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NEW DATA ON THE PRESENCE OF THREE SIMILAR SPECIES OF THE GENUS *MELITAEA*: *M. ATHALIA*, *M. AURELIA* AND *M. BRITOMARTIS* (LEPIDOPTERA: NYMPHALIDAE) IN THE NORTH-WESTERN BALKANS

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ABSTRACT

The recently collected distribution data about three similar *Melitaea* (Lepidoptera: Nymphalidae) species (*M. athalia*, *M. aurelia* and *M. britomartis*) that were reliably identified based on morphology of genitalia are presented. Three countries from the NW Balkans (Slovenia, Croatia, and Bosnia and Herzegovina) were included in the survey. All three species are widely distributed in Slovenia and Croatia from the lowlands to the subalpine belt, frequently occurring also in syntopy. The proportion of *M. aurelia* and *M. britomartis* that are often treated as rare is quite high, accounting for 28.5 % and 22.7 % of the total studied sample size, respectively. The known area of distribution for *M. aurelia* and *M. britomartis* has been significantly extended to the south, especially in Croatia from where only two records for the latter had previously existed. *M. britomartis* is recorded in Bosnia and Herzegovina for the first time.

Key words: *Melitaea athalia/aurelia/britomartis*, genitalia, distribution, Slovenia, Croatia, Bosnia and Herzegovina

NUOVE CONFERME DELLA PRESENZA DI TRE SPECIE SIMILI DEL GENERE *MELITAEA*: *M. ATHALIA*, *M. AURELIA* E *M. BRITOMARTIS* (LEPIDOPTERA: NYMPHALIDAE) NEI BALCANI NORD-OCCIDENTALI

SINTESI

L'articolo riporta recenti dati sulla distribuzione di tre specie simili di *Melitaea* (Lepidoptera, Nymphalidae: *M. athalia*, *M. aurelia* e *M. britomartis*), che sono state determinate in base alla morfologia degli organi genitali. La ricerca ha coperto il territorio di tre stati dei Balcani nord-occidentali (Slovenia, Croazia, Bosnia ed Erzegovina). I risultati indicano che tutte le specie hanno un'ampia distribuzione in Slovenia e Croazia. *M. aurelia* e *M. britomartis*, frequentemente considerate quali specie rare, hanno rappresentato un'alta percentuale del campione studiato, ossia il 28,5 % ed il 22,7 %, rispettivamente. L'area di distribuzione conosciuta di *M. aurelia* e *M. britomartis* è stata estesa significativamente verso sud, specialmente in Croazia, dove fino ad oggi si contavano solo due segnalazioni delle specie studiate. *M. britomartis* è stata trovata in Bosnia ed Erzegovina per la prima volta.

Parole chiave: *Melitaea athalia/aurelia/britomartis*, genitali, distribuzione, Slovenia, Croazia, Bosnia ed Erzegovina

INTRODUCTION

The genus *Melitaea* is comprised of about 65 small to medium-sized butterfly species distributed widely across the Palaearctic region (Leneveu et al., 2009). The radiation of diversity in the genus *Melitaea* is estimated to have happened in early the Miocene, somewhere in the Central Palaearctic region (Leneveu et al., 2009). In Europe, 15 species of the genus *Melitaea* are present (Van Swaay et al., 2010), of which eight are distributed in the area of the north-western part of the Balkan Peninsula. Most European representatives of this genus have clearly visible external diagnostic morphological characteristics and can be easily distinguished from similar species (Tolman & Lewington, 2008). Aside from those, this genus also includes some species which are difficult to recognize by external morphology, *i.e.* colour patterns on the wings. There are some species for which the morphology of the genitals must be checked for correct identification (Urbahn, 1952; Tolman & Lewington, 2008; Paulavičiūtė & Tamutis, 2009). This includes the complex of three species present in the northern Balkans: *Melitaea athalia* (Rottemburg, 1775), *Melitaea aurelia* (Nickerl, 1850) and *Melitaea britomartis* Assmann, 1847. Although some authors propose different external character keys for identification of the three species (*e.g.*, Higgins & Rille, 1970; Lafranchis, 2004; Tolman & Lewington, 2008), *i.e.* combination of coloration (lunules on hind wings and band coloration, colour of hair on the palps and size), the morphological variability prevents proper identification at all times (Tolman & Lewington, 2008; Lorković, 2009).

