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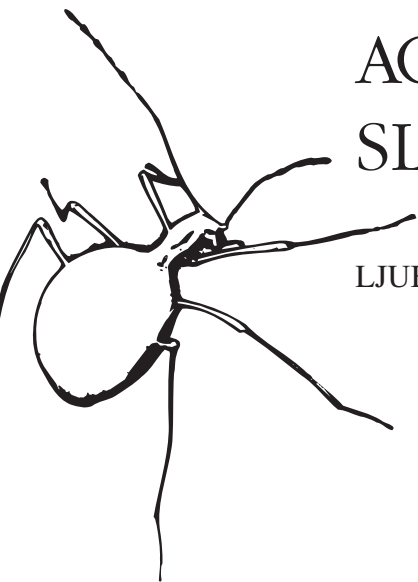
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ŠTEFANA MICHIELIJA

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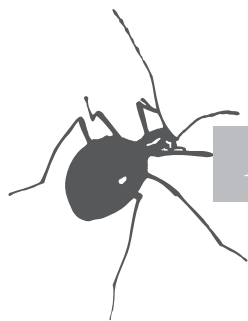
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**DIVERSITY OF ORTHOPTERA
IN THE SOUTH-WESTERN KARST-REGION OF SLOVENIA
WITH NOTES ON ACOUSTICS AND SPECIES IDENTIFICATION**

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Dedicated to Professor Norbert Elsner and Professor Nada Gogala; Norbert Elsner initiated these excursions, organized them with high enthusiasm and took part up to 2008; we mourn his early death in 2011; Nada Gogala was a wonderful host for us and many students therefore giving a brilliant example for Slovenian hospitality; we mourn her unexpected death in 2013.

Abstract - An area around Brje pri Komnu in the Karst region of Slovenia has been visited between 1995 and 2009 usually for about 10 days in June or July. During these visits Orthoptera have been studied in some detail emphasizing species identification and acoustic behaviour. A species list is provided and – focussing on sibling species – some identification problems and aspects of biology are described. Supplementary lists of cicada and bird species encountered at the same time are provided as well.

KEY WORDS: Orthoptera, Karst, Bioacoustics, *Barbitistes*, *Pachytrachis*, Slovenia

Izvleček - RAZNOVRSTNOST RAVNOKRILCEV V JUGOZAHODNEM KRAŠKEM DELU SLOVENIJE Z ZAPISKI O AKUSTIKI IN DOLOČANJU VRST

V obdobju med leti 1995 in 2009, navadno po 10 dni v juniju oz. juliju, smo obiskovali področje v okolici Brja pri Komnu na slovenskem Krasu. Raziskovali smo ravnokrilce (Orthoptera) s poudarkom na identifikaciji vrst in njihovem akustičnem vedenju. V članku predstavljamo seznam vrst, predvsem v primeru sestrskih vrst pa tudi posamezne probleme njihove identifikacije in vidike biologije. Dodajamo tudi vrstni seznam ptic in škržadov, na katere smo naleteli v času raziskav.

KLJUČNE BESEDE: Orthoptera, Kras, Bioakustika, *Barbitistes*, *Pachytrachis*, Slovenija

Introduction

Due to the constantly growing pressure of human civilization on nature, studying biodiversity has gained increasing interest during the last decades (e.g. Singh 2002, Luck 2007). A common scheme that crystallizes from many studies is – not unexpectedly – that a landscape rich in structures and plant diversity is able to house more animal species, like arthropods, than agriculturally intensely used areas (often with large areas of monocroppings; e.g. Perfecto et al. 1997, Hong-Jiao et al. 2007, Marini et al. 2008). The Karst region of Slovenia lies in the South-Western part of the country and includes a large region with predominantly rural appearance. Here, small vineyards, small farms for various crops and bushy areas or smaller forests are interspersed in a hilly landscape (see e.g. Gogala 2003). Such regions should be able to house certain richness in biodiversity – in plants as well as in animals (Tuyet 2001, Griffith et al. 2004, Clements et al. 2006). Since agriculture is rather extensive and since in the Karst region no superficial waters occur, the fields and meadows are not eutrophic and more or less dry grassland is widespread. This seems to be ideal for many Orthoptera species (e.g. Sergeev 1998, Braschler et al. 2009). We studied the occurrence of Orthoptera (= Saltatoria; grasshoppers, crickets, bushcrickets and allies) with a focus on the area around Brje pri Komnu, which we visited for yearly excursions between the years 1995 and 2009. The excursion with advanced students from the Georg-August-University in Göttingen, Germany, typically took place for ten days between mid-June and mid-July. Occasional visits at later times of the year occurred as well. The excursions focussed on acoustically active animals; therefore, in addition to Orthoptera, we also noted the presence of singing cicadas and of birds (see supplementary tables).

