get a comprehensive overview of the local butterfly fauna and to provide new records for some rare and potentially threatened habitat specialist butterflies.

Materials and methods

Butterflies were observed during four surveys: July 2010 (Prespa Lake region and surroundings of Prilep), July 2012 (surroundings of Prilep), April/May 2015 (surroundings of Bitola, Prilep, and Makedonski Brod), May 2016 (surroundings of Bitola and Gevgelija). In total, 40 localities were visited (Fig. 1). They were pre-selected based on Google Earth satellite images with a specific preference for dry rocky grasslands and gorges. Adults were captured using entomological nets and released after their identification. For this purpose, Butterflies of Britain and Europe field guide was used as a primary source of information (Tolman & Lewington 2008).

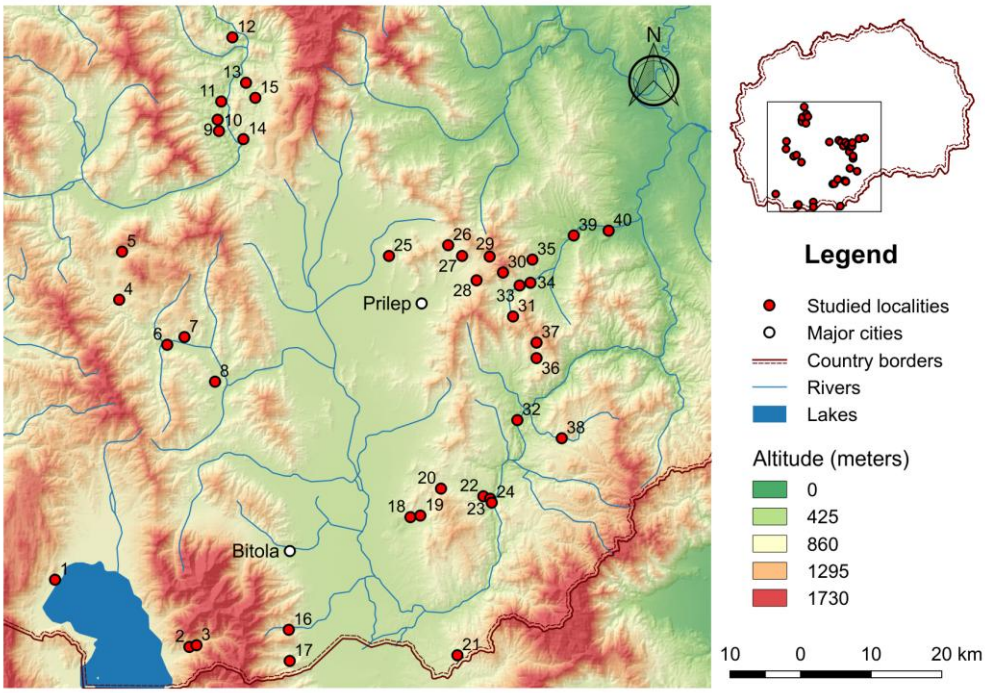

Figure 1. A map of the visited sites during four surveys of butterfly fauna in south-western part of the Republic of Macedonia. The numbering corresponds with the list of localities in the text.
Slika 1. Karta razporeditve obiskanih lokalitet med štirimi raziskavami dnevnih metuljev v Makedoniji. Oštevilčenje ustreza seznamu lokalitet v besedilu.

Results

List of localities

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

1. Resen, Sirhan, rocky and bushy steep slopes along the road south of the village; 860 m; 40°59'38", 20°55'57"; 30.4.2015.
2. Prespa, Brajčino, rocky and bushy steep slopes N of the village; 1020 m; 40°54'29", 21°9'32"; 9.7.2010.
3. Prespa, Brajčino, small glades and mixed woodlands along dirt road northeast of the village; 1060 m; 40°54'37", 21°10'15"; 9.7.2010.
4. Bitola, Železnec, rocky slopes in the gorge along the road to Belica; 850 m; 41°21'5", 21°2'27"; 26.4.2015.
5. Bitola, Cer, stony meadows and pastures on south facing slopes west from the village; 1000 m; 41°24'45", 21°2'45"; 26.4.2015.
6. Bitola, Žvan, partially overgrown meadows on southern facing slopes north of the village; 670 m; 41°17'38", 21°7'2"; 26.4.2015.
7. Bitola, Sopotnica, rocky slopes and meadows along the dirt road north of the village; 700 m; 41°18'13", 21°9'5"; 26.4.2015.
8. Bitola, Belče, meadows and pastures on south facing slopes north of the village; 650 m; 41°14'48", 21°12'11"; 26.4.2015.
9. Makedonski Brod, Treska Valley, Slatina, meadows, bushes and riparian vegetation along the road to Slatina; 520 m; 41°34'51", 21°12'30"; 1.5.2015.
10. Makedonski Brod, Treska Valley, Grešnica, meadows and bushes along the road to the village; 510 m; 41°33'59", 21°12'39"; 1.5.2015.
11. Makedonski Brod, Treska Valley, Dolni Manastirec, meadows and riparian vegetation along a dirt track west of the village; 510 m; 41°36'15", 21°12'53"; 1.5.2015.
12. Makedonski Brod, Treska Valley, Dolna Belica, rocky slopes along the road northwest of the village; 480 m; 41°41'9", 21°14'2"; 1.5.2015.
13. Makedonski Brod, Treska Valley, Modrište, bushes and meadows along the dirt road towards Vir Village; 550 m; 41°37'41", 21°15'25"; 1.5.2015.
14. Makedonski Brod, Treska Valley, Devič, screes and rocky slopes in a valley 1 km east of the village; 600 m; 41°33'22", 21°15'8"; 1.5.2015.
15. Makedonski Brod, Treska valley, Vir, rocky slopes along the road north of the village; 630 m; 41°36'31", 21°16'22"; 1.5.2015.
16. Bitola, Velušina, dry meadows on south facing slopes along the road west of the village; 850 m; 40°55'47", 21°19'34"; 27.4.2015.
17. Bitola, Kišava, dry meadows on south facing slopes above the road east of the village; 750 m; 40°53'23", 21°19'39"; 27.4.2015.
18. Bitola, Suvodol, grasslands and pastures north of the quarry; 700 m; 41°4'22", 21°31'56"; 27.4.2015.
19. Bitola, Suvodol, grasslands and pastures in a small valley east of the village near artificial lake; 700 m; 41°4'28", 21°32'56"; 27.4.2015.
20. Bitola, Makovo, bushy meadows along the road 1 km west of the village; 800 m; 41°6'32", 21°35'3"; 25.5.2016.
21. Bitola, Živojno, pastures and grasslands in a small valley southeast of the village; 770 m; 40°53'45", 21°36'356"; 25.5.2016.
22. Bitola, Rapeš, partially overgrown meadows 1 km southeast of the village; 640 m; 41°5'55", 21°39'20"; 27.4.2015.