The three most north-western Balkan countries (Slovenia, Croatia and Bosnia and Herzegovina) have a long tradition of butterfly research (*e.g.*, Mann, 1857, 1867, 1869; Hafner, 1909; Stauder, 1919–1927; Carnelutti, 1992; Lelo, 2007; Lorković, 2009; Šašić & Mihoci, 2011). Until 1991, all three countries were part of former Yugoslavia. So far only one distribution atlas for the whole area of Yugoslavia exists (Jakšić, 1988) where the presence of each species is indicated for the 10 x 10 km² UTM fields. Slovenia is the best surveyed country in the Balkans, owing to numerous recent publications, and a new Atlas of butterflies (Verovnik et al., 2012). In the last 20 years much new data regarding the butterflies of Croatia has been published (*e.g.*, Mihoci et al., 2007; Koren & Ladavac, 2010; Koren et al., 2011; Šašić & Mihoci, 2011), but large parts of the country still remain unsurveyed. For Bosnia and Herzegovina, only a small number of papers have been published in the last 20 years (*e.g.*, Lelo, 2000), including a book with general information on the distribution of butterflies in this country (Lelo, 2007). While *M. athalia* and *M. aurelia* have already been recorded in Bosnia and Herzegovina, this is not true for *M. britomartis* (Lelo, 2007).

The majority of the published data on the three species of *Melitaea* from the NW Balkans rely mostly on

identification based on external morphology. Since the latter is extremely difficult owing to the high rate of morphological variability in species (and/or population) (Tolman & Lewington, 2008), there is a high probability of a series of misidentifications in the older literature, most commonly in favour of *M. athalia* which is believed to be the most widespread and frequent of all three species (Jakšić, 1988; Lorković, 2009). As such, distribution data from papers in which species were identified only on the basis of external morphological characteristics needs to be treated differently from the data obtained from genitalia preparations. Without those data, however, almost no records would be left for Croatia and Bosnia and Herzegovina. With the application of identification based on the morphology of genitalia, we expect: (1) to reliably identify the specimens to the species rank, and (2) to provide exact data on their geographical, altitudinal and temporal distributions. Hence, we expect to considerably change the current knowled-

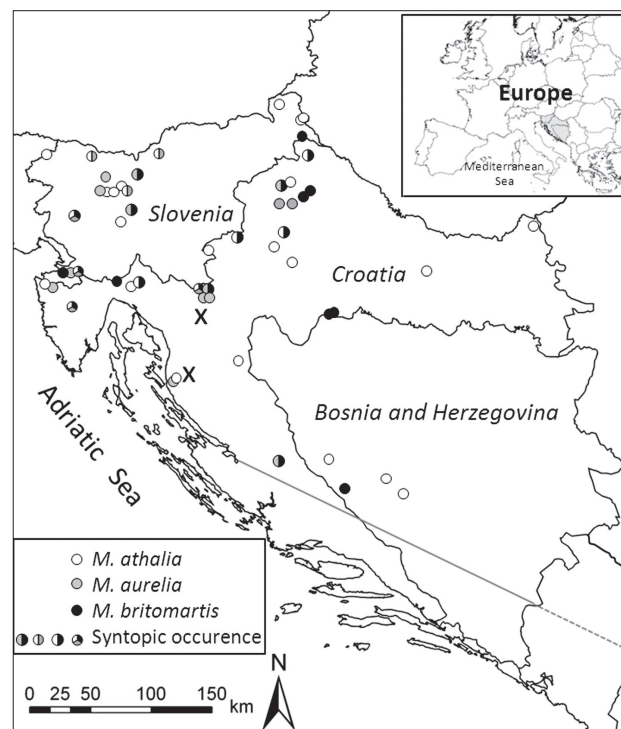


Fig. 1: Distribution of the three *Melitaea* species (*M. athalia*, *M. aurelia*, *M. britomartis*) from the NW Balkans based on the data included in the present study. The historically defined southern limit of the distribution of *M. aurelia* is denoted by the grey line. The two historical records of *M. britomartis* in Croatia are denoted by "X".
Sl. 1: Zemljevid razširjenosti treh vrst iz rodu *Melitaea* (*M. athalia*, *M. aurelia*, *M. britomartis*) na področju SZ Balkana. Zgodovinsko postavljena južna meja razširjenosti *M. aurelia* je označena s sivo črto. Dva zgodovinska podatka za *M. britomartis* na Hrvaškem sta označena z "X".

ge on the presence of these three species in some parts of the NW Balkans.

MATERIALS AND METHODS

Samples of three species of the genus *Melitaea* (Fig. 1, Appendix 1) were collected with a butterfly net for over last 30 years all over the NW Balkans, including the following countries: Slovenia (samples from 20 localities), Croatia (32 localities) and Bosnia and Herzegovina (4 localities). Sample size ranged from 1 to 12 for males and from 1 to 3 for females, with males prevailing (Appendix 1). On each sampling occasion, the data on sampling locality was gathered, which includes geographic position, altitude and a short habitat description (Appendix 1). Specimens were mounted and are deposited in two private collections in Pazin, Croatia (Koren T. collection) and Kranj, Slovenia (Jugovic I. collection) (see Appendix 1, under Coll.).

