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CONTRIBUTION TO THE KNOWLEDGE OF BUTTERFLIES (LEPIDOPTERA: RHOPALOCERA) OF BANSKO BRDO

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Bansko brdo is an elongated plateau located in the north-eastern region of Baranja (east Croatia), near the border with Hungary. During the last two years, surveys of butterflies were carried out on 10 localities. The localities were divided into two groups, 5 on the north-eastern side of the hill and 5 on the south-western side. In total, 65 species were recorded, 13 of which are new records for Bansko brdo. A far greater number of specimens were recorded on the north-eastern side, 1014, in comparison with 262 on the south-western side, meaning 74 % more butterflies. This is probably due to the seminatural habitats that are still present in the north-eastern side, including meadows, forest edges and vineyards, while the southern side is crisscrossed with forests and fields with only a small proportion of meadows remaining. On Bansko brdo Euro Siberian species are prevalent. During this survey we did not record 12 species previously recorded, which may be an indication of the changing butterfly diversity. As this is one of last natural habitats in Baranja, it should be protected from further degradation in the near future.

Butterflies, fauna, Baranja, Croatia

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Bansko brdo je nisko uzvišenje smješteno u sjeveroistočnom dijelu Baranje u istočnoj Hrvatskoj, blizu državne granice s Mađarskom. Tijekom dvije prošle godine uzorkovanja faune danjih leptira obavljena su na 10 lokaliteta. Lokaliteti su podijeljeni u dvije skupine, po pet lokaliteta sa sjeveroistočne i pet lokaliteta s jugozapadne strane Banskoga brda. Ukupno je zabilježeno 65

vrsta, od kojih je 13 novih nalaza za Bansko brdo. Mnogo veći broj leptira, tj. 1014, utvrđen je na sjeveroistočnoj strani brda, dok su na jugozapadnoj utvrđene tek 262 jedinke. Razlog tome vjerojatno je prisutnost poluprirodnih staništa na sjeveroistočnoj strani, dok je južna strana ispresjecana šumama i poljima, s malim brojem preostalih livada. Na Banskome brdu uglavnom prevladavaju vrste eurosibirskog tipa rasprostiranja. Tijekom ovog istraživanja nismo zabilježili 12 vrsta poznatih iz literature, što može upućivati na promjenu u raznolikosti danjih leptira toga područja. Bansko brdo je jedno od zadnjih prirodnih staništa u Baranji pa ga je potrebno zaštititi od daljnje degradacije.

Danji leptiri, fauna, Baranja, Hrvatska

Introduction

While resarch into the butterflies of Croatia started in the second half of the 19th century (Mann, 1857), the researchers primarily visited the Dalmatian littoral, the Adriatic islands and mountains like Gorski Kotar and Velebit. With such a selective approach, many other parts of the country remained unexplored. The research into the northern part of Croatia started much later and resulted in records of several new butterflies and moth species for Croatia, including even large and charismatic species such as *Colias erate* (Esper, 1804) (Lorković et al., 1992) and *Apatura metis* (Freyer, 1829) (Lorković, 1976) showing the importance of this area.

Bansko brdo is an elongated plateau, located in the north-eastern region of Baranja (east Croatia), near the border with Hungary. Bansko brdo, located between Beli Manastir and Batina, is 21 km long and 3 km wide. The highest peak of Bansko brdo is Kamenjak (244 m). The southern part of Bansko brdo is characterized by steep, high loess cliffs ranging from 25-58 meters in height (Bognar, 1990) Fig. 1. The potential vegetation of the loess plateau and southern slopes was loess steppe and oak woodland (Uherkovich et al., 2008). On the northern slopes, oak and hornbeam forests were once distributed, with parts of the slopes covered with steppe grassland (Csiky *et al*., 2008; Purger & Csiky, 2008; Purger et al., 2008). Nowadays, most of Bansko brdo is converted to agricultural fields and vineyards, and only small fragments of loess vegetation have remained unchanged (Figure 2). This has certainly had a high impact on the flora and fauna of the area, including the butterflies.

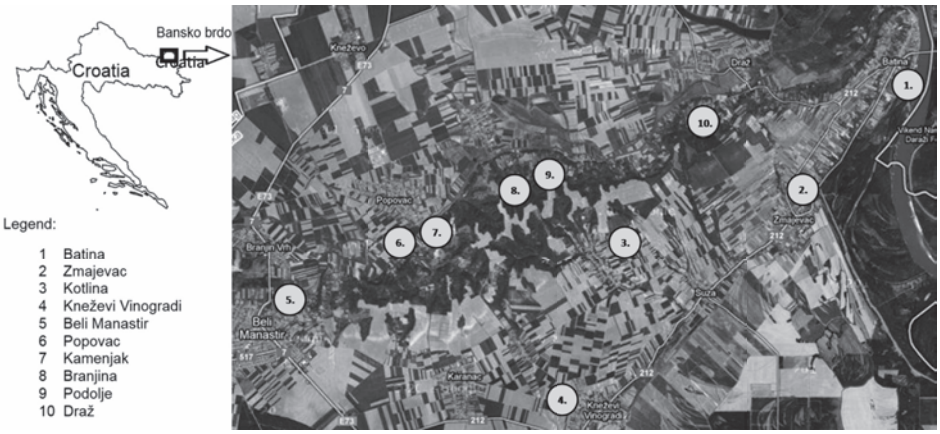

Figure 1. Map of Bansko brdo, Baranja, Croatia with localities where butterflies were sampled in 2009-2010.

Figure 2. Different habitats in Bansko brdo, Baranja, encompassed in the current study of Rhopalocera (Lepidoptera); a) Kneževi Vinogradi, b) Branjina, c) Popovac, d) Draž.

The butterflies of Bansko brdo have never been systematically researched and only a small number of species has been recorded until now (Krčmar et al., 1996; Krčmar 2002). The goal of this research is to give the first overview of the butterflies of the area, and to emphasize the importance of Bansko brdo for the butterfly diversity of northern Croatia.