23. Bitola, Rapeš, bushy and rocky south-east facing slopes above the river Crna reka; 470 m; 41°5'43", 21°40'1"; 27.4.2015, 25.5.2016.
24. Bitola, Rapes, hay meadows and riparian vegetation at Crna reka east of the village; 450 m; 41°5'26", 21°40'10"; 25.5.2016.
25. Prilep, Mali Mramorani, rocky and grassy south facing slopes east of the village; 740 m; 41°24'22", 21°29'55"; 5.7.2012.
26. Prilep, Prisad, quarry north of the town, bushy and rocky slopes east of the quarry; 920 m; 41°25'10", 21°35'57"; 14.7.2010, 6.7.2012.
27. Prilep, Prisad, dry grasslands and screes on south facing slopes of Mt. Ćave; 1020 m; 41°24'20", 21°37'21"; 6.7.2012.
28. Prilep, Pletvar, bushy and rocky slopes above the village; 1060 m; 41°22'27", 21°38'48"; 14.7.2010, 5.7.2012, 7.7.2012, 28.4.2015.
29. Prilep, Krstec, in the village at a spring and on grassy slopes north of the village; 1080 m; 41°24'16", 21°40'9"; 6.7.2012.
30. Prilep, Pletvar, steep rocky slopes above the quarry on southern slopes of Mt. Kozjak; 1200 m; 41°23'2", 21°41'30"; 7.7.2012.
31. Prilep, Belovodica, rocky and bushy slopes along the road southeast of the village; 990 m; 41°19'40", 21°42'29"; 6.7.2012.
32. Prilep, Mariovo, meadows and riparian vegetation at a bridge over river Crna reka; 370 m; 41°11'44", 21°42'50"; 8.7.2012.
33. Prilep, Trojaci, partially overgrown meadows along the main road southwest from the village; 670 m; 41°22'2", 21°43'11"; 28.4.2015.
34. Prilep, Trojaci, orchards and meadows along the road in the village and along a small stream; 550 m; 41°22'14", 21°44'17"; 14.7.2010, 8.7.2012.
35. Prilep, Toplica, wet patches in the village at a small spring; 670 m; 41°24'1", 21°44'30"; 6.7.2012.
36. Prilep, Veprčani, bushes and small clearings along the road in a gully northwest of the village; 790 m; 41°16'28", 21°44'50"; 8.7.2012.
37. Prilep, Veprčani, partially overgrown screes and rocky pastures above the quarry northwest of the hamlet; 1030 m; 41°17'39", 21°44'51"; 8.7.2012.
38. Prilep, Vitolište, screes and rocky slopes west of the village; 740 m; 41°10'19", 21°47'19"; 8.7.2012.
39. Gradsko, Raec, bushy and rocky slopes in a gorge 3 km west from the village, along an abandoned road; 300 m; 41°25'50", 21°48'44"; 14.7.2010, 28.4.2015.
40. Gradsko, Raec, south facing rocky and bushy slopes 3 km northeast from the village; 240 m; 41°26'10", 21°52'17"; 14.7.2010, 5.7.2012, 28.4.2015.

List of species

Butterfly species are listed in taxonomical order (Tab. 1) in principle following the nomenclature of the Fauna Europaea (Fauna Europaea 2016). Butterflies were not collected during our surveys, therefore the genitalia were not measured. We list *Leptidea sinapis* as *Leptidea sinapis/juvernica* species complex, although it is very likely that all specimens observed belong to the first mentioned species. Specifically, in the Southern Balkan Peninsula, *L. juvernica* is limited to high mountains hygrophilous vegetation (Shtinkov et al. 2016), while our surveys were limited to lower altitudes and mostly thermophilous localities.

Table 1. The distribution of butterfly species observed during our surveys in southwestern part of Macedonia. The localities are numbered as in the List of localities chapter. D&S stands short for Denis & Schiffermüller.
Tabela 1. Razširjenost dnevnih metuljev, opaženih med štirimi raziskavami v jugozahodnem delu Makedonije. Lokalitete so oštevilčene tako kot v poglavju Seznam lokalitet. D&S je okrajšava za Denis & Schiffermüller.

