Entomol. Croat. 2015, Vol. 19. Num 1–2: 11–24

doi: 10.17971/EC.2015.19.02

BUTTERFLY FAUNA (LEPIDOPTERA: HESPERIOIDEA & PAPILIONOIDEA) OF KLEK MOUNTAIN

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Accepted: October, 2015

During two years of research (2004 and 2005), 82 butterfly species were identified on Mt. Klek. The diversity of the species registered is related to the mountain's abundant flora, its geomorphological characteristics and its specific climate. A great number of endangered and protected species were recorded. In this paper, the most interesting findings and their threat status are discussed. Two species mentioned in the literature, *Hipparchia semele* (Linnaeus, 1758) and *Erebia stirius kleki* (Lorković, 1955), were not found (Lorković, 1955; Mihoci et al., 2007b). If they are included, however, the total of identified butterfly species of Mt. Klek comes to 84. This paper represents the first list of butterfly species from the area of Mt. Klek.

Butterflies, fauna, Mt. Klek, *Erebia stirius kleki*, Croatia

D. (Perković) Gumhalter: Fauna danjih leptira (Lepidoptera: Hesperioidea i Papilionoidea) planine Klek. Entomol. Croat. 2015. Vol. 19. Num. 1–4: 11–24.

U vremenskom razdoblju od dvije godine (2004. i 2005.) na prostoru planine Klek zabilježene su 82 vrste danjih leptira. Raznolikost vrsta uvjetovana je velikom brojnošću flore i faune, geomorfološkim karakteristikama i specifičnim klimatskim uvjetima planine. Zabilježen je velik broj ugroženih i zakonom zaštićenih vrsta. U radu se raspravlja o najznačajnijim vrstama, te njihovom statusu ugroženosti. Dvije vrste spomenute u literaturi, *Hipparchia semele* (Linnaeus, 1758) i *Erebia stirius kleki* (Lorković, 1955) ovim istraživanjem nisu utvrđene (Lorković, 1955.; Mihoci i sur., 2007.b). Uključujući njih, popis danjih leptira planine Klek daje ukupno 84 vrsta. Ovaj rad predstavlja prvi cjeloviti popis danjih leptira s područja planine Klek.

Danji leptiri, fauna, planina Klek, *Erebia stirius kleki*, Hrvatska

Introduction

Klek Mountain is located in western Croatia (Fig. 1), on the edge of the Lika and Gorski kotar regions, rising above the city of Ogulin (Aleraj, 1980). It is the eastern mountain of the Velika Kapela range of the Dinaric Alps. Except for the rocky part, which includes Klek – the highest peak of the mountain at 1182 meters above sea level and Klečice – the second highest peak at 1040 meters above sea level, the mountain itself is covered with forest (Fig. 2). Since 1971 it has been a protected Botanical Reserve (Đurić, 2002).

As defined by the Köppen climate classification the region of Gorska Hrvatska has a moderately continental climate. The average temperature is approximately 20 °C in the warmest months, and in the coldest months the average temperature is below – 2 °C (Magaš, 2013).

As a result of the climate and the geomorphological characteristics, the region has a variety of different habitats. The area around Mt. Klek is on the edge of the Continental and of the Alpine biogeographic region. Although forest habitats predominate, on Mt. Klek there are also alpine meadows and grasslands with rich vegetation, as well as rocky habitats on the cliffs of the mountain with sparse vegetation and many endemic species like *Pedicularis brachiodonta* or *Primula kitaibeliana* in the crevices of the rock (Poljak, 1986).

Dinaridian forest of beech and European silver fir *Omphalodo-Fagetum* (*Abieti-Fagetum dinaricum* Treg. 1957) covers huge areas along the Dinaric mountains (Surina, 2002). On Mt. Klek it covers the area between 600 and 1100 meters above sea level, except for the mountain's peak. The dominant genera of *Omphalodo-Fagetum* are *Fagus* and *Abies* with the ancillary genera *Picea* and *Acer* (Čargonja et al., 2008).

The area between 400 and 800 meters above sea level is covered by Illyrian forest of montane beech with giant dead nettle (*Lamio orvale-Fagetum* Ht. 1938). The dominant genus of this forest community is *Fagus* and ancillary genera are *Quercus*, *Acer*, *Fraxinus*, *Ulmus* and *Carpinus* (Čargonja et al., 2008).

Figure 1. Location of the researched area – Mt. Klek, Croatia.

Figure 2. Klek Mt. – the highest peak Klek on the left and the second highest peak Klečice on the right (photo: D. Gumhalter).