As a high morphological variability of the wing size, pattern and coloration has been reported by several studies (e.g., Tolman & Lewington, 2008), no specimens were attributed to a single species regarding these characteristics (see Introduction for details). Specimens were identified to the species level according to the genitalia structure that is species specific (Urbahn, 1952; Tolman & Lewington, 2008; Paulavičiūtė & Tamutis, 2009). A completely certain identification, however, is possible only in males (Urbahn, 1952). In females there are slight differences among the species, but not all specimens can be reliably attributed to the species level (Urbahn, 1952). The genitalia of each specimen were isolated using the standard procedure for genitalia isolation. The procedure includes the cutting of the abdomen and immersing it in a 10 % KOH solution overnight. Isolated genitalia were examined under a stereomicroscope (Leica MZ 12.5) and stored in 75 % ethanol afterwards. The storage vials are vouchered accordingly to specimens from the collections.

All sampling localities were geo-referenced either by using a GPS device (e-Trex Vista) or by the use of Google Earth afterwards (Appendix 1). For the distribution and statistical analyses, ArcGIS software, Excel 2010 (Microsoft) and SPSS 14.0 were used, respectively.

RESULTS

Species and geographic occurrence

The principal result of our analysis is the confirmation of the expected presence of all three species in Slovenia, Croatia and Bosnia and Herzegovina (Fig. 1). Of 123 collected specimens, 60 (48.8 %) belong to *M. athalia* (32 localities), followed by 35 specimens (28.5 %) of *M. aurelia* (23 localities) and 28 specimens (22.7 %) of *M. britomartis* (21 localities). The distribution of all three species seems to be more or less contiguous,

and the distribution areas of the all three species greatly overlap (Fig. 1). Nevertheless, all three species were found together only at 7.1 % of all localities, and in an additional 21.4 %, two species were found in syntopy. In other cases, only one species was found in a single locality (Appendix 1).

Temporal and altitudinal distribution

The temporal and altitudinal occurrence phenology of the three studied *Melitaea* species is presented in Figure 2. The adults are active from the beginning of May until the end of July. Nevertheless, the presence of *M. aurelia* was not recorded in approximately the first third of the season (i.e., first record is from 8th of June from Šterna in Croatian Istria).

Specimens of all three studied species of *Melitaea* were found from the lowlands (< 100 m. a.s.l.) to the sub-alpine zone, as high as 1600 m a. s. l., with a shortened period of occurrence at higher elevations, especially on account of the time delay at the beginning of the season. The seasonal occurrence of each of the three species is positively correlated with altitude, meaning that the higher the altitude, the later the data on the first occurrence of *Melitaea*. For all three species pooled together, Pearson's correlation coefficient between the altitude and the date of record ($r = 0.55$) is statistically significant at $p < 0.001$. There is no statistically significant difference (ANOVA, $p > 0.05$) either between the species and dates of recordings, or between the species and altitude.

DISCUSSION

Reliable notes on the geographic distribution of the *Melitaea* species for each of the three countries of the

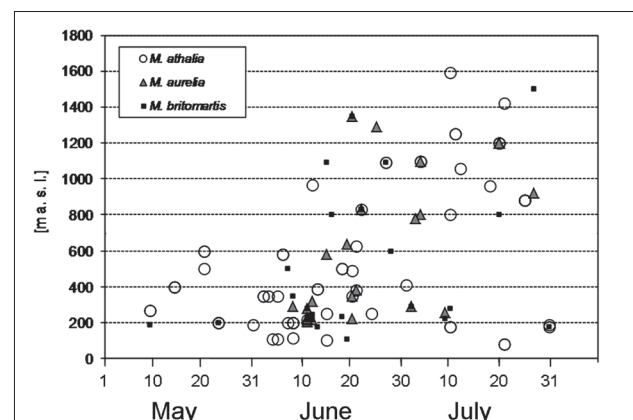


Fig. 2: Temporal and altitudinal occurrence of three *Melitaea* species (*M. athalia*, *M. aurelia*, *M. britomartis*) from the NW Balkans.

Sl. 2: Sezonsko in višinsko pojavljanje odraslih živali treh vrst iz rodu *Melitaea* (*M. athalia*, *M. aurelia*, *M. britomartis*) na področju SZ Balkana.