Species	**Localities**
Papillionidae	
Iphiclides podalirius (Linnaeus, 1758)	4, 10, 15, 19, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 38, 39, 40
Papillio machaon Linnaeus, 1758	7, 10, 13, 14, 15, 26, 27, 28, 31, 40
Zerynthia cerisy (Godart, 1824)	24
Zerynthia polyxena ([D&S], 1775)	10, 19, 22, 23, 39
Pieridae	
Aporia crataegi (Linnaeus, 1758)	2, 3, 20, 21, 23, 24, 38
Pieris balcana (Lorkovic, 1968)	3, 8, 14, 21, 24, 34, 40
Pieris ergane (Geyer, 1828)	3, 5, 6, 7, 14, 28, 33, 34, 39
Pieris mannii (Mayer, 1851)	32, 40
Pieris napi (Linnaeus, 1758)	1, 6, 7, 8, 13, 16, 17, 19, 21, 22, 28, 39
Pieris rapae (Linnaeus, 1758)	7, 13, 14, 21, 28, 34, 35, 36, 38, 39, 40
Pieris brassicae (Linnaeus, 1758)	2
Pontia edusa (Fabricius, 1777)	10, 18, 19, 21, 22, 25, 26, 27, 28, 29, 32, 34, 35, 36, 38
Anthocharis cardamines (Linnaeus, 1758)	6, 7, 8, 10, 11, 12, 13, 14, 15, 17, 18, 22, 23, 28, 33, 39, 40
Anthocharis gruneri Herrich-Schäffer, 1851	4, 5, 10, 11, 13, 15, 28, 39
Euchloe ausonia (Hübner, 1804)	14, 22, 23, 24
Euchloe penia (Freyer, 1852)	12, 13, 15, 28
Colias alfacariensis Ribbe, 1905	6, 10, 13, 15, 25, 26, 27, 28, 29, 30, 31, 34, 35, 36, 37, 38, 39, 40
Colias croceus (Fourcroy, 1785)	1, 2, 3, 7, 8, 11, 16, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 34, 35, 36, 37, 38, 40
Gonepteryx cleopatra (Linnaeus, 1767)	25
Gonepteryx rhamni (Linnaeus, 1758)	1, 4, 5, 7, 10, 12, 13, 15, 18, 19, 23, 27
Leptidea duponcheli (Staudinger, 1871)	2, 5, 6, 23, 25, 26, 27, 28, 34, 35, 36, 40
Leptidea sinapis/juvernica	4, 5, 6, 7, 8, 9, 11, 13, 14, 15, 17, 23, 25, 26, 28, 33, 34, 39
Lycaenidae	
Satyrium acaciae (Fabricius, 1787)	2, 3, 40
Satyrium ilicis (Esper, 1779)	3, 24, 28
Satyrium spini ([D&S], 1775)	26, 27, 28, 30, 31
Satyrium w-album (Knoch, 1782)	34
Favonius quercus (Linnaeus, 1758)	34
Callophrys rubi (Linnaeus, 1758)	1, 5, 6, 8, 14, 15, 17, 20, 21, 24, 28, 33
Lycaena alciphron (Rottemburg, 1775)	20, 24, 34
Lycaena phlaeas (Linnaeus, 1761)	2, 3, 7, 8, 16, 18, 19, 20, 21, 23, 24, 25, 28, 29, 32, 34, 35, 36, 38, 39
Lycaena thersamon (Esper, 1784)	25, 32, 36
Lycaena tityrus (Poda, 1761)	1, 2, 10, 17, 18, 20, 23, 25, 28, 29, 32, 34, 38, 39
Lycaena virgaureae (Linnaeus, 1758)	2, 3
Tarucus balkanica (Freyer, 1844)	24, 32, 39
Leptotes pirithous (Linnaeus, 1767)	34
Cupido alcetas (Hoffmannsegg, 1804)	34
Cupido argiades (Pallas, 1771)	10, 14
Cupido minimus (Fuessly, 1775)	9, 13, 14, 24, 25, 26, 27, 28, 29, 31, 34, 36, 37, 38
Cupido osiris (Meigen, 1829)	2, 9, 20, 24, 25
Celastrina argiolus (Linnaeus, 1758)	3, 7, 16, 17, 25, 32, 34, 40
Pseudophilotes bavius (Eversmann, 1832)	9, 13, 14
Pseudophilotes vicrama (Moore, 1865)	9, 14, 15, 24, 25, 26, 27, 28, 30, 35, 36, 37, 39
Scolitantides orion (Pallas, 1771)	9, 12, 15, 39
Glaucopsyche alexis (Poda, 1761)	6, 9, 13, 14, 18, 23, 24, 28, 40
Iolana iolas (Ochsenheimer, 1816)	23, 24
Phengaris alcon ([D&S], 1775)	28, 29
Cyaniris semiargus (Rottemburg, 1775)	3, 24
lebejus argyrognomon (Bergstrasser, 1779)	3