Materials and Methods

This survey was carried out during 2009 and 2010 at 10 localities in Bansko brdo, 5 located in the north-eastern part of the hill and five in the south-western part (Table 1). Each locality was visited several times, and each time species diversity and abundance were recorded. Butterflies were collected with an entomological net or photographed while they were visiting flowers. The identification of the butterflies was done in the field using illustrated guides (Tolman & Lewington, 2008) and most of the butterflies were released afterward. Only a few specimens per species were collected to form a butterfly collection of the area, which is now held at the Department of Biology, J. J. Strossmayer University, Osijek. The butterfly nomenclature follows the European Red List of Butterflies (Van Swaay et al., 2010). Biogeographical analysis was made on the basis of combined data from Hruby (1964), Mihoci et al. (2007) and Tolman & Lewington (2008).

Table 1. List of researched localities on Bansko brdo with coordinates and altitude.

Locality	Coordinates		Altitude (a.s.l.)
Popovac	N 45°48′16″	E 18°39′53″	88 m
Kamenjak	N 45°48′08″	E 18°42′02″	233 m
Branjina	N 45°49′25″	E 18°41′35″	86 m
Podolje	N 45°48′58″	E 18°43′40″	91 m
Draž	N 45°50′17″	E 18°47′23″	84 m
Batina	N 45°51′03″	E 18°51′07″	90 m
Zmajevac	N 45°47′53″	E 18°48′27″	85 m
Kneževi Vinogradi	N 45°45′02″	E 18°44′06″	88 m
Kotlina	N 45°47′19″	E 18°44′16″	115 m
Beli Manastir	N 45°46′02″	E 18°36′22″	75 m

Results

During the two years survey period we recorded 65 butterfly species. While the recorded number represents only 33 % of the butterfly fauna of Croatia (Šašić & Mihoci, 2011), 13 species were recorded for the first time for Bansko brdo: *Parnassius mnemosyne* (Linnaeus, 1758), *Pieris mannii* (Mayer, 1851), *Lycaena virgaurea* (Linnaeus, 1758), *Satyrium w-album* (Knoch, 1782), *Phengaris arion* (Linnaeus, 1758), *Aricia agestis* (Dennis and Schiffermüller 1775), *Polyommatus daphnis* (Dennis & Schiffermüller, 1775), *Polyommatus bellargus* (Rottemburg, 1775), *Libythea celtis* (Laicharting, 1782), *Melitaea phoebe* (Dennis & Schiffermüller, 1775), *Brintesia circe* (Fabricius, 1775), *Thymelicus lineola* (Ochsenheimer, 1808) and *Thymelicus sylvestris* Poda 1761.

The list of Rhoplaocera species (Lepidoptera) recorded in the Croatian part of Baranja during 2009-2010 (including UTM referenes, dates, and numbers of the specimens collected):

Legend: i (imago), c (caterpillars), female (♀), male (♂).

Papilio machaon Linnaeus, 1758

Kamenjak (CR 27), 28.IV.2010., 1i, Popovac (CR 17), 5.VII. 2010., 1i, 20.VIII. 2010., 2i.

Iphiclides podalirius (Linnaeus, 1758)

Batina (CR 38), 28.IV.2010., 1i, Branjina (CR 27), 28.IV.2010., 2i, 20.VIII.2010., 2i, Draž (CR 27), 28.IV.2010., 1i, 5.VII.2010., 1i, 12.VII.2010., 1i, 20.VIII.2010., 1i, Kamenjak (CR 27), 28.IV.2010., 2i, Podolje (CR 27), 28.IV.2010., 1i, 10.VII.2010., 1i, Popovac (CR 17), 12.VII.2010., 4i, 22.VII..2010., 8i, 20.VIII. 2010., 9i, Zmajevac (CR 37), 28.IV.2010., 1i, 10.VII.2010., 1i, 26.VIII. 2010., 1i, 27.VIII.2010., 1i.

Zerynthia polyxena (Denis and Schiffermüller, 1775)

Kamenjak (CR 27), 19.VI.2010., 1c, 20.VI.2010., 1c.

Parnassius mnemosyne (Linnaeus, 1758)

Popovac (CR 17), 27.V.2010., 1i.

Pieris brassicae (Linnaeus, 1758)

Batina (CR 38), 28.IV.2010., 1i, 27.V.2010., 2i, Beli Manastir (CR 17), 5.VII.2010., 1i, Branjina (CR 27), 28.IV.2010., 1i, 19.VI.2010., 1i, 20.VI.2010., 1i, 5.VII.2010., 2i, 22.VII.2010., 2i, 13.VIII.2010., 3i, Draž (CR 27), 28.IV.2010., 1i, 9.VI.2010., 1i, 5.VII.2010., 1i, Kamenjak (CR 27), 28.IV.2010., 1i, 27.V.2010., 1i, 9.VI.2010., 1i, 20.VI.2010., 1i, Kneževi Vinogradi (CR 26), 20.VI.2010., 1i, Kotlina (CR 27), 28.IV.2010., 1i, 9.VI.2010., 2i, 5.VII.2010., 2i, 13.VIII.2010., 1i, Podolje (CR 27),

13.VIII.2010., 2i, Popovac (CR 17), 9.VI.2010., 8i, 19.VI.2010., 10i, 5.VII.2010., 1i, 22.VII.2010., 10i, 13.VIII.2010., 2i, 20.VIII.2010., 1i, Zmajevac (CR 37), 9.VI.2010., 1i, 5.VII.2010., 1i.

Pieris mannii (Mayer, 1851)

Zamjevac (CR 37), 19.VII.2009., 2i.

Pieris rapae (Linnaeus, 1758)

Beli Manastir (CR 17), 13.VIII. 2010., 2i, Branjina (CR 27), 28.IV.2010., 1i, 19.VI.2010., 6i, 20.VIII.2010., 5i, Draž (CR 27), 9.VI.2010 1i, 5.VII.2010., 1i, 20.VIII.2010., 3i, Kamenjak (CR 27), 9.VI.2010., 2i, Kneževi Vinogradi (CR 26), 20.VI.2010., 4i, Podolje (CR 27), 9.VI.2010., 1i, Popovac (CR 17), 9.VI.2010., 1i, 19.VI.2010., 15i, 15.VII.2010., 8i, 22.VII.2010., 10i, 20.VIII.2010., 10i, Zmajevac (CR 37), 20.VI.2010., 2i, 26.VIII.2010., 5i.