The alpine meadow on Mt. Klek includes the sub-association *Hippocrepidetosum comosae* from the plant association *Bromo erecti-Plantaginetum mediae* Ht. 1931. It covers areas with less precipitation and higher temperatures and the dominant species are *Koeleria pyramidata, Globularia punctata, Cirsium acaule, Plantago media etc.,* while sunny areas with alkaline soils up to 700 meters above sea level are covered by beech forest with hop hornbeam (*Ostryo-Fagetum* W. 1954) and are overgrown by the genera *Fagus, Ostrya, Fraxinus*, *Cornus etc.* (Perković, 2005).

At the beginning of the 20th century, Koča studied the area of Bukovnik which is 15 km away from Mt. Klek. In 1891 he found one female specimen of a satyrid butterfly (Central Butterfly Collection CNHM Zagreb, inv. no. 4589), which he incorrectly determined as *Erebia gorge* Esp. (Koča, 1901) and later on as *Erebia nerine* Frr. (Koča, 1925). In 1955 Academician Lorković identified it correctly as the subspecies *Erebia stirius kleki* (Lorković, 1955). According to him it is an endemic subspecies because it has a small distribution area and is restricted to the highest parts of the mountain. In 2004 the subspecies was listed in the Red Data Book of Croatian Butterflies (Šašić et al., 2015) and was classified as EN (endangered species). Although it was not recorded during this research, its occurrence was confirmed later in 2005 (Mihoci et al., 2007b). According to Mihoci et al. (2007b), during the research in 2005, an additional 24 butterfly species were collected. Those findings are all amongst the species registered in this paper.

Apart from these few records, no systematic research of butterfly fauna from this area has ever been conducted. This paper is based upon the investigation *Butterflies and moths (Insecta, Lepidoptera) of Mt. Klek (*Perković, 2005).

Materials and Methods

Butterflies were collected from June to October 2004 and from April to June 2005. They were collected with an entomological net at eight localities on Mt. Klek (Fig. 3). All collected specimens are deposited in the private collection of the author. Taxonomic determination was done according to the wing morphology of Tolman & Lewington (1997) while systematic classification follows the European Red List of Butterflies (Swaay et al., 2010). The analysis of the morphological characteristics of the genitals of specimens from the genera *Leptidea* and *Melitaea* was done according to Lorković (1993) and Jakšić (1998). Analysis was done by the standard method of cooking the terminal part of the abdomen in KOH, cleaning the genital organs and preparation of genital slides.

Altitudes were determined using the GPS device Garmin eTrex Vista.

List of studied localities (Fig. 3):

Locality 1: Village Turkovići (N45°16'24.8" and EO15°10'03.7") – grasslands and meadows, located on the northern side of the mountain near the village of Turkovići, 369 m a.s.l.;

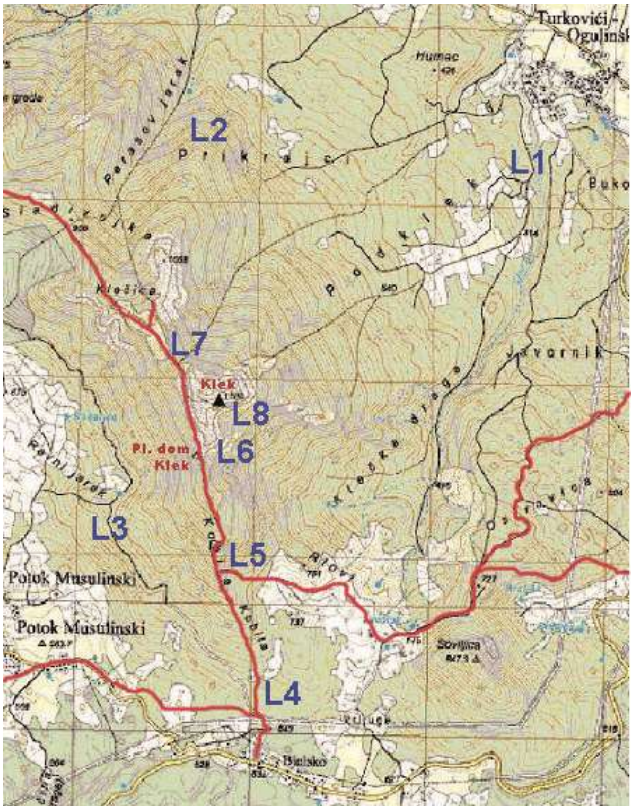

Figure 3. Researched localities (L1 – L8) on Mt. Klek, Croatia.