Material and Methods

The area visited is indicated in Fig. 1. We visited the site at the following times: June 17–25 1995, June 23–30 1996, June 21–29 1997, June 21–28 1998, July 4–11 1999 and August 7, 8 and 21 1999, June 16–25 2000, July 15–24 2001, July 18–28



Fig. 1: Map of the Karst region of Slovenia with the gross area studied delimited by the red line (license: GURS).

2003 (extremely hot and dry year), June 18–27 2006, June 16–27 2008, July 5–14 2009. Typical views and habitats of the area are shown in Fig. 2.

Orthoptera were studied by listening to their songs and recording them as well as by catching them, determining their species identity and mostly releasing them in the field, while some were preserved for collection or later identification. For studying we used magnifying glasses (10x) and stereo-microscopes (WILD M3, WILD M5, ZEISS Stemi SV 6). Taxonomic literature with keys used for identification was Harz (1969, 1975), Us (1992), Ragge and Reynolds (1998), Bellmann (1993), Corey and Thorens (2001). Orthopteran taxonomy and systematics largely follows Eades et al.

(2015). For recording we used a set of two microphones, one specialized for lower frequencies, one for ultrasound, together with a parabolic screen from flexible PVC, amplifier and headphones (Telinga ProIII, Sweden). The microphone output was in some occasions connected to an ultrasound detector (Pettersson D120, Sweden). Alternatively, we used a Brüel & Kjaer ½" condenser microphone (4130) and a portable Brüel & Kjaer amplifier type 2804. Recordings were made either on a DAT-recorder (Pioneer D-C88, 96 kHz sampling rate) or on various Mini-Disc-recorders. The recorded songs were analysed on an oscilloscope (Hameg 205) or after digitisation (Cool Edit, Syntryllium) on notebooks. Photographs were taken using a Nikon-SLR with macro-lens or a Canon digital camera (Powershot 3, S5 IS). Cicadas were identified by their songs according to Gogala (1998) and a PC-presentation kindly provided by Matija Gogala. For bird identification several standard field guides were used.

Results and discussion

List of species, with some notes on their acoustic signals and behaviour

Table 1 and 2 give a list of Orthoptera including the years, when they were encountered. Altogether we identified 58 species: 5 species of crickets, 30 species of other Ensifera (mostly bush crickets) and 23 species of Caelifera. The species observed most frequently, and also the dominant species in the majority of years (see also Fig. 3), were the cricket *Melanogryllus desertus* (Pallas, 1771), the phaneropterid katydids *Barbitistes ocskayi* (Charpentier, 1850) and *Poecilimon ornatus* (Schmidt, 1850), the tettigoniid bush crickets *Eupholidoptera schmidtii* (Fieber, 1861), *Bicolorana kuntzeni* (Ramme, 1931), *Pachytrachis striolatus* (Fieber, 1853), *Pholidoptera littoralis* (Fieber, 1853), and *Tettigonia viridissima* (Linnaeus, 1758), and the acridid grasshoppers *Euchorthippus declivus* (Brisout de Barneville, 1848), *Odontopodisma schmidtii* (Fieber, 1853), *Omocestus rufipes* (Zetterstedt, 1821) and *Stenobothrus rubicundus* (Germar, 1817). Further characteristic species, but typically occurring in smaller numbers, are the bush crickets *Decticus verrucivorus* (Linnaeus, 1758), Tettigoniidae, *Barbitistes yersini* (Brunner, 1878) and *Polysarcus denticauda* (Charpentier, 1825), both Phaneropteridae, the acridid grasshopper *Kisella irena* (Fruhstorfer, 1921) and the pamphagid grasshopper *Prionotropis hystrix hystrix* (Germar, 1817). Interestingly, they represent a diverse group of species not only in their ecology and general behaviour, but also seen under the light of acoustic communication. A student report from the research camp Dekani 2004 (Koce, 2005) listed 22 species in two localities close to our research area including only one species that we did not find, namely the tettigoniid *Modestana modesta* (Fieber, 1853).