Pieris napi (Linnaeus, 1758)

Beli Manastir (CR 17), 13.VIII.2010., 1i, Branjina (CR 27), 5.VII.2010., 1i, 22.VII.2010., 1i, Draž (CR 27), 28.IV.2010.,1i, 9.VI.2010., 2i, Podolje (CR 27), 28.IV.2010., 1i, 5.VII.2010., 1i, Popovac (CR 17), 9.VI.2010., 1i, 15.VII.2010., 1i, 13.VIII.2010., 1i, Zmajevac (CR 37), 9.VI.2010., 1i.

Pontia edusa (Fabricius, 1777)

Draž (CR 27), 5.VII.2010., 1i, Popovac (CR 17), 13.VIII.2010., 1i.

Antocharis cardamines (Linnaeus, 1758)

Beli Manastir (CR 17), 27.V.2010., 2♂, Branjina (CR 27), 28.IV.2010., 2♂, Draž (CR 27), 28.IV.2010., 1♀, Kneževi Vinogradi (CR 26), 28.IV.2010., 1♂, Kotlina (CR 27), 28.IV.2010., 2♀, 2♂, Podolje (CR 27), 28.IV.2010., 2♂, Zmajevac (CR 37), 28.IV.2010., 1♀.

Colias hyale (Linnaeus, 1758)

Popovac (CR 17), 22.VII.2010., 1i.

Colias alfacariensis Ribbe, 1905

Branjina (CR 27), 5.VII.2010., 2i, Popovac (CR 17), 5.VII.2010. 1i, 22.VII.2010., 1i, 20.VIII. 2010., 1i.

Colias crocea (Geoffroy, 1785)

Branjina (CR 27), 20.VIII.2010., 1♂, Podolje (CR 27), 10.VII.2010., 1♂, Popovac (CR 17), 22.VII.2010., 1♂, 20.VIII.2010., 3♂, Zmajevac (CR 37), 26.VIII.2010., 1♂.

Colias erate Esper, 1804

Kamenjak (CR 27), 5.VII.2010., 1i, Popovac (CR 17), 20.VIII.2010., 1i.

Gonepteryx rhamni (Linnaeus, 1758)

Beli Manastir (CR 17), 5.VII.2010., 1♀, Branjina (CR 27), 20.VI.2010., 3♂, Draž (CR 27), 28.IV.2010., 1♂, 9.VI.2010., 2♂, 20.VII. 2010., 1♂, 1♀, Kamenjak (CR 27),

28.IV.2010., 1♀, 5.VII.2010., 1♂, Kotlina (CR 27), 28.IV.2010., 2♂, 13.VIII.2010., 1♂, Popovac (CR 17), 27.V.2010., 2♂, 19.VI.2010., 1♀, 3♂, 5.VII.2010., 4♂, 20.VIII.2010., 3♀, 5♂, Zmajevac (CR 37), 28.IV.2010., 1♂, 27.VIII.2010., 2♂.

Leptidea sinapis (Linnaeus, 1758)

Batina (CR 38), 28.IV.2010., 1i, Branjina (CR 27), 28.IV.2010., 3i, 20.VI.2010., 1i, Kamenjak (CR 27), 27.V.2010., 1i, 20.VI.2010., 1i, Kotlina (CR 27), 13.VIII.2010., 1i, Popovac (CR 17), 9.VI.2010., 1i, 19.VI.2010., 2i.

Hamearis lucina (Linnaeus, 1758)

Kotlina (CR 27), 5.VII.2010., 1i.

Lycaena phlaeas (Linnaeus, 1761)

Branjina (CR 27), 19.VI.2010., 1i, Draž (CR 27), 9.VI.2010., 1i.

Lycaena dispar (Haworth, 1802)

Batina (CR 38), 27.V.2010., 2♂, Beli Manastir (CR 17), 27.V.2010., 1♂, 2♀, Draž (CR 27), 9.VI.2010., 1♀, Kotlina (CR 27), 9.VI.2010., 1♀, Popovac (CR 17), 19.VI. 2010., 2♂, 15.VII.2010., 1♂, 22.VII.2010., 1♀.

Lycaena virgaureae (Linnaeus, 1758)

Branjina (CR 27), 22.VII.2010., 1i.

Thecla betulae (Linnaeus, 1758)

Kotlina (CR 27), 23.VII.2009., 1i.

Callophrys rubi (Linnaeus, 1758)

Branjina (CR 27), 19.VI.2010., 1i.

Satyrium w-album (Knoch, 1782)

Kamenjak (CR 27), 9.VI.2010., 1i.

Cupido argiades (Pallas, 1771)

Zmajevac (CR 37), 19.VII.2009., 1i.

Cupido alcetas (Hoffmannsegg, 1804)

Podolje (CR 27), 28.IV.2010., 1i.

Celastrina argiolus (Linnaeus, 1758)

Branjina (CR 27), 20.VI.2010., 2i, Popovac (CR 17), 9.VI.2010., 2i.

Phengaris arion (Linnaeus, 1758)

Branjina (CR 27), 22.VII.2010., 1i, Popovac (CR 17), 22.VII.2010., 1i.

Plebeius argus (Linnaeus, 1758)

Batina (CR 38), 9.VI.2010., 2i, Branjina (CR 27), 27.V.2010., 1i, 5.VII.2010., 1i, 22.VII.2010., 1i, Kamenjak (CR 27), 27.V.2010., 5i, Popovac (CR 17), 27.V.2010., 26i, 22.VII.2010., 4i, Zmajevac (CR 37), 9.VI.2010., 4i.

Plebeius idas (Linnaeus, 1761)

Batina (CR 38), 27.V.2010., 5i, 9.VI.2010., 6i, Branjina (CR 27), 27.V.2010., 2i, 5.VII.2010., 2i, Draž (CR 27), 27.V.2010., 2i, Kamenjak (CR 27), 27.V.2010., 8i,

Popovac (CR 17), 27.V.2010., 2i, 22.VII.2010., 2i, 13.VIII.2010., 4i, Zmajevac (CR 37), 9.VI.2010., 1i.

Plebeius argyrognomon (Bergsträsser, 1779)

Branjina (CR 27), 27.V.2010., 6i.