Locality 2: Peras ditch (N45°16'58.1" and EO15°08'31.1") – wetter grasslands and woodland clearings, located on the northern side of the mountain near the village of Vitunj, 430 m a.s.l.;

Locality 3: Ravni ditch – woodland clearings, located on the southern side of the mountain near the village of Bjelsko, 640 m a.s.l.;

Locality 4: Mountain meadow (N45°14'41.7" and EO15°09'10.8") – an alpine meadow, located on the northern side of the mountain near the village of Bjelsko, 696 m a.s.l.;

Locality 5: Mountain trail (N45°15'16.0" and EO15°08'53.7") – a forest habitat which follows the mountain trail from Bjelsko to the peak of the mountain, 867 m a.s.l.;

Locality 6: Klek Mountain hut (N45°15'25.7" and EO15°08'40.0") – a rocky habitat located by the mountain hut which is surrounded by forest, 1014 m a.s.l.;

Locality 7: Klečice (N45°16'00.9" and EO15°08'28.9") – a rocky habitat on the second highest peaks of the mountain, 1040 m a.s.l.;

Locality 8: Klek (N45°15'37.1" and EO15°08'43.5") – a rocky habitat on the highest peak of the mountain, 1182 m a.s.l.

Results

During two years of research (2004 and 2005) 82 species of butterflies were identified on Mt. Klek. In this investigation, two species which were previously mentioned in the literature, *Hipparchia semele* (Linnaeus, 1758) and *Erebia stirius kleki* (Lorković, 1955), were not found (Lorković, 1955; Mihoci et al., 2007b). But if they are nevertheless included, the butterfly list of Mt. Klek comes to a total of 84 species. This number includes 43% of all butterfly species recorded in Croatia, the list of which includes 197 species (Perković, 2006; Mihoci et al., 2007a; Šašić & Mihoci, 2011; Koren & Černe 2012; Toth et al., 2013; Kučinić et al., 2013, 2014; Šašić et al., 2015).

Table 1. List of studied localities, altitudes and number of identified species on each finding site.

No.	Locality	Altitude (m a.s.l.)	Number of recorded species
1.	Village of Turkovići (L1)	369	48
2.	Peras ditch (L2)	430	43
3.	Ravni ditch (L3)	640	35
4.	Mountain meadow (L4)	696	40
5.	Mountain trail (L5)	867	12
6.	Klek Mountain hut (L6)	1014	13
7.	Klečice (L7)	1040	14
8.	Klek (L8)	1182	16

The material from Mt. Klek was collected at 8 sites. Diverse habitats were chosen in order to get a complete insight into the butterfly diversity of the area: forest habitats, meadows, grasslands, moist habitats near a stream and rocky habitats of the peaks. The localities covered different altitudes, the northern and southern side of the mountain and two highest peaks (Tab. 1).

Discussion

In 2004 and 2005, 82 butterfly species were identified on Mt. Klek (Tab. 2). The endemic subspecies *Erebia stirius kleki* (Lorković, 1955) was not recorded during the field work. Its occurrence was cofirmed later, in 2005, on the south-western part of Mt. Klek (Mihoci et al., 2007b). Further, the species *Hipparchia semele* (Linnaeus, 1758), which is also mentioned in the literature (Lorković, 1955), was not recorded during this research. If these two species are included, the butterfly list of Mt. Klek comes to 84 species in total.

Table 1 shows the list of the researched localities together with the altitude and the number of recorded species for each finding site on Mt. Klek. Localities with the highest number of recorded species are the village of Turkovići, the Peras ditch and Mountain meadow (Fig. 4.). The researched habitat types of those localities are grasslands, meadows and woodland clearings. The major threat to the recorded species is loss of specific habitats, especially habitats like grasslands and meadows which are traditionally maintained by mowing or grazing. Prevention of the destruction of existing habitats is a necessary action for successful butterfly conservation.

The butterfly families with the most species recorded are the family Nymphalidae with 42 species and the family Lycaenidae with 17 species. The smallest number of species was recorded for the family Riodinidae (1 species) and family Papilionidae (3 species).

Seventeen species from the family Lycaenidae were identified, which means that this is the second most numerous family after the Nymphalidae. Two recorded species should be mentioned, both from the *Lycaena* genus: *Lycaena dispar* (Haworth, 1802) – a species protected by Annex II of the Bern Convention and *Lycaena hippothoe* (Linnaeus, 1758) – a species that is not yet on the verge of extinction but could be soon. *Lycaena dispar* was found in Turkovići village on a sunny meadow, and *Lycaena hippothoe* on the Mountain meadow and the Ravni ditch, in a wet meadow. Although the species *Lycaena hippothoe* is still widely distributed in the Croatian lowlands on wet meadows, it is necessary to preserve its habitats in order to protect the species.