Species	**Localities**
Plebejus argus (Linnaeus, 1758)	3, 20, 21, 26, 29, 31, 34, 36
Plebejus idas (Linnaeus, 1761)	24, 25, 26, 28, 29, 30, 34, 35
Aricia agestis ([D&S], 1775)	2, 3, 6, 9, 10, 13, 14, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 38, 39, 40
Aricia artaxerxes (Fabricius, 1793)	3
Aricia anteros (Freyer, 1838)	20
Polyommatus bellargus (Rottemburg, 1775)	28, 31, 34, 38, 40
Polyommatus coridon (Poda, 1761)	34
Polyommatus daphnis ([D&S], 1775)	25, 29, 34, 35, 36, 39
Polyommatus eros (Ochsenheimer, 1808)	3
Polyommatus icarus (Rottemburg, 1775)	1, 2, 3, 6, 18, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 32, 34, 35, 36, 37, 38, 39, 40
Polyommatus thersites (Cantener, 1835)	2, 23, 24, 25, 26, 31, 34, 40
Polyommatus escheri (Hübner, 1823)	35
Polyommatus amandus (Schneider, 1792)	3, 24
Polyommatus dorylas ([D&S], 1775)	28, 31
Polyommatus admetus (Esper, 1783)	2, 3, 25, 26, 28, 30, 34, 35
Polyommatus aroaniensis (Brown, 1976)	25, 26, 28, 29, 30
Polyommatus ripartii (Freyer, 1830)	3, 28, 34, 36
Nymphalidae	
Libythea celtis (Laicharting, 1782)	6, 23, 24
Apatura ilia ([D&S], 1775)	29
Apatura iris (Linnaeus, 1758)	3
Limenitis reducta Staudinger, 1901	21, 23, 24, 25, 29, 34, 39, 40
Aglais io (Linnaeus, 1758)	3, 6, 7, 8, 9, 13, 34
Aglais urticae (Linnaeus, 1758)	29
Nymphalis antiopa (Linnaeus, 1758)	6, 11, 31, 34, 39
Nymphalis polychloros (Linnaeus, 1758)	6, 7
Polygonia c-album (Linnaeus, 1758)	3, 11, 15, 20, 34, 36, 39, 40
Vanessa atalanta (Linnaeus, 1758)	3, 9, 21, 24, 29
Vanessa cardui (Linnaeus, 1758)	1, 3, 7, 9, 10, 13, 14, 15, 20, 21, 23, 24, 25, 27, 28, 29, 30, 31
Araschnia levana (Linnaeus, 1758)	11
Argynnis adippe ([D&S], 1775)	3, 36
Argynnis aglaja (Linnaeus, 1758)	28, 29
Argynnis niobe (Linnaeus, 1758)	2, 3, 25, 26,29, 34
Argynnis pandora ([D&S], 1775)	3, 21, 23, 24, 25, 26, 27, 28, 34, 38
Argynnis paphia (Linnaeus, 1758)	3, 29, 34
Issoria lathonia (Linnaeus, 1758)	3, 8, 13, 14, 18, 20, 21, 24, 25, 26, 28, 29, 30, 35, 36, 37, 38
Boloria dia (Linnaeus, 1767)	8, 9, 29, 34
Brenthis daphne (Bergstrasser, 1780)	3, 25, 29, 34, 40
Brenthis hecate ([D&S], 1775)	20, 25
Melitaea athalia (Rottemburg, 1775)	3
Melitaea phoebe ([D&S], 1775)	2, 3, 21
Melitaea ornata Cristoph, 1893	39
Melitaea arduinna (Esper, 1783)	20
Melitaea cinxia (Linnaeus, 1758)	20, 24
Melitaea didyma (Esper, 1778)	2, 3, 20, 21, 24, 25, 28, 29, 30, 31, 37, 40
Melitaea trivia ([D&S], 1775)	2, 23, 30, 35
Aphantopus hyperanthus (Linnaeus, 1758)	3, 34
Brintesia circe (Fabricius, 1775)	2, 3, 25, 26, 27, 28, 29, 30, 34, 35, 36, 37, 38, 40
Maniola jurtina (Linnaeus, 1758)	2, 3, 20, 21, 23, 24, 25, 26, 28, 29, 34, 35, 36, 37, 40
Hyponephele lupinus (O. Costa, 1836)	34
Hyponephele lycaon (Kuhn, 1774)	25, 38
Pyronia tithonus (Linnaeus, 1767)	32, 34
Kirinia roxelana (Cramer, 1777)	3, 29, 34, 39
Lasiommata maera (Linnaeus, 1758)	39
Lasiommata megera (Linnaeus, 1767)	12, 20, 21, 23, 30, 32, 33, 34, 35, 36, 40

Species	Localities
Pararge aegeria (Linnaeus, 1758)	3, 9, 13, 21, 34, 39
Coenonympha arcania (Linnaeus, 1761)	3
Coenonympha leander (Esper, 1784)	21, 23, 24
Coenonympha pamphilus (Linnaeus, 1758)	2, 6, 8, 16, 18, 20, 21, 22, 25, 29, 30, 31, 32, 33, 34, 38, 39, 40
Melanargia galathea (Linnaeus, 1758)	2, 3, 25, 26, 28, 29, 34, 36, 38
Melanargia larissa (Geyer, 1828)	2, 25, 26, 27, 28, 29, 30, 31, 34, 35, 36, 37, 38, 39, 40
Hipparchia senthes (Fruhstorfer, 1908)	27, 30, 31
Hipparchia syriaca (Staudinger, 1871)	28, 29, 30, 31, 34, 35, 38
Satyrus ferula (Fabricius, 1793)	26, 27, 28, 29, 30, 31, 38
Chazara briseis (Linnaeus, 1764)	26, 27, 28, 30, 37, 40
Pseudochazara cingovskii (Gross, 1973)	26, 27, 28, 30, 31, 37, 38
Pseudochazara anthelea (Hübner, 1824)	40
Hesperiidae	
Erynnis tages (Linnaeus, 1758)	5, 6, 11, 13, 14, 15, 25, 28, 34, 39, 40
Carcharodus alceae (Esper, 1780)	6, 23, 24, 34, 35, 39, 40
Carcharodus floccifera (Zeller, 1847)	34
Carcharodus lavatherae (Esper, 1783)	25, 30
Carcharodus orientalis Reverdin, 1913	3, 9, 21, 23, 24, 34
Muschampia tessellum (Hübner, 1803)	21
Pyrgus alveus (Hübner, 1803)	28
Pyrgus armoricanus (Oberthür, 1910)	1, 20, 21, 24, 27, 28, 34, 36, 40
Pyrgus serratulae (Rambur, 1839)	24, 25
Pyrgus cinarae (Rambur, 1839)	2, 3, 25, 26, 28, 29, 30, 34, 35, 36, 38
Pyrgus sidae (Esper, 1784)	20, 24, 25
Pyrgus malvae (Linnaeus, 1758)	3, 6, 9, 11, 13, 14, 20, 21, 24, 25, 27, 31
Spialia orbifer (Hübner, 1823)	21, 23, 24, 25, 28, 36, 40
Ochlodes sylvanus (Esper, 1777)	2, 3, 24, 25, 28, 29, 34
Thymelicus acteon (Rottemburg, 1775)	25, 29
Thymelicus lineola (Ochsenheimer, 1808)	3, 21, 23, 24, 25, 26, 28, 29, 30, 34, 37
Thymelicus sylvestris (Poda, 1761)	3, 20, 21, 23, 24, 25, 26, 34