Aricia agestis (Denis & Schiffermüller, 1775)

Beli Manastir (CR 17), 27.V.2010., 1i, Branjina (CR 27), 22.VII.2010., 1i.

Polyommatus daphnis (Denis & Schiffermüller, 1775)

Zmajevac (CR 37), 19.VII.2009., 1i.

Polyommatus bellargus (Rottemburg, 1775)

Kamenjak (CR 27), 9.VI.2010., 1i.

Polyommatus icarus Rottemburg, 1775

Batina (CR 38), 27.V.2010., 7♂, 9.VI.2010., 1♀, Beli Manastir (CR 17), 27.V.2010., 1♂, Branjina (CR 27), 27.V.2010., 3♂, 9.VI.2010., 1♀, Draž (CR 27), 27.V.2010., 2♂, 5.VII.2010., 1♂, Kamenjak (CR 27), 27.V.2010., 2♂, 9.VI.2010., 2♂, Popovac (CR 17), 27.V.2010., 3♂, 9.VI.2010., 3♂, 19.VI.2010., 2♂, 13.VIII.2010., 4♂, 20.VIII.2010., 6♂, Zmajevac (CR 37), 9.VI.2010., 1♀.

Libythea celtis (Laicharting, 1782)

Popovac (CR 17), 22.VII.2010., 1i.

Argynnis paphia (Linnaeus, 1758)

Branjina (CR 27), 19.VI.2010., 6i, 20.VI.2010., 3i, 20.VIII.2010., 2i, Draž (CR 27), 5.VII.2010., 23i, Draž (CR 27), 12.VII.2010., 20i, 20.VIII.2010., 2i, Kamenjak (CR 27), 20.VI.2010., 2i, Kotlina (CR 27), 5.VII.2010., 2i, Popovac (CR 17), 19.VI.2010., 10i, 22.VII.2010., 1i, 20.VIII.2010., 12i, Zmajevac (CR 37), 26.VIII.2010., 1i, 27.VIII.2010., 4i.

Issoria lathonia (Linnaeus, 1758)

Batina (CR 38), 9.VI.2010., 1i, Beli Manastir (CR 17), 13.VIII.2010., 1i, Branjina (CR 27), 5.VII.2010., 2i, Draž (CR 27), 5.VII.2010., 1i, Popovac (CR 17), 9.VI.2010., 1i, 19.VI.2010., 1i, Zmajevac (CR 37), 5.VII.2010., 1i.

Brenthis daphne (Bergsträsser, 1780)

Branjina (CR 27), 9.VI.2010., 2i, 20.VI.2010., 1i, 5.VII.2010., 1i, Kneževi Vinogradi (CR 26), 20.VI.2010., 1i, Kotlina (CR 27), 9.VI.2010., 1i, Popovac (CR 17), 9.VI.2010., 10i, 19.VI.2010., 15i.

Boloria dia (Linnaeus, 1767)

Branjina (CR 27), 28.IV.2010., 8i, Draž (CR 27), 28.IV.2010., 1i, 5.VII.2010., 3i, Popovac (CR 17), 19.VI.2010., 2i, 22.VII.2010., 2i, Zmajevac (CR 37), 3.VII.2010., 2i.

Vanessa atalanta (Linnaeus, 1758)

Beli Manastir (CR 17), 5.VII.2010., 1i, 13.VIII.2010., 2i, Branjina (CR 27), 28.IV.2010., 1i, 19.VI.2010., 2i, 20.VI.2010., 2i, 5.VII.2010., 1i, 22.VII.2010., 8i, 13.VIII.2010., 5i, 20.VIII.2010., 7i, Draž (CR 27), 9.VI.2010., 3i, Kamenjak (CR 27), 27.V.2010., 5i, 5.VII.2010., 1i, Kneževi Vinogradi CR 26), 20.VI.2010., 1i, 5.VII.2010., 1i, Kotlina (CR 27), 5.VII.2010., 5i, 13.VIII.2010., 3i, Podolje (CR 27), 5.VII.2010., 1i, Popovac (CR 17), 19.VI.2010., 7i, 5.VII.2010., 7i, 22.VII.2010., 4i, 13.VIII.2010., 32i, 20.VIII.2010., 8i, Zmajevac (CR 37), 27.VIII.2010., 2i.

Vanessa cardui (Linnaeus, 1758)

Branjina (CR 27), 19.VI.2010., 1i, 20.VI.2010., 2i, Podolje (CR 27), 28.IV.2010., 1i, Popovac (CR 17), 9.VI.2010., 1i, Zmajevac (CR 37), 20.VI.2010., 1i.

Aglais io (Linnaeus, 1758)

Beli Manastir (CR 17), 5.VII.2010., 5i, Branjina (CR 27), 19.VI.2010., 10i, 20.VI.2010., 7i, 5.VII.2010., 2i, Kamenjak (CR 27), 20.VI.2010., 2i, Kneževi Vinogradi (CR 26), 20.VI.2010., 1i, Kotlina (CR 27), 13.VIII.2010., 3i, Popovac (CR 17), 19.VI.2010., 5i, 5.VII.2010., 1i, 13.VIII.2010., 22i, 20.VIII.2010., 10i, Podolje (CR 27), 5.VII.2010., 1i, Zmajevec (CR 37), 28.IV.2010., 1i, 20.VI.2010., 2i.

Polygonia c-album (Linnaeus, 1758)

Branjina (CR 27), 20.VIII.2010., 1i, Draž (CR 27), 9.VI.2010., 2i, Kamenjak (CR 27), 20.VI.2010., 1i, Branjina (CR 27), 19.VI.2010., 2i, Kotlina (CR 27), 28.IV.2010., 1i, Popovac (CR 17), 27.V.2010., 2i, 9.VI.2010., 1i, 19.VI.2010., 8i, 15.VII.2010., 1i, 18.VII.2010., 1i, 22.VII.2010., 2i, 13.VIII.2010., 2i, 20.VIII.2010., 5i, Zmajevac (CR 37), 26.VIII.2010., 1i.