NW Balkans are scarce due to lack of genitalia-based identification. Nevertheless, the distribution area of all three *Melitaea* species has been shown to be scattered across the whole region. Their wide distribution area was to be expected because most of the feeding plants of the *Melitaea* species (Tolman & Lewington, 2008) are common and widespread in the Balkans. Some of the primary feeding plants (Jonko, 2012) are common for all three species (e.g., *Plantago* spp. and *Veronica* spp. for all the three, with an addition of *Melampyrum nemorosum* for *M. athalia/aurelia*); secondary food plants of *M. athalia* (Jonko, 2012) are also *Valeriana officinalis*, *Polygonum bistorta* and *Centaurea* spp. *M. athalia* is therefore the least specialized of the *Melitaea* species from the NW Balkans. Nevertheless, the proportion of the other two species is somewhat higher than might be expected, and they are by no means rare or local (as suggested by some authors, e.g., Lorković, 2009). There is an indication, however, that in some localities *M. aurelia* or *M. britomartis* can be the dominant (or the only) species of the complex (Appendix 1).

Our sampling covered the whole season of the flight period of the three species. According to Tolman & Lewington (2008) the flight period for *M. athalia* and *M. aurelia* lasts during June and July, and for *M. britomartis*, from late May/Early June until end of July/early August. Our data correspond to the mentioned literature, however the flight period starts earlier in the NW Balkans for *M. athalia* and *M. britomartis*. Although two generations have been reported for *M. britomartis* in some southern localities (e.g., the Ticino Valley in NW Italy; Tolman & Lewington, 2008), no gap between the (two) generations could be seen from our data. According to data from Slovenia (Verovnik *et al.*, 2012), *M. aurelia* and *M. britomartis* fly in a single generation from mid-May until the end of July, with a distinctive peak in the second half of June for the latter. For *M. aurelia*, also a partial second generation was recorded in the Vipava Valley (Verovnik *et al.*, 2012). Adults of *M. athalia*, however, appear mostly in two partially overlapping generations from late April until September, with few fresh specimens observed in September and October that probably belong to a partial third generation (Verovnik *et al.*, 2012).

Our results indicate that the altitudinal distribution of the studied species in the NW Balkans is broader than mentioned from the literature (Tolman & Lewington, 2008; Verovnik *et al.*, 2012): *M. athalia*: 0–800 m a.s.l., occasionally even above 2000 m a.s.l. (Verovnik *et al.*, 2012); *M. aurelia*: 100–1500 m a.s.l. (1600 m: Verovnik *et al.*, 2012); *M. britomartis*: 300–900 m a.s.l. (1250 m: Verovnik *et al.*, 2012). While the data obtained for *M. athalia* and *M. aurelia* are within the already published range, we found *M. britomartis* from 110 up to 1500 m a.s.l. For *M. britomartis*, we can report that the highest known locality from Slovenia was at an elevation of 1350 m a.s.l. (Ambrož Pod Krvavcem, Kamniško Savinjske Alpe), and the absolute highest elevation from

Bosnia and Herzegovina was at an elevation of 1500 m a.s.l. (Troglav Mountain, The Dinarides).

Additional notes on geographic distribution

For Bosnia and Herzegovina, Lelo (2007) reports the country-wide distribution of *M. athalia*, except for the small area in the south-eastern Mediterranean part. According to the same author, *M. aurelia* inhabits the central mountainous part of the country. No data on the presence of *M. britomartis* exists for the country (Lelo, 2000, 2007), or for the wider area of southern part of the NW Balkans (e.g., Jakšić, 1988). Hence, our record from the Bosnian part of Troglav Mountain, Vješić Gora is the first record of this species for Bosnia and Herzegovina. This specimen was collected on dry grassland at the beginning of the hiking path toward the highest peak, Troglav. Only one specimen was observed and collected. Additionally, we would expect that *M. britomartis* is also present in NW Bosnia as it was observed in Croatia in the Hrvatska Kostajnica region, only a few kilometres from the Bosnian border. Thus we predict that its range in Bosnia and Herzegovina is possibly much wider. With this addition and the recent record of *Proterebia afro* (Koren & Trkov, 2011) the butterfly fauna of Bosnia and Herzegovina now includes 192 butterfly species.

As no recent atlas about the butterflies of Croatia exists, the information on the distribution could be discerned from the atlas of the butterflies of Yugoslavia (Jakšić, 1988), and recent faunistic studies (e.g., Mihoci *et al.*, 2007; Koren *et al.*, 2011). According to Jakšić (1988), *M. athalia* is widespread in Croatia which is in line with our survey. Regarding *M. aurelia*, 42 records for Croatia exist (Bohatsch, 1892; Rebel, 1895; Koča, 1900; Abafi-Aigner, 1910; Grund, 1916; Gussich, 1917; Lorković & Mladinov, 1971; Mladinov, 1973; Cribb, 1976; Goossens-Cromphout & Goossens-Cromphout, 1982; Kranjčev, 1985; Hafner, 1994; Mihoci *et al.*, 2007; Marčec, 2008; Ábraham, 2008; Lorković, 2009; Koren & Ladavac, 2010; Koren *et al.*, 2011) but the means of identification are not clearly stated.