The highest number of identified species is from the family Nymphalidae. Forty two species were recorded and several of them should be discussed here (Tab. 2).

From the *Erebia* genus, only two species were identified: *Erebia ligea* (Linnaeus, 1758) and *Erebia aethiops* (Esper, 1777). Although its occurrence was confirmed later in 2005, the mountain subspecies *Erebia stirius kleki* was not detected during this

Table 2. Systematic list of butterflies in the area of the Klek Mountain found in this research.

Species	Sampling site and date
Family Hesperiidae	
1 *Erynnis tages* (Linnaeus, 1758)	Turkovići 14.V.2005, Peras ditch 4.V.2005
2 *Spialia orbifer* (Hübner, 1823)	Mountain meadow 21.VII.2005
3 *Pyrgus malvae* (Linnaeus, 1758)	Turkovići 14.V.2005, Peras ditch 04.VI.2005
4 *Heteropterus morpheus* (Pallas, 1771)	Turkovići 03.VIII.2004
5 *Thymelicus lineola* (Ochsenheimer, 1808)	Peras ditch 04.VIII.2004, Mountain meadow 09.VII.2004
6 *Thymelicus sylvestris* (Poda, 1761)	Turkovići 03.VIII.2004, Peras ditch 04.VIII.2004, Mountain meadow 26. VII.2004, Ravni ditch 16.VIII.2004
7 *Thymelicus acteon* (Rottemburg, 1775)	Turkovići 03.VIII.2004, Peras ditch 04.VIII.2004, Ravni ditch 16.VIII.2004
8 *Hesperia comma* (Linnaeus, 1758)	Turkovići 03.IX.2004, Ravni ditch 16.VIII.2004
9 *Ochlodes sylvanus* (Esper, 1777)	Turkovići 03.VIII.2004, 14.VI.2005, Peras ditch 04.VIII.2004, Mountain meadow 09.VII.2004, Ravni ditch 16.VIII.2004, Mountain trail 09. VII.2004, Klečice 09.VII.2004, Klek 09.VII.2004
Family Papilionidae	
10 *Parnassius mnemosyne* (Linnaeus, 1758)	Mountain meadow 09.VII.2004, 14.VI.2005
11 *Iphiclides podalirius* (Linnaeus, 1758)	Turkovići 03.VIII.2004, Peras ditch 04.VIII.2004, Mountain meadow 14.V.2005, Klek Mountain hut 14.VI.2005, Klek 09.VII.2004, 14.V.2005
12 *Papilio machaon* (Linnaeus, 1758)	Turkovići 03.VIII.2004, Peras ditch 14.V.2005
Family Pieridae	
13 *Leptidea sinapis* (Linnaeus, 1758)	Turkovići 03.VIII.2004, 14.V.2005, Peras ditch 04.VIII.2004, 03.IX.2004, 14.V.2005, Mountain meadow 14.V.2005, Ravni ditch 16.VIII.2004, 04. IX.2004, Klek Mountain hut 14.V.2005, Klečice 09.VII.2004, Klek 09. VII.2004
14 *Anthocharis cardamines* (Linnaeus, 1758)	Turkovići 14.V.2005, Peras ditch 14.V.2005, Mountain meadow 14.V.2005, Mountain trail 14.V.2005, Klek mountain hut 14.V.2005
15 *Aporia crataegi* (Linnaeus, 1758)	Turkovići 03.VIII.2004, 14.VI.2005, Peras ditch 10.VII.2004, Mountain meadow 10.VII.2004, 14.VI.2005, Ravni ditch 16.VIII.2004
16 *Pieris brassicae* (Linnaeus, 1758)	Turkovići 03.VIII.2004, 14.V.2005, Peras ditch 04.VIII.2004, Mountain meadow 14.V.2005, Ravni ditch 16.VIII.2004
17 *Pieris mannii* (Mayer, 1851)	Turkovići 03.VIII.2004
18 *Pieris rapae* (Linnaeus, 1758)	Turkovići 03.VIII.2004, 03.IX.2004, Peras ditch 04.VIII.2004, Ravni ditch 16.VIII.2004
19 *Pieris napi* (Linnaeus, 1758)	Turkovići 03.VIII.2004, 14.V.2005, Peras ditch 04.VIII.2004, Mountain meadow 14.V.2005, Ravni ditch 16.VIII.2004, Klek Mountain hut 09. VII.2004, Klečice 09.VII.2004
20 *Colias crocea* (Geoffroy, 1785)	Turkovići 03.VIII.2004, 03.IX.2004, Peras ditch 04.VIII.2004, Mountain meadow 03.IX.2004, Ravni ditch 16.VIII.2004, 04.IX.2004, Klečice 09. VII.2004
21 *Colias cf. hyale* (Linnaeus, 1758)	Ravni ditch 16.VIII.2004
22 *Gonepteryx rhamni* (Linnaeus, 1758)	Turkovići 03.VIII.2004, 14.V.2005, Peras ditch 04.VIII.2004, Mountain meadow 09.VII.2004, Ravni ditch 16.VIII.2004, Mountain trail 09. VII.2004, Klek Mountain hut 09.VII.2004, Klečice 09.VII.2004, 14.V.2005, Klek 09.VII.2004
Family Riodinidae	
23 *Hamearis lucina* (Linnaeus, 1758)	Turkovići 14.V.2005, Peras ditch 04.VIII.2004, 14.V.2005, Ravni ditch 05. VIII.2004