Araschnia levana (Linnaeus, 1758)

Branjina (CR 27), 20.VI.2010., 1i, 20.VIII.2010., 2i, Draž (CR 27), 5.VII.2010., 10i, Kamenjak (CR 27), 20.VI.2010., 2i, Kotlina (CR 27), 28.IV.2010., 1i, 13.VIII.2010., 4i, Podolje (CR 27), 28.IV.2010., 1i, Popovac (CR 17), 9.VI.2010., 1i, 19.VI.2010., 6i, 5.VII.2010., 1i, 22.VII.2010., 4i, 13.VIII.2010., 3i, 20.VIII.2010., 1i, Zmajevac (CR 37), 26.VIII.2010., 2i.

Melitaea phoebe (Dennis & Schiffermüller, 1775)

Popovac (CR 17), 19.VI.2010., 2i.

Melitaea athalia (Rottemburg, 1775)

Beli Manastir (CR 17), 5.VII.2010., 13i, Branjina (CR 27), 27.V.2010., 2i, 9.VI.2010., 2i, 22.VII.2010., 1i, Draž (CR 27), 27.V.2010., 3i, 20.VIII.2010., 5i, Kamenjak (CR 27), 27.V.2010., 8i, Kotlina (CR 27), 13.VIII.2010., 13i, Podolje (CR 27), 9.VI.2010., 3i, Popovac (CR 17), 27.V.2010., 12i, 9.VI.2010., 6i, 19.VI.2010., 4i, 18.VII.2010., 1i, 22.VII.2010., 6i, 13.VIII.2010., 1i, 20.VIII.2010., 1i, Zmajevac (CR 37), 9.VI.2010., 2i.

Limenitis reducta (Staudinger, 1901)

Beli Manastir (CR 17), 27.V.2010., 2i, Draž (CR 27), 27.V.2010., 2i, Kamenjak (CR 27), 27.V.2010., 9i, Kotlina (CR 27), 9.VI.2010., 1i, Popovac (CR 17), 27.V.2010., 4i, 22.VII.2010., 2i.

Neptis sappho (Pallas, 1771)

Beli Manastir (CR 17), 27.V.2010., 1i, Kamenjak (CR 27), 5.VII.2010., 1i, Kotlina (CR 27), 28.IV.2010., 1i, Popovac (CR 17), 15.VII.2010., 1i, 22.VII.2010., 1i, 20.VIII.2010., 4i, Zmajevac (CR 37), 26.VIII.2010., 1i.

Apatura metis Freyer, 1829

Batina (CR 38), 27.V.2010., 6i, Popovac (CR 17), 9.VI.2010., 1i.

Pararge aegeria (Linnaeus, 1758)

Beli Manastir (CR 17), 27.V.2010., 1i, Kamenjak (CR 27), 5.VII.2010., 10i, Podolje (CR 27), 28.IV.2010., 1i, Zmajevac (CR 37), 26.VIII.2010., 1i.

Lasiommata megera (Linnaeus, 1758)

Branjina (CR 27), 20.VI.2010., 1i, Kamenjak (CR 27), 28.IV.2010., 1i.

Coenonympha pamphilus (Linnaeus, 1758)

Batina (CR 38), 9.VI.2010., 3i, Branjina (CR 27), 27.V.2010., 8i, 9.VI.2010., 3i, Draž (CR 27), 27.V.2010., 6i, Podolje (CR 27), 27.V.2010., 1i, Popovac (CR 17), 27.V.2010., 12i, 9.VI.2010., 1i, 22.VII.2010., 1i.

Coenonympha glycerion (Borkhausen, 1788)

Branjina (CR 27), 27.V.2010., 10i, Kamenjak (CR 27), 27.V.2010., 2i.

Aphantopus hyperantus (Linnaeus, 1758)

Beli Manastir (CR 17), 5.VII.2010., 2i, Branjina (CR 27), 20.VI.2010., 2i, 5.VII.2010., 1i, Draž (CR 27), 5.VII.2010., 9i, Kamenjak (CR 27), 9.VI.2010., 1i, 5.VII.2010., 2i, Popovac (CR 17), 5.VII.2010., 3i.

Maniola jurtina (Linnaeus, 1758)

Beli Manastir (CR 17), 5.VII.2010., 1i, 13.VIII.2010., 1i, Branjina (CR 27), 27.V.2010., 2i, 9.VI.2010., 1i, 19.VI.2010., 1i, 20.VI.2010., 2i, Draž (CR 27), 27.V.2010., 1i, 9.VI.2010., 2i, 5.VII.2010., 11i, Kamenjak (CR 27), 9.VI.2010., 1i, 20.VI.2010., 6i, Kneževi Vinogradi (CR 26), 20.VI.2010., 2i, Podolje (CR 27), 9.VI.2010., 2i, Popovac (CR 17), 27.V.2010., 2i, 9.VI.2010., 5i, 19.VI.2010., 30i, 5.VII.2010., 1i, 22.VII.2010., 1i, 13.VIII.2010., 1i, Zmajevac (CR 37), 3.VII.2010., 6i.

Melanargia galathea (Linnaeus, 1758)

Beli Manastir (CR 17), 5.VII.2010., 20i, Branjina (CR 27), 9.VI.2010., 1i, 19.VI.2010., 6i, 20.VI.2010., 1i, 5.VII.2010., 2i, Kamenjak (CR 27), 20.VI.2010., 20i, 5.VII.2010., 6i, Kneževi Vinogradi (CR 26), 20.VI.2010., 2i, Podolje (CR 27), 5.VII.2010., 1i,,Popovac (CR 17), 9.VI.2010., 3i, 19.VI.2010., 35i, 5.VII.2010., 1i, 22.VII.2010., 1i, Zmajevac (CR 37), 20.VI.2010., 20i.

Minois dryas (Scopoli, 1763)
Beli Manastir (CR 17), 13.VIII.2010., 1i, Draž (CR 27), 20.VIII.2010., 1i, Popovac (CR 17), 18.VII.2010., 1i, 22.VII.2010., 2i, Branjina (CR 27), 5.VII.2010., 1i.

Brintesia circe (Fabricius, 1775)
Zmajevac (CR 37), 18.VII.2010., 3i.

Erynnis tages (Linnaeus, 1758)
Podolje (CR 27), 28.IV.2010., 1i.

Carcharodus alceae (Esper, 1780)
Popovac (CR 17), 15.VII.2010., 3i.