Regarding the presence of *M. britomartis* in Croatia, Jakšić (1988) mentions only one locality, in the area of Jospdol near Ogulin in NW Croatia. This record was originally published by Mann (1867), and was later only cited by Abafi-Aigner *et al.* (1896) and Jakšić (1988). Mihoci *et al.* (2007) report *M. britomartis* from the Velebit Mountains, Švica. In this survey *M. britomartis* was collected from 15 different localities (Appendix 1) across Croatia. This indicates a much wider distribution than was previously known. With the addition of our data, we expand the known distribution of *M. britomartis* in Croatia to different regions, including Istria, Dalmatia, Zagorje, Međimurje and Slavonija. It seems that *M. britomartis* is missing from eastern Slavonia and south-eastern Dalmatia, but as those areas were not sufficiently surveyed, the possibility exists that it will be recorded there.

CONCLUSIONS

In the case of the three studied *Melitaea* species, for which their variability sometimes renders them almost impossible to identify using only external morphology, investigating the genitalia morphology is an irreplaceable tool. Our survey has showed that: (1) *M. athalia* is widespread in the whole researched area; (2) *M. aurelia* is more common and widespread than was previously known, especially in Croatia, and (3) *M. britomartis* is widespread in the surveyed regions of Slovenia and Croatia, and was recorded also in Bosnia and Herzegovina. All three species are widely distributed from lowlands to the mountainous belt, frequently occurring

also in sintopy. The proportion of *M. aurelia* and *M. britomartis* that are often treated as rare is quite high, accounting for 28.5 % and 22.7 % of total sample size, respectively.

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NOVI PODATKI O RAZŠIRJENOSTI TREH PODOBNIH VRST IZ RODU *MELITAEA*, *M. ATHALIA*, *M. AURELIA* IN *M. BRITOMARTIS* (LEPIDOPTERA: NYMPHALIDAE), NA PODROČJU SEVEROZAHODNEGA BALKANA

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POVZETEK

V prispevku so zbrani podatki o razširjenosti treh podobnih vrst iz rodu *Melitaea* (Lepidoptera: Nymphalidae) na področju SZ Balkana. V raziskavo smo vključili podatke iz treh držav: Slovenije, Hrvaške ter Bosne in Hercegovine. V preteklih 30 letih je bilo zbranih 123 osebkov metuljev treh podobnih vrst, navadnega pisančka (*M. athalia*), jetičnikovega pisančka (*M. aurelia*) in temnega pisančka (*M. britomartis*). Čeprav za pomoč pri razlikovanju med temi vrstami obstajajo opisi njihove zunanje morfologije in določevalni ključi, smo ugotovili, da visoka morfološka (znotraj- in medvrstna) raznolikost ne omogoča zanesljive določitve. Genitalne preparate smo pripravili za vse živali, vključene v analizo, in jih zanesljivo določili do vrste. Ugotovili smo, da so vse tri vrste razmeroma pogoste, čeprav navadni pisanček s skoraj polovico (48,8 %) vseh analiziranih živali prevladuje. Preostali vrsti sta približno enako zastopani z 28,5 % (*M. aurelia*) in 22,7 % (*M. britomartis*). Vse tri vrste se pogosto pojavljajo sintopo, najdemo pa lahko tudi lokalitete, kjer smo zabeležili vse tri skupaj. Razširili smo znano vertikalno razširjenost za temnega pisančka v Sloveniji do višine 1350 m (Ambrož pod Krvavcem, Kamniško-Savinjske Alpe), sicer pa do višine 1500 m (Troglav, Bosna in Hercegovina). Podatek s Troglava je obenem tudi najjužnejši podatek za to vrsto na območju SZ Balkana in prva najdba za Bosno in Hercegovino. Tudi na Hrvaškem smo znano območje razširjenosti te vrste močno razširili, saj je bila do sedaj (določena na podlagi zunanje morfologije) na Hrvaškem znana le z dveh lokalitet.

Ključne besede: *Melitaea athalia/aurelia/britomartis*, genitalije, razširjenost, Slovenija, Hrvaška, Bosna in Hercegovina

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Appendix 1: Data on sampling localities of three *Melitaea* species (*M. athalia*, *M. aurelia*, *M. britomartis*) from the NW Balkans. Legend: SN = sample number, BIH = Bosnia and Herzegovina, CRO = Croatia, SLO = Slovenia), X, Y = GPS coordinates, M = number of males, F = number of females, Coll. = collection (TK = Toni Koren, Jul = Ivan Jugovic): data for leg. and det. the same, except for cases denoted with asterisk (*), where leg. J. Premrl.