Family Lycaenidae	
24 *Lycaena dispar* (Haworth, 1802)	Turkovići 14.VI.2005
25 *Lycaena virgaureae* (Linnaeus, 1758)	Mountain meadow 09.VII.2004, Ravni ditch 16.VIII.2004, 04.IX.2004
26 *Lycaena tityrus* (Poda, 1761)	Turkovići 03.VIII.2004, 03.IX.2004, Ravni ditch 16.VIII.2004
27 *Lycaena alciphron* (Rottemburg, 1775)	Mountain meadow 21.VII.2005
28 *Lycaena hippothoe* (Linnaeus, 1761)	Mountain meadow 09.VII.2004
29 *Callophrys rubi* (Linnaeus, 1758)	Turkovići 14.V.2005, Peras ditch 14.V.2005
30 *Satyrium spini* (Dennis and Schiffermüller, 1775)	Turkovići 03.VIII.2004, Ravni ditch 16.VIII.2004, Klečice 09.VII.2004, Klek 09.VII.2004
31 *Cupido minimus* (Fuessly, 1775)	Peras ditch 14.VI.2005, Klek Mountain hut 14.VI.2005
32 *Celastrina argiolus* (Linnaeus, 1758)	Turkovići 05.VIII.2004, Peras ditch 04.VIII.2004
33 *Glaucopsyche alexis* (Poda, 1761)	Turkovići 14.V.2005, Peras ditch 14.V.2005
34 *Plebejus argus* (Linnaeus, 1758)	Turkovići 03.IX.2004, Peras ditch 04.VIII.2004, Klečice 09.VII.2004
35. *Aricia agestis* (Dennis and Schiffermüller, 1775)	Mountain meadow 09.VII.2004
36 *Aricia artaxerxes* (Fabricius, 1793)	Turkovići 03.IX.2004, Mountain meadow 03.IX.2004
37 *Polyommatus amandus* (Schneider, 1792)	Mountain meadow 09.VII.2004
38 *Polyommatus icarus* (Rottemburg, 1775)	Turkovići 03.VIII.2004, 03.IX.2004, Peras ditch 04.VIII.2004, 03.IX.2004, Mountain meadow 09.VII.2004, 03.IX.2004, Ravni ditch 04.IX.2004
39 *Polyommatus bellargus* (Rottemburg, 1775)	Peras ditch 03.IX.2004, Mountain meadow 03.IX.2004, Ravni ditch 04. IX.2004
40 *Polyommatus coridon* (Poda, 1761)	Turkovići 03.VIII.2004, 03.IX.2004, Peras ditch 03.IX.2004, Mountain meadow 03.IX.2004, Ravni ditch 03.IX.2004
Family Nymphalidae	
41 *Libythea celtis* (Laicharting, 1782)	Mountain meadow 09.VII.2004
42 *Argynnis paphia* (Linnaeus, 1758)	Turkovići 03.VIII.2004, Peras ditch 04.VIII.2004, Mountain meadow 04. VIII.2004, Ravni ditch 16.VIII.2004, 04.IX.2004
43 *Argynnis pandora* (Dennis and Schiffermüller, 1775)	Mountain meadow 21.VII.2005
44 *Argynnis aglaja* (Linnaeus, 1758)	Peras dike 04.VIII.2004, Mountain meadow 09.VII.2004, Ravni ditch 16. VIII.2004
45 *Argynnis adippe* (Dennis and Schiffermüller, 1775)	Mountain meadow 21.VII.2005
46 *Issoria lathonia* (Linnaeus, 1758)	Turkovići 03.IX.2004, Peras ditch 03.IX.2004
47 *Brenthis daphne* (Bergsträsser, 1780)	Turkovići 03.VIII.2004, Peras ditch 04.VIII.2004, Mountain meadow VII.2004, 26.VII.2004, Ravni ditch 16.VIII.2004
48 *Brenthis hecate* (Dennis and Schiffermüller, 1775)	Mountain meadow 10.VII.2004, Mountain trail 09.VII.2004
49 *Boloria euphrosyne* (Linnaeus, 1758)	Turkovići 14.V.2005, Peras ditch 14.V.2005
50 *Vanessa atalanta* (Linnaeus, 1758)	Turkovići 14.V.2005, Peras ditch 04.VIII.2004, Mountain meadow 10. VII.2004, Klečice 14.V.2005, Klek 09.VII.2004
51 *Vanessa cardui* (Linnaeus, 1758)	Turkovići 14.V.2005, Peras ditch 04.VIII.2004, Mountain meadow 09. VII.2004, Klek Mountain hut 09.VII.2004, Klek 09.VII.2004
52 *Aglais io* (Linnaeus, 1758)	Turkovići 14.V.2005, Peras ditch 03.ix.2004, Mountain meadow 10. VII.2004, Ravni ditch 16.VIII.2004, Klečice 14.V.2005, Klek 09.VII.2004
53 *Aglais urticae* (Linnaeus, 1758)	Klek Mountain hut 14.VI.2005
54 *Polygonia c-album* (Linnaeus, 1758)	Turkovići 03.VIII.2004, Mountain meadow 10.VII.2004, Ravni ditch 16.VIII.2004