Pyrgus malvae (Linnaeus, 1758)
Branjina (CR 27), 20.VIII.2010., 1i, Popovac (CR 17), 20.VIII.2010., 1i.

Heteropterus morpheus (Pallas, 1771)
Popovac (CR 17), 18.VII.2010., 1i, Popovac (CR 17), 22.VII.2010., 1i, Popovac (CR 17), 20.VIII.2010., 1i.

Thymelicus lineola (Ochsenheimer, 1808)
Popovac (CR 17), 9.VI.2010., 1i.

Thymelicus sylvestris (Poda, 1761)
Popovac (CR 17), 19.VI.2010., 2i.

Ochlodes sylvanus (Esper, 1777)
Batina (CR 38), 27.V.2010, 3i, Draž (CR 27), 27.V.2010., 1i, Kotlina (CR 27), 9.VI.2010., 1i, Popovac (CR 17), 27.V.2010., 2i, Popovac (CR 17), 19.VI.2010., 2i.

A systematic list of species, along with the number of specimens recorded at each location is given in Table 2. The zoogeographical analysis showed the prevalence of Euro-Siberian species with the high proportion of oriental and Mediterranean species (Table 3).

Discussion

When one compares the butterfly fauna of the two sides of the Bansko brdo, it is clear that the north-eastern side is more favourable for the butterflies. There we recorded 34 % more species, meaning 59 recorded species in the north-eastern side and 39 species on the south-western side of the Bansko brdo. Also, a far greater number of specimens were recorded on the north-eastern side, 1014 in comparison with 262 on the south-western side, meaning 74 % more butterflies.

On the northern side of Bansko brdo far more seminatural habitats are present, including meadows, forest edges and vineyards, while the southern side

Table 2. List and the number of butterfly specimens (Lepidoptera: Rhopalocera) recorded in the localities of the north-eastern and south-western sides of Bansko brdo during 2009 and 2010.

Species list	Northeastern side					Southwestern side				
	Popovac	Kamenjak	Branjina	Podolje	Draž	Batina	Zmajevac	Knežević Vinogradi	Kotlina	Beli Manastir
Papilio machaon (Linnaeus, 1758)	3	1	-	-	-	-	-	-	-	-
Iphiclides podalirius (Linnaeus, 1758)	21	2	4	2	4	1	4	-	-	-
Zerynthia polyxena (Denis & Schiffermüller, 1775)	-	2	-	-	-	-	-	-	-	-
Parnassius mnemosyne (Linnaeus, 1758)	1	-	-	-	-	-	-	-	-	-
Pieris brassicae (Linnaeus, 1758)	32	4	10	2	3	3	2	1	6	1
Pieris mannii (Mayer, 1851)	-	-	-	-	-	-	2	-	-	-
Pieris rapae (Linnaeus, 1758)	44	2	12	1	5	-	7	4	-	2
Pieris napi (Linnaeus, 1758)	3	-	2	2	3	-	1	-	-	1
Pontia edusa (Fabricius, 1777)	1	-	-	-	1	-	-	-	-	-
Antocharis cardamines (Linnaeus, 1758)	-	-	2	2	1	-	1	1	4	2
Colias hyale (Linnaeus, 1758)	1	-	-	-	-	-	-	-	-	-
Colias alfacariensis Ribbe, 1905	3	-	2	-	-	-	-	-	-	-
Colias crocea (Geoffroy, 1785)	4	-	1	1	-	-	1	-	-	-
Colias erate Esper, 1804	1	1	-	-	-	-	-	-	-	-
Gonepteryx rhamni (Linnaeus, 1758)	18	2	3	-	5	-	3	-	3	1
Leptidea sinapis (Linnaeus, 1758)	3	2	4	-	-	1	-	-	1	-
Hamearis lucina (Linnaeus, 1758)	-	-	-	-	-	-	-	-	1	-
Lycaena phlaeas (Linnaeus, 1761)	-	-	1	-	1	-	-	-	-	-
Lycaena dispar (Haworth, 1802)	4	-	-	-	1	2	-	-	1	3
Lycaena virgaureae (Linnaeus, 1758)	-	-	1	-	-	-	-	-	-	-
Thecla betulae (Linnaeus, 1758)	-	-	-	-	-	-	-	-	1	-

Table 2. continued

Callophrys rubi (Linnaeus, 1758)	-	-	1	-	-	-	-	-	-	-
Satyrium w-album (Knoch, 1782)	-	1	-	-	-	-	-	-	-	-
Cupido argiades (Pallas, 1771)	-	-	-	-	-	-	1	-	-	-
Cupido alcetas (Hoffmannsegg, 1804)	-	-	-	1	-	-	-	-	-	-
Celastrina argiolus (Linnaeus, 1758)	2	-	2	-	-	-	-	-	-	-
Phengaris arion (Linnaeus, 1758)	1	-	1	-	-	-	-	-	-	-
Plebejus argyrognomon (Bergsträsser, 1779)	-	-	6	-	-	-	-	-	-	-
Plebejus argus (Linnaeus, 1758)	30	5	3	-	-	2	4	-	-	12
Plebejus idas (Linnaeus, 1761)	8	8	4	-	2	11	1	-	-	-
Aricia agestis (Dennis & Schiffermüller, 1775)	-	-	1	-	-	-	-	-	-	1
Polyommatus daphnis (Dennis & Schiffermüller, 1775)	-	-	-	-	-	-	1	-	-	-
Polyommatus bellargus (Rottemburg, 1775)	-	1	-	-	-	-	-	-	-	-
Polyommatus icarus Rottemburg, 1775	18	4	4	-	3	8	1	-	-	1
Libythea celtis (Laicharting, 1782)	1	-	-	-	-	-	-	-	-	-
Argynnis paphia (Linnaeus, 1758)	23	2	11	-	45	-	5	-	2	-
Issoria lathonia (Linnaeus 1758)	2	-	2	-	1	1	1	-	-	1
Brenthis daphne (Bergsträsser, 1780)	25	-	4	-	-	-	-	1	1	-
Boloria dia (Linnaeus, 1767)	4	-	8	-	4	-	2	-	-	-
Vanessa atalanta (Linnaeus, 1758)	58	6	26	1	3	-	2	2	8	3
Vanessa cardui (Linnaeus, 1758)	1	-	3	1	-	-	1	-	-	-
Aglais io (Linnaeus, 1758)	38	2	19	1	-	-	3	1	3	5
Polygonia c-album (Linnaeus, 1758)	22	1	3	-	2	-	1	-	1	-
Araschnia levana (Linnaeus, 1758)	16	2	3	1	10	-	2	-	5	-
Melitaea phoebe (Dennis & Schiffermüller, 1775)	2	-	-	-	-	-	-	-	-	-
Melitaea athalia (Rottemburg, 1775)	31	8	5	3	8	-	2	-	13	13