Discussion

A total of 131 species were encountered during the survey representing roughly 65% of the butterfly fauna of Macedonia. Given the size of the surveyed area and lack of high alpine localities, the number of the species observed is relatively high and could be attributed to sampling in spring and summer period when butterfly diversity is the highest. Also, wide variety of habitats was surveyed and potentially butterfly rich sites were selected over intensively managed areas.

The multivoltine species like *Aricia agestis*, *Polyommatus icarus* and *Lycaena phleas* were the most widespread and are generally known as common in Macedonia (Schaider & Jakšić 1989). In contrast, several rare and locally distributed species were encountered during our surveys. Records of two of these, *Gonepteryx cleopatra* and *Pseudochazara cingovski*, were published and discussed separately (Verovnik et al. 2013, Micevski & Micevski 2014), while additional interesting species observations are briefly presented below:

- *Muschampia tessellum* – This butterfly was mentioned for the first time for Macedonia by Thurner (1964) for the surroundings of Ohrid and Struga towns, but without further details on locality or collector. An additional record is roughly depicted in the atlas from the region southwest of Dojran Lake (Schaider & Jakšić 1989). The species was also reported from Grupčin village east of Skopje (Russell 1992), however, the record was later revoked due to confusion with even more local *Muschampia cribrellum* (Eversmann, 1841) (Dincă et al. 2010, Peter Russell pers. comm.). The species was recently found on Mt. Suva Planina south of Skopje (Nikola Micevski, pers. comm.). We discovered this impressively large skipper at Živojno village not far from the Greek border. The habitat is dominated by overgrazed grasslands, but small gullies with steep, partially eroded slopes still provide some flower rich patches (Fig. 2a). No host plants were detected at the site, but observation of two territorial males (Fig. 2b) patrolling the small valley indicates potential residence of the species in this area.

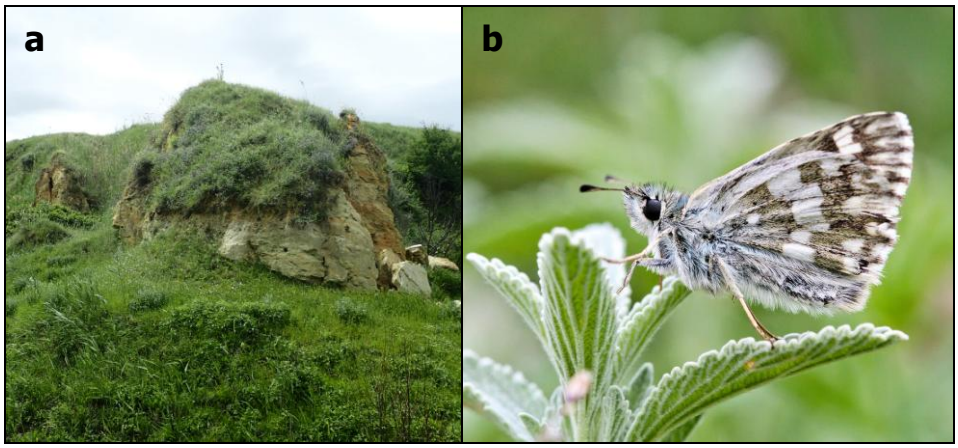

Figure 2. Habitat (a) and territorial male (b) of Tessellated Skipper *Muschampia tessellum* discovered at Živojno village southeast of Bitola.
Slika 2. Habitat (a) in teritorialni samec (b) debeloglavčka vrste *Muschampia tessellum*, najden pri vasi Živojno jugovzhodno od Bitole.

- *Anthocharis gruneri* – The species is locally distributed in Macedonia in the Vardar valley and Ohrid Lake region (Schaider & Jakšić 1989). We found it at several sites in the upper part of the Treska Valley, which is not unexpected given the known presence of the species in the lower part of the valley (Thurner 1964, Verovnik 2012) and recent observations from the southern Serbia (Popović & Milenković 2012). More interestingly, the species was found for the first time in the Raec Gorge and at Pletvar Pass, both well studied localities with extensive faunistic records (Alberti 1922, Schaider 1984, Russell 1992). Additionally, we recorded it on dry rocky slopes at Cer and Železnec villages filling the gap between the Treska Valley and Mt. Galičica. Apparently, the species is more widespread in Macedonia than previously thought and will probably be recorded in additional localities during future spring surveys.