55 *Nymphalis antiopa* (Linnaeus, 1758)	Peras ditch 04.VIII.2004
56 *Nymphalis polychloros* (Linnaeus, 1758)	Klek Mountain hut 10.VII.2004
57 *Euphydryas maturna* (Linnaeus, 1758)	Mountain meadow 14.VI.2005
58 *Melitaea cinxia* (Linnaeus, 1758)	Mountain meadow 26.VII.2004, Klek 09.VII.2004
59 *Melitaea phoebe* (Dennis and Schiffermüller, 1775)	Turkovići 03.IX.2004, Peras ditch 04.VIII.2004, Klečice 09.VII.2004
60 *Melitaea didyma* (Esper, 1778)	Mountain meadow 09.VII.2004, 03.IX.2004, 14.VI.2005
61 *Melitaea diamima* (Lang, 1789)	Mountain meadow 10.VII.2004, 26.VII.2004, Mountain trail 09.VII.2004, Klečice 09.VII.2004
62 *Melitaea aurelia* (Nickerl, 1850)	Mountain meadow 10.VII.2004
63 *Melitaea athalia* (Rottemburg, 1775)	Turkovići 03.VIII.2004, 14.VI.2005, Peras ditch 03.IX.2004, Mountain meadow 10.VII.2004, 26.VII.2004, Ravni ditch 04.IX.2004, Klečice 09. VII.2004, Klek 09.VII.2004
64 *Limenitis camilla* (Linnaeus, 1758)	Ravni ditch 16.VIII.2004
65 *Limenitis reducta* (Staudinger, 1901)	Mountain meadow 10.VII.2004
66 *Neptis sappho* (Pallas, 1771)	Peras ditch 10.VII.2004
67 *Neptis rivularis* (Scopoli, 1763)	Peras ditch 21.VII.2005
68 *Pararge aegeria* (Linnaeus, 1758)	Mountain meadow 09.VII.2004, Ravni ditch 04.IX.2004
69 *Lasiommata megera* (Linnaeus, 1758)	Klek 09.VII.2004
70 *Lasiommata maera* (Linnaeus, 1758)	Mountain trail 09.VII.2004, Klek Mountain hut 09.VII.2004, 14.VI.2005, Klečice 09.VII.2004, Klek 09.VII.2004
71 *Lopinga achine* (Scopoli, 1763)	Klečice 10.VII.2004
72 *Coenonympha arcania* (Linnaeus, 1758)	Turkovići 03.VIII.2004, 14.VI.2005, Mountain meadow 10.VII.2004, 14.VI.2005, Mountain trail 09.VII.2004, Klek Mountain hut 09.VII.2004, Klečice 09.VII.2004, Klek 09.VII.2004
73 *Coenonympha glycerion* (Borkhausen, 1788)	Turkovići 14.VI.2005
74 *Coenonympha pamphilus* (Linnaeus, 1758)	Turkovići 03.VIII.2004, Peras ditch 04.VIII.2004, 16.VIII.2004, 14.VI.2005, Mountain meadow 14.VI.2005, Ravni ditch 04.VIIII.2004
75 *Aphantopus hyperantus* (Linnaeus, 1758)	Turkovići 03.VIII.2004, Peras ditch 04.VIII.2004, Ravni ditch 16.VIII.2004
76 *Maniola jurtina* (Linnaeus, 1758)	Turkovići 03.VIII.2004, Peras ditch 04.VIII.2004, Mountain meadow 09.VII.2004, Ravni ditch 16.VIII.2004, Mountain trail 10.VII.2004, Klek Mountain hut 10.VII.2004, 03.IX.2004
77 *Erebia ligea* (Linnaeus, 1758)	Mountain meadow 09.VII.2004, Mountain trail 09.VII.2004, Klek Mountain hut 09.VII.2004, Klek 09.VII.2004
78 *Erebia aethiops* (Esper, 1777)	Turkovići 03.VIII.2004, Ravni ditch 16.VIII.2004
79 *Melanargia galathea* (Linnaeus, 1758)	Turkovići 03.VIII.2004, Peras ditch 04.VIII.2004, Mountain meadow 09.VII.2004, 26.VII.2004, Ravni ditch 16.VIII.2004, Klek 09.VII.2004
80 *Minois dryas* (Scopoli, 1763)	Turkovići 03.VIII.2004
81 *Hipparchia fagi* (Scopoli, 1763)	Peras ditch 04.VIII.2004
82 *Brintesia circe* (Fabricius, 1775)	Turkovići 03.IX.2004, Peras ditch 03.IX.2004, Ravni ditch 04.IX.2004