Priloga 1: Podatki o vzorčnih lokalitetah za tri vrste iz rodu *Melitaea* (*M. athalia*, *M. aurelia*, *M. britomartis*) s področja SZ Balkana. Legenda: SN = številka vzorca, BIH = Bosna in Hercegovina, CRO = Hrvaška, SLO = Slovenija, X, Y = GPS koordinata, M = število samcev, F = število samic, Coll. = zbirka (TK = Toni Koren, Jul = Ivan Jugovic): podatki za leg. in det. enaki, razen v primerih, označenih z zvezdico (*), kjer je leg. J. Premrl.

SN	Country	Locality	X	Y	Date	Altitude (m)	Habitat	Syntopic occurrence	Gender	Coll.
<i>Melitaea athalia</i>										
1	BIH	Kupres, Demirovac	5683172	4876659	11.7.1988	1250	mountain grassland		1M, 1F	Jul
2	BIH	Makljen, mountain pass	5709025	4861175	12.7.1988	1060	mountain grassland		1M, 0F	Jul
3	BIH	Šator, Medugorje	5632681	4890062	21.7.2011	1420	mountain grassland		0M, 1F	TK
4	CRO	Grdanjci, Samobor	5549483	5076453	10.7.2010	175	wet grassland	<i>M. britomartis</i>	2M, 0F	TK
5	CRO	Ivanščica, hiking path	5586114	5118082	12.6.2011	967	dry grassland		1M, 0F	TK
6	CRO	Obruč, hiking path »Pod planinu«	5458566	5029635	13.6.2010	390	dry grassland		1M, 1F	TK
7	CRO	Papuk, toward Klinovac	5709760	5041569	21.6.2011	624	woodland edge		1M, 0F	TK
8	CRO	Peščenica, Velika Gorica	5591311	5051891	15.6.2009	105	woodland edge		1M, 0F	TK
9	CRO	Platak, Planinarski dom	5466155	5031809	27.6.2001	1090	alpine grassland	<i>M. britomartis</i>	2M, 0F	TK
10	CRO	Plitvice	5547652	4967041	10.7.1988	-	wet grassland		1M, 0F	Jul
11	CRO	Plovanija, Istra	5393198	5035042	5.6.2011	111	dry grassland		1M, 0F	TK
11	CRO	Plovanija, Istra	5393198	5035042	4.6.2011	111	dry grassland		1M, 0F	TK
12	CRO	Skoblič Brdo, Bosiljevo	5523865	5030113	11.6.2011	215	dry grassland	<i>M. aurelia</i> , <i>M. britomartis</i>	1M, 0F	TK
13	CRO	Šenkovec, Čakovec	5609093	5142392	30.7.2011	175	wet grassland	<i>M. britomartis</i>	0M, 1F	TK
14	CRO	Vela Traba, Pazin	5411485	5012008	2.6.2008	350	dry grassland	<i>M. aurelia</i> , <i>M. britomartis</i>	2M, 0F	TK
14	CRO	Vela Traba, Pazin	5411485	5012008	3.6.2008	350	dry grassland	<i>M. aurelia</i> , <i>M. britomartis</i>	0M, 1F	TK
14	CRO	Vela Traba, Pazin	5411485	5012008	5.6.2008	350	dry grassland	<i>M. aurelia</i> , <i>M. britomartis</i>	0M, 1F	TK
14	CRO	Vela Traba, Pazin	5411485	5012008	20.6.2009	350	dry grassland	<i>M. aurelia</i> , <i>M. britomartis</i>	1M, 0F	TK
15	CRO	Velebit, Zavižan	5498251	4961973	10.7.2002	1594	alpine grassland		0M, 1F	TK
16	CRO	Vugrovec, Zagreb	5586762	5081473	8.6.2008	200	dry grassland	<i>M. britomartis</i>	1M, 0F	TK
16	CRO	Vugrovec, Zagreb	5586762	5081473	24.5.2009	200	dry grassland	<i>M. britomartis</i>	3M, 0F	TK
16	CRO	Vugrovec, Zagreb	5586762	5081473	7.6.2010	200	dry grassland	<i>M. britomartis</i>	1M, 0F	TK
16	CRO	Vugrovec, Zagreb	5586762	5081473	8.6.2010	200	dry grassland	<i>M. britomartis</i>	1M, 1F	TK
17	CRO	Zagreb, Savski nasip	5573958	5071307	8.6.2001	112	wet grassland		1M, 0F	TK
18	CRO	Zmajevac, Baranja	5797019	5081041	21.7.2011	80	dry grassland		0M, 2F	TK