- *Euchloe penia* – This is another extremely local species known only from the lower and middle part of the Treska Valley (Thurner 1964, Verovnik et al. 2010). Two new sites further south in the upper part of the Treska Valley are only a small extension of its known range, however, this is a good indication of potentially wider distribution of the species in the region. It was rather common during both visits at Pletvar Pass, a known stronghold of the species (Russell 1992, Hainsch 1993).
- *Tarucus balkanicus* – This attractive little blue is distributed in the hottest parts of Macedonia, which include the Vardar Valley, surroundings of Štip and Ohrid town (Thurner 1964, Schaider & Jakšić 1989, Verovnik et al. 2010, Verovnik 2012). We found the species at two sites, both in the valley of the river Crna reka east of Bitola. *Paliurus spina-christi* Mill., the host plant of the species, is common on steep rocky slopes at both sites, therefore the presence of local populations is not questionable. These new localities are well outside its known range in Macedonia.
- *Cupido alcetas* – This is a very rare species in Macedonia, known only from Ohrid region, Mt. Shar (Lešok) and central part of the Treska Valley (Thurner 1964, Schaider & Jakšić 1989, Verovnik et al. 2010). We found a single specimen along the road near a small stream in Trojaci village. Based on two consecutive observations, the presence of streams and riparian vegetation seems to be important habitat requirement for this species.
- *Pseudophilotes bavius* – Historically, the species was known from the lower Treska Valley (Thurner 1964), where it is still present (Verovnik 2012), and from the valley of the Babuna and Topolka Rivers south of Veles town (Schaider 1984). Despite several visits by the authors to both valleys near Veles in spring, the species could not be re-found there. The situation is also deteriorating at the Treska-Matka dam site, where overgrowing of the larval habitat is a serious problem (Verovnik 2012). Observing strong populations at three new sites further up the Treska Valley is therefore a welcoming relief, as the species is nearly extinct at the previously known sites. The species is listed in the Habitats Directive (Council Directive 92/43/EGS 2009), therefore the newly discovered populations should be targeted for long term conservation.
- *Polyommatus escheri* – Owing to the rarity of its hostplant *Astragalus monspessulanus* (Bernh.) in Macedonia, the species has so far been recorded only at three localities (Micevski et al. 2009b). We observed a single male mud puddling at a spring in Toplica village, which is less than 10 km away from a historically known site in the Raec Gorge, central Macedonia (Thurner 1964). No host plants were observed in the vicinity, but as this butterfly is relatively sedentary (Verovnik 2004) a local population is likely to occur in close proximity of the village.
- *Polyommatus aroaniensis* – The species was first mentioned for Macedonia by Kolev & van der Poorten (1997) from the vicinity of Prilep and Mt. Galičica (Petrina Planina). Recently it was also found near Mariovo in southern Macedonia (Melovski & Bozhinovsk 2014). Our records came from several sites in vicinity of Pletvar Pass and at Mali Mramorani village, northeast of Prilep. The identification of this species is, however, tentative and based on lack of white stripe on the hind wing underside (Fig. 3), which is considered the main characteristic of the species (Pamperis 2009). However, it has been recently shown that this character is extremely variable in closely related *P. ripartii* (Lovrenčić et al. 2016), which is also present in this region.

Figure 3. A male of the Grecian Anomalous Blue *Polyommatus aroaniensis* mud puddling on a road in Trojaci village. A vestigial white stripe on hind wings, typical for the species, is visible.
Slika 3. Samec modrina vrste *Polyommatus aroaniensis* med srkanjem mineralov na cesti v vasi Trojaci. Vidna je komaj opazna bela proga na zadnjih krilih, ki je značilna za to vrsto.

- *Araschnia levana* – First recorded for Macedonia by Thomas (1993) and subsequently reported as new for the country by Melovski (2003, 2004). The species is becoming more widespread in the region (Verovnik et al. 2010) and our record from Dolni Manastirec in the upper part of the Treska Valley is in line with this observation.
- *Melitaea ornata* – Based on the adult characteristics, the species was first reported for Macedonia by Verovnik et al. (2010), followed by several additional observations in southeastern part of the country (Verovnik 2012). Its presence in Macedonia has also been confirmed using larval stage, with conspicuous red head of the caterpillars being a more reliable taxonomic character (Russell et al. 2015). This study also concluded that the species should be more widespread in the country. We found specimens with typical phenotype just at a single locality in the Raec Gorge in spring 2015.

Among the species observed, the endemic *Pseudochazara cingovskii* is one of the most threatened butterflies worldwide. Only a few localities are known, all within the territory of the Republic of Macedonia. Habitat destruction due to quarrying is considered as the largest threat for this butterfly. However, its critically endangered status (CR) has recently been downgraded to endangered (EN) due to new data on distribution and population size (Verovnik et al. 2013). Additional European red list species (van Swaay et al. 2010) recorded during our surveys are: *Carcharodus lavatherae*, *Carcharodus floccifera*, *Thymelicus acteon*, *Zerynthia cerisy*, *Pseudophilotes vicrama*, *Aricia anteros*, *Polyommatus eros*, *Polyommatus dorylas*, and *Chazara briseis*, all categorized as near threatened (NT). The majority of them were observed at one or two localities and are not widespread in the country. A notable exception is

P. vicrama found at 13 sites. Considering the red list of butterflies of Macedonia (Krpač & Darcemont 2012), 18 of the observed species are listed. Yet, this red list assessment should be considered tentative, given the lack of sufficient butterfly data coverage, specific studies of habitat requirements and major threats for the butterflies in the country.

The butterfly data coverage for Macedonia is still insufficient and there are many regions with very limited butterfly records. This is especially true for the north-eastern part of the country, where further surveys should be targeted covering at least some of the unstudied areas. By providing new records for several rare, local and potentially threatened butterfly species we hope to contribute to their conservation and long term survival. We also wish to encourage further butterfly surveys in Macedonia and call for a more concerted effort on a modern butterfly distribution atlas, which is essential for red list assessments and conservation decisions.