- *Pholidoptera littoralis* is widely distributed in the study area and typically hidden in the vegetation on or close to the ground. Singing males have been reported at maximum heights between 0.6 and 1.2 m (Keuper et al. 1986). Males can be heard all day and parts of the night and show a clear incitement to songs of other males. They usually do not sing synchronously but repeatedly in sequence with three to five males involved. These sequences (e.g. which male starts) appear to be stable at certain times,

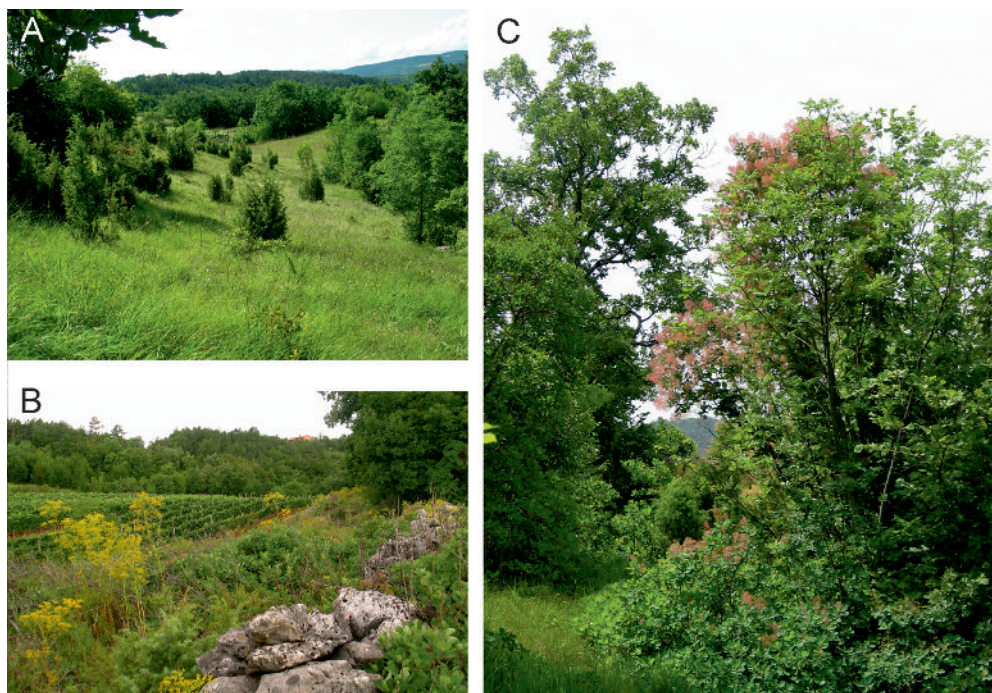


Fig. 2: Photos of typical habitats in the Karst region housing numerous Orthoptera. A) Meadows with bushes on slopes; these are typically used for making hay only. B) Vineyards with the typical stony fences around them. Also some relatively loose forests are found, in which e.g. caves with *Troglophilus neglectus* may occur or bushes with *Pholidoptera griseoaptera* or grassy areas with *Gomphocerus rufus*. C) Bushes (*Cotinus*, *Fraxinus*) in which the *Barbitistes* species are very typical, but also *Tettigonia viridissima* or *Eupholidoptera schmidtii*.

but hierarchies, when tested with the same individuals over several days, are not stable. This behaviour appears to be common in Pholidopterini (Jones 1966) and involves some degree of aggressive rivalry and territoriality. It is also found in the more alpine relative *Pholidoptera aptera* (Fabricius, 1793), an abundant species in the Kucelj area North of the region studied here.

- *Bicolorana kuntzeni* (synonymous: *Metriopectera kuntzeni*; Fig. 3I) is mostly singing during the days. Its song spectrum lies mainly in the ultrasound. If one uses an ultrasound detector, the scenery during the day is dominated by *B. kuntzeni*'s nearly uninterrupted song (reminding of a helicopter).