research on Mt. Klek. Possible explanations of why the species was not recorded during the fieldtrips are the occasional bad weather conditions and the small number of the species on Mt. Klek (Mihoci et al., 2007b).

The presence of the Woodland Brown *Lopinga achine* (Scopoli, 1763) on Mt. Klek is very interesting since the species is considered rare in Croatia. *Lopinga achine* is

classified as NT – nearly threatened in the Red Data Book of Croatian Butterflies (Šašić et al. 2015) and as VU – vulnerable in the European Red List of Butterflies (Swaay et al., 2010). The butterfly occurs in Croatian fauna locally and is very rare. According to Šašić & Mihoci (2007) it was observed during several field trips in Hrvatsko Zagorje (on Žgano Vino), on Mt. Ivanščica, near the city of Vrbovec (Varoški Lug) and in the Gorski kotar, Slavonia and Istria regions (Šašić et al. 2015). According to Koča (1900, 1901) this species was collected at Mt. Papuk, Bazjaš and Zvirince near Vinkovci and near Velika. According to Mladinov (1978) *Lopinga achine* was collected along the upper course of the river Kupa, in Ložec and Grintovec. There are also several findings of this species from the area around Zagreb (Turopolje, Sljeme, Samobor), and specimens are preserved in the central butterfly collection of the Department of Zoology and at the Croatian National History Museum in the butterfly collection of Academician Lorković. *Lopinga achine* inhabits open woodlands where average bush and tree cover is at least 60%, but with glades that allow flying in the sun. Only one specimen was recorded on the rocky habitat on Klečice, which is a sunny locality surrounded by woodlands. Similar habitats should be checked for the presence of this species and further studies of its distribution in this area are needed. Changes in woodland management lead to succession or to fragmentation of the habitat, and since *Lopinga achine* is a declining species, preservation of its habitats should be a high priority.

Another interesting finding is the species *Euphydryas maturna* (Linnaeus, 1758). Only one specimen was collected on the Mountain meadow locality. This species is classified as NT – nearly threatened in the Red Data Book of Croatian Butterflies (Šašić et al. 2015). The occurrence of *Euphydryas maturna* is very significant since it is a rare species in Croatia and until now was not confirmed in other well-researched areas like Mt. Dinara (Tvrtković et al., 2012), Mt. Biokovo (Mihoci et al., 2011), Mt. Velebit (Mihoci et al., 2007c) or the area around Karlovac (Špani*ć*, 2012). *Euphydryas maturna*, like many other woodland species, depends on a continual supply of open-canopy structures, traditionally maintained by coppicing or forest pasture (Warren & Key, 1991). Since forestry practitioners view these forms of woodland management as wasteful, it is difficult to conserve those habitats. Another limiting factor is the quality of woodland vegetation: the post-hibernation larvae consume a wide range of herbs and shrubs, and adult distribution is linked to nectar availability. The butterfly thus depends on highly heterogeneous early successional stages of deciduous woods (Freese et al., 2006). It is mandatory to protect this species by protecting its habitats. The restoration of traditional ways of maintenance offers the only way for survival of *Euphydryas maturna*.