Povzetek

V obdobju zadnjih šestih let (2010–2016) smo štirikrat obiskali Republiko Makedonijo, kjer smo se osredotočili na popisovanje dnevnih metuljev v slabše raziskanih območjih na jugozahodu države. Skupno smo obiskali 40 lokacij in zabeležili 131 vrst, kar pomeni približno 65 % vseh za Makedonijo znanih vrst. Tako velik delež opaženih vrst pripisujemo kombinaciji popisovanja v pomladanski in poletni sezoni ter načrtnemu iskanju za dnevne metulje potencialno vrstno bogatih življenjskih okolij. S tem smo v popis zajeli tudi nekatere redke in potencialno ogrožene habitatne specialiste. Najbolj zanimiva je najdba debeloglavčka vrste *Muschampia tessellum* pri vasi Živojno, jugovzhodno od Bitole. Ta vrsta je bila glede na zgodovinske vire znana iz dveh območij, naša najdba pa je druga recentna za Makedonijo. Favnistično so zanimive tudi nove najdbe za vrste *Araschnia levana*, *Melitaea ornata*, *Anthocharis gruneri*, *Euchloe penia*, *Tarucus balkanicus*, *Cupido alcetas*, *Pseudophilotes bavius*, *Polyommatus aroaniensis* in *Polyommatus escheri*. Za slednjega je najdba v vasi Topolec četrta za Makedonijo.

Naravovarstveno najvidnejša je najdba okarja *Pseudochazara cingovskii*, ki pa je podrobneje obravnavana v predhodni objavi (Verovnik et al. 2013). Od drugih vrst jih je devet vključenih v rdeči seznam na evropskem nivoju kot potencialno ogrožene (NT), v rdečem seznamu Makedonije pa jih je navedenih 18. To priča o veliki naravovarstveni vrednosti območja raziskave in ohranjenosti nekaterih posebnih življenjskih okolij, na katera so vezane ogrožene vrste metuljev. Razveseljujejo tri nove najdbe modrina vrste *Pseudophilotes bavius*, ki je navedena v habitatni direktivi in sodi med najbolj ogrožene vrste dnevnih metuljev v Makedoniji.

Gledano v celoti je favna metuljev še vedno nepopolno raziskana, saj obstajajo večja območja, v katerih niso bili opravljeni nobeni favnistični popisi. To velja predvsem za severovzhodni del države, kjer bi v prihodnje bilo smiselno organizirati obširnejše raziskave. Prav tako je nujno bolj sistematsko in organizirano popisovanje favne metuljev Makedonije, ki bi omogočilo pripravo sodobnega atlasa razširjenosti te naravovarstveno zelo pomembne skupine žuželk.

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References

Abdija X., Beadini N., Beadini S., Iseni A. (2013a): Taxonomic data for Pieridae family (Rhopalocera) of the Sharr Mountain and its surroundings (Mavrovo and Pollog). Am. J. Zool. Res. 1: 12-16.

Abdija X., Beadini N., Beadini S., Rexhepi B. (2013b): A taxonomic study of the family Hesperiidae (Rhopalocera) of the Massif Mountains of Sharr, Pollog Valley and Mavrovo National Park. J. Nat. Sc. Res. 3: 47-51.

Abdija X., Beadini N., Beadini S., Iseni A. (2013c): Preliminary data for the familia Nymphalidae of Sharr Mountain and its surroudings (Mavrovo and Pollog). Anglisticum Inter. J. Lite. Lingui. Interdiscipl. St. 2: 246-252.

Abdija X., Beadini N., Beadini S. (2013d): The basic characteristics of the study of butterfly (Rhopalocera) fauna in the Mountain Massif of Sharr, Pollog Valley and the National Park of Mavrovo. Adv. Life Sc. Technol. 8: 28-34.

Alberti B. (1922): Beitrag zur Kenntnis der Macrolepidopteren Mazedoniens. Zeitschr. wissensch. Insektenbiol. 17: 33-40, 73-82.

Dincă V., Kolev Z., Verovnik R. (2010): The distribution, ecology and conservation status of the Spinose Skipper *Muschampia cribrellum* (Eversmann, 1841) at the western limit of its range in Europe (Hesperiidae). Nota Lepidopt. 33: 39-57.

Fauna Eropaea (2016): Fauna Europaea version 2.5. http://www.fauna-eu.org [accessed on 10.10.2016].

Franeta F., Kogovšek N., Verovnik R. (2012): On the presence of *Pontia chloridice* (Lepidoptera: Pieridae) in the Republic of Macedonia. Phegea 40: 17-20.

Hainsch H. (1993): Einige Tagfalterbeobachtungen in Mazedonien und Griechenland (Lepidoptera, Papilionoidea). Nachr. Ent. Ver. Apollo 14: 231-248.

Hristovski S., Slavevska-Stamenković V., Hristovski N., Arsovski K., Bekchiev R., Chobanov D., Dedov I., Devetak D., Karaman I., Kitanova D., Komenenov M., Ljubomirov T., Melovski D., Pešič V., Simov N. (2015): Diversity of invertebrates in the Republic of Macedonia. Mac. J. Ecol. Environ. 17: 5-44.

Huemer P., Krpač V., Plössl B., Tarmann G.M. (2011): Contribution to the fauna of Lepidoptera of the Mavrovo National Park (Republic of Macedonia). Acta Ent. Slo. 19: 169-186.

Kolev Z., van der Poorten D. (1997): Review of the distribution of the Balkan endemic *Polyommatus* (*Agrodiaetus*) *aroaniensis* (Lepidoptera: Lycaenidae), with notes on its sympatry with related species. Phegea 25: 35-40.

Krpač V.T., Mihajlova B. (1997): *Gonepteryx cleopatra* (Linnaeus 1767), a new species of the butterfly fauna in Macedonia (Lepidoptera: Pieridae). Acta Ent. Slo. 5: 113-116.

Krpač V.T., Darcemont C., Krpač M., Lemonnier-Darcemont M. (2011): Fauna of butterflies (Papilionoidea) in the National Park Galičica, Republic of Macedonia. Nota lepidopt. 34: 49-78.

Krpač V.T., Darcemont C. (2012): Red list of butterflies (Lepidoptera: Hesperoidea & Papilionoidea) for Republic of Macedonia. Revue Ecologie (Terre Vie) 67: 117-122.