Table 2. continued

Limenitis reducta (Staudinger, 1901)	6	9	-	-	2	-	-	-	1	2
Neptis sappho (Pallas, 1771)	6	1	-	-	-	-	1	-	1	1
Apatura metis Freyer, 1829	1	-	-	-	-	6	-	-	-	-
Pararge aegeria (Linnaeus, 1758)	-	10	-	1	-	-	1	-	-	1
Lasiommata megera (Linnaeus, 1767)	-	1	1	-	-	-	-	-	-	-
Coenonympha pamphilus (Linnaeus, 1758)	14	-	11	1	6	3	-	-	-	-
Coenonympha glycerion (Borkhausen, 1788)	-	2	10	-	-	-	-	-	-	-
Aphantopus hyperantus (Linnaeus, 1758)	3	3	3	-	9	-	-	-	-	2
Maniola jurtina (Linnaeus, 1758)	40	7	6	2	14	-	6	2	-	2
Melanargia galathea (Linnaeus, 1758)	40	26	10	1	-	-	20	2	-	20
Minois dryas (Scopoli, 1763)	3	-	1	-	1	-	-	-	-	1
Brintesia circe (Fabricius, 1775)	-	-	-	-	-	-	3	-	-	-
Erynnis tages (Linnaeus, 1758)	1	-	-	1	-	-	-	-	-	-
Carcharodus alceae (Esper, 1780)	3	-	-	-	-	-	-	-	-	-
Pyrgus malvae (Linnaeus, 1758)	1	-	1	-	-	-	-	-	-	-
Heteropterus morpheus (Pallas, 1771)	3	-	-	-	-	-	-	-	-	-
Thymelicus lineola (Ochsenheimer, 1808)	1	-	-	-	-	-	-	-	-	-
Thymelicus sylvestris (Poda, 1761)	2	-	-	-	-	-	-	-	-	-
Ochlodes sylvanus (Esper, 1777)	4	-	-	-	1	3	-	-	1	-
Σ 65	549	115	191	24	135	41	79	14	53	75

Table 3. Systematic checklist of butterflies of Bansko Brdo, Baranja, Croatia.

	Family and species	Krčmar et al. (1996)	Krčmar (2002)	Present Study	Zoogeographical affiliation**
Papilionidae					
1.	*Papilio machaon* (Linnaeus, 1758)	+		+	ES
2.	*Iphiclides podalirius* (Linnaeus, 1758)	+		+	ES
3.	*Zerynthia polyxena* (Denis & Schiffermüller, 1775)	+		+	OR
4.	*Parnassius mnemosyne* (Linnaeus, 1758)*			+	OR
Pieridae					
5.	*Pieris brassicae* (Linnaeus, 1758)	+		+	ES
6.	*Pieris mannii* (Mayer, 1851)*			+	OR
7.	*Pieris rapae* (Linnaeus, 1758)	+		+	ES
8.	*Pieris napi* (Linnaeus, 1758)	+		+	HA
9.	*Pontia edusa* (Fabricius, 1777)	+		+	ES
10.	*Anthocharis cardamines* (Linnaeus, 1758)	+		+	ES
11.	*Aporia crataegi* (Linnaeus, 1758)	+			ES
12.	*Colias hyale* (Linnaeus, 1758)	+		+	ES
13.	*Colias alfacariensis* Ribbe, 1905	+		+	ES
14.	*Colias crocea* (Geoffroy, 1785)	+		+	TR
15.	*Colias myrmidone* (Esper, 1780)	+			ES
16.	*Colias erate* Esper 1804	+		+	ES
17.	*Gonepteryx rhamni* (Linnaeus, 1758)	+		+	ES
18.	*Leptidea sinapis* (Linnaeus, 1758)	+		+	ES
Riodinidae					
19.	*Hamearis lucina* (Linnaeus, 1758)	+		+	ME
Lycaenidae					
20.	*Lycaena phlaeas* (Linnaeus, 1761)	+		+	HA
21.	*Lycaena dispar* (Haworth, 1803)	+		+	ES
22.	*Lycaena virgaurea* (Linnaeus, 1758)*			+	ES
23.	*Lycaena thersamon* (Esper, 1784)	+			ES

Table 3. continued

24.	*Thecla betulae* (Linnaeus, 1758)	+		+	ES
25.	*Callophrys rubi* (Linnaeus, 1758)	+		+	ES
26.	*Satyrium w-album* (Knoch, 1782)*			+	ME
27.	*Cupido argiades* (Pallas, 1771)	+		+	ES
28.	*Cupido decoloratus* (Staudinger, 1886)	+			ES
29.	*Cupido alcetas* (Hoffmannsegg, 1804)	+		+	ES
30.	*Celastrina argiolus* (Linnaeus, 1758)	+		+	ES
31.	*Glaucopsyche alexis* (Poda, 1761)	+			ES
32.	*Iolana iolas* (Ochsenheimer, 1816)		+		ME
33.	*Phengaris arion* (Linnaeus, 1758)*			+	ES
34.	*Plebeius argus* (Linnaeus, 1758)	+		+	ES
35.	*Plebeius idas* (Linnaeus, 1761)			+	EU
36.	*Plebeius argyrognomon* (Bergsträsser, 1779)	+		+	RS
37.	*Aricia agestis* Denis and Schiffermüller 1775*			+	ES
38.	*Polyommatus daphnis* (Dennis & Schiffermüller, 1775)*			+	OR
39.	*Polyommatus bellargus* (Rottemburg, 1775)*			+	OR
40.	*Polyommatus icarus* Rottemburg 1775	+		+	ES
Nymphalidae					
41.	*Libythea celtis* (Laicharting, 1782)*			+	ME
42.	*Argynnis paphia* (Linnaeus, 1758)	+		+	ES
43.	*Issoria lathonia* (Denis & Schiffermüller, 1775)	+		+	ES
44.	*Brenthis daphne* (Denis & Schiffermüller, 1775)	+		+	ES
45.	*Boloria dia* (Linnaeus, 1767)	+		+	ES
46.	*Vanessa atalanta* (Linnaeus, 1758)	+		+	ES
47.	*Vanessa cardui* (Linnaeus, 1758)	+		+	KO
48.	*Aglais io* (Linnaeus, 1758)	+		+	ES
49.	*Aglais urticae* (Linnaeus, 1758)	+			ES
50.	*Polygonia c-album* (Linnaeus, 1758)	+		+	ES
51.	*Araschnia levana* (Linnaeus, 1758)	+		+	ES
52.	*Nymphalis antiopa* (Linnaeus, 1758)	+			HA