Species of the *Melitaea* genus were identified by analysis of the morphological characteristics of the genitals. Several species from this genus could be identified: *Melitaea athalia, M. aurelia, M. cinxia, M. diamina, M. didyma meridionalis* and *M. phoebe.* The species *Melitaea aurelia* is listed in the European Red List of Butterflies and has a near threatened (NT) status in Europe (van Swaay et al., 2010) due to habitat fragmentation and/or loss.

From the family Papilionidae three species were identified: *Iphiclides podalirius* (Linnaeus, 1758), *Papilio machaon* (Linnaeus, 1758) and *Parnassius mnemosyne* (Linnaeus, 1758). The species *Papilio machaon* and *Parnassius mnemosyne* are classified as NT – nearly threatened species in the Red Data Book of Croatian Butterflies (Šašić et al., 2015).

From the Pieridae family, 10 species were recorded. All specimens of the genus *Leptidea* were identified by analysis of the morphological characteristics. The results identified all the specimens as *Leptidea sinapis*. Since the species resembles the rare *Leptidea morsei*, which occurs on other Croatian mountains, like Mt. Velebit (Mihoci et al., 2007b), this method was used in order to prevent misidentification.

During the field work, only one specimen of the species *Colias cf. hyale* (Linnaeus, 1758) was recorded. It was found at the locality Ravni ditch, which is a woodland clearing located on the southern side of the mountain at 640 meters above sea level. According to Tolman & Lewington (1997) the species is distributed in Central Europe, but is absent from Mediterranean islands and countries like Italy, Greece, the west and southwest Balkans. Therefore, its finding on Mt. Klek could represent the southernmost limit of its distribution range in Croatia and further studies of its distribution in this area are recommended. The specimen was identified using Tolman & Lewington (1997).

The species *Hamaeris lucina* (Linnaeus, 1758) from the Riodinidae family was recorded at the localities Turkovići, Peras ditch and Ravni ditch. All finding sites are grasslands and woodland clearings. This species is also a declining species in Croatia since it relies on types of habitats that require regular forest management (Swaay & Warren, 1999).

In all, a great number of endangered and protected species according to the Red Data Book of Croatian Butterflies (Šašić et al., 2015) were registered during this study. Also, 7 species are listed in the European Red List of Butterflies: Woodland Brown *Lopinga achine* (Scopoli, 1763), which has a vulnerable status in Europe and was found only once on Klečice (a rocky habitat); Lulworth Skipper *Thymelicus acteon* (Rottemburg, 1775), which has a near threat status in Europe and was found at Turkovići, Peras ditch and Ravni ditch (meadows and woodland clearings); Woodland Grayling *Hipparchia fagi* (Scopoli, 1763), which has a near threat status in Europe and was collected once at Peras ditch (a woodland clearing); Nickerl's Fritillary *Melitaea aurelia* (Nickerl, 1850), which has a near threat status in Europe and was collected only on the Mountain meadow (Fig. 4); Clouded Apollo *Parnassius mnemosyne* (Linnaeus, 1758) which has a near threat status in Europe and was recorded only on the Mountain meadow; Purple-edged Copper *Lycaena hippothoe* (Linnaeus, 1758) and False Hearth Fritillary *Melitaea diamina* (Lang, 1789), which have the status of least concern in Europe and were both recorded only on Mountain meadow.

The major threat for the butterfly species recorded is loss of specific habitats, especially mountain meadows, which require traditional agricultural ways of maintenance (like mowing or grazing) in order to prevent succession and/or invasion of trees and scrubs, as well as woodland clearings which require regular woodland

Figure 4. The researched location 'Mountain meadow' (photo: D. Gumhalter).

management. Reduction and fragmentation of habitats are a growing threat to butterflies in this area.

This paper represents the first complete list of registered butterfly species for Mt. Klek and therefore it is an important contribution to knowledge of the butterfly fauna of Croatia. Findings of several new species can be expected, and further activities should be undertaken in order to continue field investigations, especially during a longer period of time.

Acknowledgements

The author is very grateful to prof. dr. sc. Ivana Maguire, Faculty of Science, University of Zagreb for her assistance with the English language and prof. dr. sc. Mladen Kučinić for technical help.

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