19	CRO	Žumberak, Pilatovci	5523549	5062242	20.6.2009	490	woodland edge		1M, 0F	TK
20	SLO	Bobovek, Kranj	5450705	5125738	15.5.1988	400	grassland		0M, 3F	Jul
21	SLO	Šenčur, near airport Ljubljana	5456256	5121139	21.6.1992	380	grassland & shrubs	<i>M. aurelia</i>	1M, 0F	Jul
22	SLO	Bukovnica, Bukovniško jezero	5602357	5171252	31.5.1991	190	cultivated grassland		1M, 0F	Jul
23	SLO	Čaven	5409270	5088045	4.7.1992	1100	dry grassland	<i>M. aurelia</i> , <i>M. britomartis</i>	2M, 1F	Jul
24	SLO	Črna na Koroškem	5487586	5146958	6.6.2002	580	woodland edge	<i>M. aurelia</i>	1M, 1F	TK
25	SLO	Grad, Goričko	5582925	5184520	10.5.1992	270	-		2M, 0F	Jul
26	SLO	Strmec, Mangart, Julijske Alpe	5393091	5142528	18.7.1992	960	mountain grassland		0M, 1F	Jul
27	SLO	Kobilje, Murska Sobota	5605131	5172643	30.7.1993	190	wet grassland		0M, 1F	Jul
28	SLO	Pševo, Kranj	5447330	5122012	21.5.1972	500	cultivated grassland		0M, 1F	Jul
28	SLO	Pševo, Kranj	5447330	5122012	18.6.1984	500	cultivated grassland		1M, 1F	Jul
29	SLO	Slavnik	5419065	5045274	22.6.1991	830	dry grassland	<i>M. aurelia</i> , <i>M. britomartis</i>	0M, 1F	Jul
30	SLO	Smrekovec	5455326	5084255	15.6.2002	248	-		2M, 0F	TK
31	SLO	Stražišče, Kranj	5447596	5120616	1.7.1984	410	-		0M, 1F	Jul
32	SLO	Završnica	5435616	5142011	20.7.1984	1200	mountain grassland	<i>M. aurelia</i>	3M, 1F	Jul
<i>Melitaea aurelia</i>										
33	CRO	Grabrk, Bosiljevo	5522898	5024839	11.6.2011	230	wet grassland		1M, 0F	TK
34	CRO	Klimen, Konščina	5590333	5106635	11.6.2010	220	wet grassland	<i>M. britomartis</i>	1M, 0F	TK
34	CRO	Klimen, Konščina	5590333	5106635	20.6.2009	220	wet grassland	<i>M. britomartis</i>	1M, 0F	TK
35	CRO	Lomska Duliba, Velebit	5501560	4959268	25.6.2009	1292	alpine grassland		1M, 0F	TK
36	CRO	Mali Komor, Zagorje	5579587	5106815	9.7.2011	255	dry grassland		0M, 1F	TK
37	CRO	Novi Golubovec, Zagorje	5576317	5114684	12.6.2011	320	dry grassland		1M, 1F	TK
38	CRO	Orišje, Bosiljevo	5522896	5029172	12.6.2011	215	dry grassland	<i>M. britomartis</i>	1M, 0F	TK
12	CRO	Skoblič Brdo, Bosiljevo	5523865	5030113	11.6.2011	215	dry grassland	<i>M. athalia</i> , <i>M. britomartis</i>	1M, 0F	TK
39	CRO	Šterna, Istra	5404566	5030623	8.6.2011	293	dry grassland		1M, 0F	TK
40	CRO	Varoš, Bosiljevo	5522522	5029364	11.6.2011	206	dry grassland		1M, 0F	TK
14	CRO	Vela Traba, Pazin	5411485	5012008	20.6.2009	350	woodland edge	<i>M. athalia</i> , <i>M. britomartis</i>	1M, 0F	TK
41	CRO	Zrmanja Vrelo, Gračac	5513001	4895146	2.7.2010	290	-	<i>M. britomartis</i>	0M, 1F	TK
21	SLO	Šenčur, near airport Ljubljana	5456256	5121139	21.6.1992	380	grassland & shrubs	<i>M. athalia</i>	0M, 1F	Jul
23	SLO	Čaven	5409270	5088045	4.7.1992	1100	dry grassland	<i>M. athalia</i> , <i>M. britomartis</i>	1M, 0F	Jul
24	SLO	Črna na Koroškem	5487586	5146958	15.6.2002	580	dry grassland	<i>M. athalia</i>	1M, 0F	TK
42	SLO	Črni kal	5412693	5045611	26.5.1975	-	dry grassland		1M, 0F	Jul*
43	SLO	Dom v Dragi, Draga, Begunje	5439927	5138585	4.7.1993	800	grassland		0M, 1F	Jul