Lovrenčić L., Podnar M., Šašić M., Koren T., Tvrtković N. (2016): Molecular data do not confirm the Grecian Anomalous Blue *Polyommatus* (*Agrodiaetus*) *aroaniensis* (Brown, 1976) as a member of the Croatian fauna. Nat. Croat. 25: 119-129.

Melovski D. (2003): Daily butterflies (Rhopalocera) of the Shar Planina Mountain. Bull. Biol. Stud. Res. Soc. 2: 125-138. (in Macedonian)

Melovski D. (2004): *Araschnia levana* (Linneaus, 1758), a new species for the Macedonian butterfly fauna (Lep.: Nymphalidae). Ent. Rec. J. Var. 116: 273-275.

Melovski D., Bozhinovsk E. (2014): New records for four butterfly species (Lepidoptera: Papilionoidea & Hesperioidea) in the Republic of Macedonia. J. Nat. Sc. Res. 4: 40-44.

Micevski N. (2013): De Prunner's Ringlet *Erebia triaria* (de Prunner, 1798) (Lepidoptera: Nymphalidae: Satyrinae) – a new species for the Republic of Macedonia. Nat. Slov. 16: 53-58.

Micevski N., Micevski B. (2002/2003): Butterfly fauna (Lepidoptera: Papilionidea & Hesperioidea) in the National park Pelister. Annual. Biol. Skopje 55-56: 75-98.

Micevski B., Micevski N., Keymeulen A. (2009a): *Melitaea aurelia* Nickerl, 1850 (Nymphalidae, Lepidoptera), a new species for the Republic of Macedonia. Lambillionea 109: 322-325.

Micevski B., Micevski N., Verovnik R. (2009b): New records of the rare Escher's Blue, *Polyommatus escheri* (Lepidoptera: Lycaenidae), from the Republic of Macedonia. Phegea 37: 69-73.

Micevski N., Micevski B. (2014): Distribution of *Gonepteryx cleopatra* (L., 1767) (Lepidoptera: Pieridae) in the Republic of Macedonia. Acta Zool. Bulg. 66: 577-578.

Pamperis L.N. (2009): The Butterflies of Greece. Editions Pamperis, Athens, 768 pp.

Popović M., Milenković M. (2012): First record of *Anthocharis gruneri* for Serbia (Lepidoptera: Pieridae). Phegea 40: 37-38.

Rebel H. (1913): Studien Über die Lepidopterenfauna der Balkanländer, part III: Sammelergebnisse aus Montenegro, Albanien, Mazedonien und Thrazien. Ann. K. K. Naturhistor, Hofmuse, Wien 27: 281-334.

Russell P. (1992): Butterflying in southern Yugoslavia during May 1990. AES bullet. 51: 40-48, 74-79.

Russell P., Zitnan D., Major V. (2015): Confirmation of the presence of *Melitaea ornata* Christoph, 1893 (Lepidoptera: Nymphalidae) in Macedonia (FYROM) and its host-plants 2015. Ent. Gazette 66: 13-24.

Schaider P. (1984): Ergänzungen zur Lepidopterenfauna SR Mazedonien. Frag. Balcan. Mus. Sci. Nat. 3: 21-30.

Schaider P., Jakšić P. (1989): Die Tagfalter von Jugoslawisch Mazedonien (Rhopalocera und Hesperidae). Selbstverlag Paul Schaider, München, 199 pp.

Shtinkov N., Kolev Z., Vila R., Dincă V. (2016): The sibling species *Leptidea juvernica* and *L. sinapis* (Lepidoptera, Pieridae) in the Balkan Peninsula: ecology, genetic structure, and morphological variation. Zoology 119: 11-20.

Thomas K. (1993): Die entomologischen reisen von Werner Nachr. Ent. Ver. Apollo 13: 405-446.

Thurner J. (1964): Die Lepidopterenfauna jugoslavisch Mazedoniens. I. Rhopalocera, Grypocera und Noctuidae. Posebno Izdanie, Prirodonaučen Muzej Skopje 1: 1-158.

Tolman T., Lewington R. (2008): Collins field guide. Butterflies of Britain and Europe. Harper Collins Publishers, London, 384 pp.

van Swaay C., Cuttelod A., Collins S., Maes D., Lopez Munguira M., Šašić M., Settele J., Verovnik R., Verstrael T., Warren M., Wiemers M., Wynhof I. (2010): European Red List of Butterfies. Publications Office of the European Union, Luxembourg, 48 pp.

Verovnik R. (2004): Distribution and conservation status of *Polyommatus escheri* (Huebner, 1823) in Slovenia (Lepidoptera: Lycaenidae). Linneana Belg. 19: 253-257.

Verovnik R. (2012): Contribution to the knowledge of the spring butterfly fauna of the Republic of Macedonia (Lepidoptera: Papilionoidea & Hesperioidea). Nat. Slov. 14: 39-50.

Verovnik R., Micevski B. (2008): Chequered skipper (*Carterocephalus palaemon*) new species for the fauna of the Republic of Macedonia (Lepidoptera: Hesperiidae). Biol. Mac. 61: 93-96.

Verovnik R., Micevski B., Đurić M., Jakšić P., Keymeulen A., van Swaay C., Veling K. (2010): Contribution to the knowledge of the butterfly fauna of the Republic of Macedonia (Lepidoptera: Papilionoidea & Hesperioidea). Acta Ent. Slo. 18: 31-46

Verovnik R., Micevski B., Maes D., Wynhoff I., van Swaay C., Warren M. (2013): Conserving Europe's most endangered butterfly: the Macedonian Grayling (*Pseudochazara cingovskii*). J. Insect Conserv. 17: 941-947.