Table 3. continued

53.	*Nymphalis polychloros* (Linnaeus, 1758)	+			ES
54.	*Melitaea phoebe* (Denis & Schiffermüller, 1775)*			+	ES
55.	*Melitaea athalia* (Rottemburg, 1775)	+		+	ES
56.	*Limenitis populi* (Linnaeus, 1758)	+			ES
57.	*Limenitis reducta* Staudinger, 1901		+	+	ES
58.	*Neptis sappho* (Pallas, 1771)	+		+	OR
59.	*Apatura metis* Freyer 1829	+		+	OR
60.	*Pararge aegeria* (Linnaeus, 1758)	+		+	ME
61.	*Lasiommata megera* (Linnaeus, 1767)	+		+	OR
62.	*Lasiommata maera* (Linnaeus, 1758)	+			OR
63.	*Coenonympha pamphilus* (Linnaeus, 1758)	+		+	ES
64.	*Coenonympha glycerion* (Borkhausen, 1788)	+		+	ES
65.	*Aphantopus hyperantus* (Linnaeus, 1758)	+		+	ES
66.	*Maniola jurtina* (Linnaeus, 1758)	+		+	OR
67.	*Melanargia galathea* (Linnaeus, 1758)	+		+	OR
68.	*Minois dryas* (Scopoli, 1763)	+		+	ES
69.	*Brintesia circe* (Fabricius, 1775)*			+	ME
Hesperiidae					
70.	*Erynnis tages* (Linnaeus, 1758)	+		+	ES
71.	*Carcharodus alceae* (Esper, 1780)	+		+	ME
72.	*Pyrgus malvae* (Linnaeus, 1758)	+		+	ES
73.	*Heteropterus morpheus* (Pallas, 1771)	+		+	ES
74.	*Thymelicus lineola* (Ochsenheimer, 1808)*			+	ES
75.	*Thymelicus sylvestris* Poda 1761*			+	ES
76.	*Ochlodes sylvanus* (Esper 1777)	+		+	ES
	Total:	60	2	65	

*New records for Bansko Brdo

**KO-Cosmopolitan species, ES- Euro-Sibirian species, EU- European species, HA- Holarctic species, ME- Mediterranean species, OR- Oriental species, TR- Tropic species.

Table 4. Endangered butterfly species recorded on Bansko Brdo during this and previous surveys

Species List	Red List Status*		Habitats Directive Annexes[3]	Bern Convention Annexes[4]
	Europe[1]	Croatia[2]		
Heteropterus morpheus (Pallas, 1771)		NT		
Zerynthia polyxena (Denis & Schiffermüller, 1775)		NT	IV	II
Parnassius mnemosyne (Linnaeus, 1758)	NT	NT	IV	II
Lycaena dispar (Haworth, 1803)	LC	NT	II; IV	II
Phengaris arion (Linnaeus, 1758)	EN	DD	IV	II
Apatura metis Freyer, 1829		VU	IV	II

[1] Van Swaay et al. (2010), [2]Šašić & Kučinić (2004), [3]Anon. (1992), [4]Anon. (1996)
* EN- Endangered, VU- vulnerable, NT-Near threatened, LC- Least concern, DD- Data deficient.

is crisscrossed with forests and fields with only a small proportion of meadows remaining. When dealing with the recorded butterfly fauna from a conservation aspect, 6 recorded species are listed either in the Red List of European Butterflies (Van Swaay et al., 2010) or in the Red List of Croatian Butterflies (Šašić & Kučinić, 2004) as well in other European nature conservation documents (Table 4).

When we add literature data to our findings (Krčmar et al., 1996; Krčmar, 2002), 76 butterfly species are known for Bansko brdo (Table 4). The only nearby locality that was sufficiently researched is Kopački Rit, with 61 recorded butterfly species (Szent-Iványi, 1944; Krčmar, 1998; Krčmar, 2004; Krčmar et al., 1996; Reinstra, 2004). This comparison with Kopački Rit, a protected Nature Park, indicates the importance of Bansko brdo.

Another factor emphasising the importance of Bansko brdo is that it is one of the last known locations of *Colias myrmidone* (Esper, 1780) in Croatia (Krčmar et al., 1996). This species was not recorded during our survey, but the possibility that *C. myrmidone* is still present in Croatia exists and should be checked with further researches.

Aside from *C. myrmidone*, the following butterfly species that were recorded during previous researches (Krčmar et al., 1996, Krčmar, 2004) were not recorded during this survey: *Aporia crataegi* (Linnaeus, 1758), *Lycaena thersamon* (Esper, 1784), *Cupido decoloratus* (Staudinger, 1886), *Glaucopsyche alexis* (Poda, 1761), *Iolana iolas* (Ochsenheimer, 1816), *Aglais urticae* (Linnaeus, 1758), *Nymphalis antiopa* (Linnaeus, 1758), *Nymphalis polychloros* (Linnaeus, 1758), *Limenitis populi* (Linnaeus, 1758) and *Lasiommata maera* (Linnaeus, 1758).

While many parts of north-eastern Croatia, as well as Baranja have been completely changed due to the high anthropogenic impact, Bansko brdo still contains many of its natural habitats (Fig. 2 a-d). It would be of the great importance for the survival of many butterfly species to retain such habitat diversity on Bansko brdo in the future.

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