44	SLO	Javornik, Kranj	5445746	5121595	19.6.1994	640	cultivated grassland		1M, 0F	Jul
45	SLO	Ambrož, Kravec, Kamniške Alpe	5463371	5126537	20.6.1992	1350	grassland & shrubs	<i>M. britomartis</i>	1M, 0F	Jul
46	SLO	Sv. Jošt, Kranj	5446049	5122185	3.7.1995	780	grassland		1M, 0F	Jul
29	SLO	Slavnik	5419065	5045274	22.6.1991	830	dry grassland	<i>M. athalia</i> , <i>M. britomartis</i>	2M, 0F	Jul
47	SLO	Vremščica	5426322	5060845	27.7.1995	920	dry grassland		1M, 0F	Jul
48	SLO	Zadvor, Ljubljana	5468719	5099919	11.6.2011	280	woodland edge	<i>M. britomartis</i>	1M, 0F	TK
32	SLO	Završnica	5435616	5142011	20.7.1984	1200	alpine grassland	<i>M. athalia</i>	9M, 1F	Jul
<i>Melitaea britomartis</i>										
49	BIH	Troglav, Vještici Gora	5629438	4865960	27.7.2011	1500	alpine grassland		1M, 0F	TK
4	CRO	Grdanjci, Samobor	5549483	5076453	13.6.2011	175	wet grassland	<i>M. athalia</i>	1M, 0F	TK
50	CRO	Hrvatska Kostajnica	5618449	5009397	19.6.2011	110	dry grassland		1M, 0F	TK
51	CRO	Jovac, Hrvatska Kostajnica	5616039	5004984	18.6.2011	235	wet grassland		1M, 0F	TK
34	CRO	Klimen, Konščina	5590333	5106635	11.6.2011	220	wet grassland	<i>M. aurelia</i>	1M, 0F	TK
38	CRO	Orišje, Bosiljevo	5522896	5029172	12.6.2011	215	dry grassland	<i>M. aurelia</i>	1M, 0F	TK
52	CRO	Pažurovec, Zagorje	5591436	5110791	9.7.2011	220	dry grassland		0M, 1F	TK
9	CRO	Platak, Planinarski dom	5466155	5031809	15.6.2002	1090	mountain grassland	<i>M. athalia</i>	1M, 0F	TK
9	CRO	Platak, Planinarski dom	5466155	5031809	27.6.2002	1090	mountain grassland	<i>M. athalia</i>	1M, 0F	TK
53	CRO	Podrute, Novi Marof	5596886	5113393	10.7.2011	280	woodland edge		1M, 0F	TK
54	CRO	Radoboj, Malogorski	5571673	5114812	12.6.2011	245	dry grassland		1M, 0F	TK
55	CRO	Rupa, Rijeka	5443502	5038328	7.6.1982	500	dry grassland		1M, 0F	Jul*
12	CRO	Skoblič Brdo, Bosiljevo	5523865	5030113	11.6.2011	215	dry grassland	<i>M. athalia</i> , <i>M. aurelia</i>	2M, 0F	TK
13	CRO	Šenkovec, Čakovec	5609093	5142392	30.7.2011	175	wet grassland	<i>M. athalia</i>	1M, 0F	TK
14	CRO	Vela Traba, Pazin	5411485	5012008	8.6.2008	350	dry grassland	<i>M. athalia</i> , <i>M. aurelia</i>	1M, 0F	TK
16	CRO	Vugrovec, Zagreb	5586762	5081473	24.5.2010	200	dry grassland	<i>M. athalia</i>	1M, 0F	TK
41	CRO	Zrmanja Vrelo, Gračac	5585027	4895475	2.7.2010	290	wet grassland	<i>M. aurelia</i>	1M, 0F	TK
23	SLO	Čaven	5409270	5088045	19.6.1978	800	dry grassland	<i>M. athalia</i> , <i>M. aurelia</i>	1M, 0F	Jul*
23	SLO	Čaven	5409270	5088045	28.6.1982	600	dry grassland	<i>M. athalia</i> , <i>M. aurelia</i>	0M, 1F	Jul*
45	SLO	Ambrož, Kravec, Kamniške Alpe	5463371	5126537	20.6.1992	1350	grassland & shrubs	<i>M. aurelia</i>	0M, 1F	Jul
29	SLO	Slavnik	5419065	5045274	22.6.1991	830	dry grassland	<i>M. athalia</i> , <i>M. aurelia</i>	3M, 1F	Jul
29	SLO	Slavnik	5419065	5045274	16.6.1969	800	dry grassland	<i>M. athalia</i> , <i>M. aurelia</i>	1M, 0F	Jul*
56	SLO	Veščica, Ormož	5597409	5153326	10.5.1992	190	wet grassland		1M, 0F	Jul
48	SLO	Zadvor, Ljubljana	5468719	5099919	11.6.2011	280	woodland edge	<i>M. aurelia</i>	1M, 0F	TK