- *Poecilimon ornatus* (Fig. 3 A-C) is a widespread species with reduced wings – more frequently found in the denser and slightly more humid vegetation. Males sing very short one-syllabic songs with receptive females responding (see Heller and von Helversen 1986, Helversen et al. 2001). Acoustic communication may occur over 20 m or so.



Fig. 3: Photos of various orthopteran species: A) – C) Females of *Poecilimon ornatus* (Po); D) Female of *Polysarcus denticauda* (Pd); E) Male and F) female, carrying a male of *Prionotropis hystrix* (Ph); G) Male of *Odontopodisma schmidtii*; H) Female and male of *Kisella irena*; I) Female of *Bicolorana kuntzeni*; K) Male and L) – N) females of *Stenobothrus rubicundus* (Sr).

- The two *Barbitistes* species *B. ocskayi* and *B. yersini* (see Fig. 4 and below), brachypterous as well, are living in bushes and show extreme variations in density over the years (mainly occurring in June as adults). In some years they are rarely found, in other years one may find several individuals, often sitting less than 20 cm apart in each bush of the many host plants they may occur on. In both species males mainly sing during the days and early night and receptive females may reply to males many meters away.

- *Stenobothrus rubicundus* (synonymous: *S. rubicundulus*; Fig. 3K-N) is a species with mainly montane distribution, but in Slovenian Istria it also occurs down to about 250 m above NN (Koce, 2005). Its behaviour is quite spectacular, with males courting in the sun and producing song flights in which the forewings are clapped together producing loud sound (see e.g. Elsner and Wasser 1995). It occurs in high densities in meadows. Its colouration (especially among females) may vary widely from green/brown, to combinations of brown to mostly purple (Fig. 3).

- The species with the most complex song – only paralleled by songs of some cicadas or grasshoppers – is the large *Polysarcus denticauda*. This rare insect is adult early in the year. Males sing their multi-component song often also during walking (see Heller 1988, Kalmring et al. 1997). Females (Fig. 3D) can easily be confused with female *Poecilimon ornatus* (see below and Fig. 3A-C).

- *Odontopodisma schmidti* (Fig. 3G) and *Kisella irena* (Fig. 3H) are living in bushes, which is quite unusual for grasshoppers. Neither of them produces songs. *Kisella* is often seen in pairs, with mate guarding males sitting on females (Fig. 3H). Also the large and spectacular grasshopper *Prionotropis hystrix hystrix* is often encountered as such pairs in the field (Fig. 3E, F), with the considerably larger females carrying a male on the back. It is found on few places only like on exposed meadows close to Škofi, but never in large numbers. A conspicuous structure well seen on the outer cuticle of the second abdominal segment is the “Krauss’ organ”, which appears to have a function in stridulation (Massa 2012).

Some comments on species identification

The majority of species are easy to identify, while for some species identification is more difficult due to sibling species.

- Phaneropteridae: Barbitini: *Barbitistes*

Barbitistes ocskayi and *B. yersini* are two members of the Barbitistini of great morphological similarity. The easiest criterion for species identity is the song, described in detail by Meyer and Stumpner (2000). Even though their distribution indicates slightly different preferences of the two species, we could not identify any clear criterion, what parameters differed. Both species have been found on a number of bushes, which they obviously also use as forage plants (see also Fig. 2); these are mainly *Cotinus coggygria* and *Fraxinus ornus*, but also thirteen more plant species (*Asparagus acutifolius*, *Cornus mas*, *Crataegus spec.*, *Juniperus communis*, *Ligustrum vulgare*, *Prunus mahaleb*, *Quercus pubescens*, *Paliurus spina-christi*, *Pistacia terebinthus*, *Rubus spec.*, *Ulmus spec.*, *Viburnum lantana*, *Vitis vinifera*). On a single bush both species regularly occur in immediate vicinity. Nevertheless, in all the years we found no indication that hybridisation might occur – neither from morphology, nor from songs. The overall shape of the body differs in the two species, with *B. yersini* having a more rounded back and *B. ocskayi* having an even to saddle like back (especially obvious in some males; Fig. 4A, D, E). The most prominent character to discriminate among the males of the two species is a protrusion of the subgenital plate, which is very prominent in *B. ocskayi*, but much less clearly expressed in *B. yersini*.

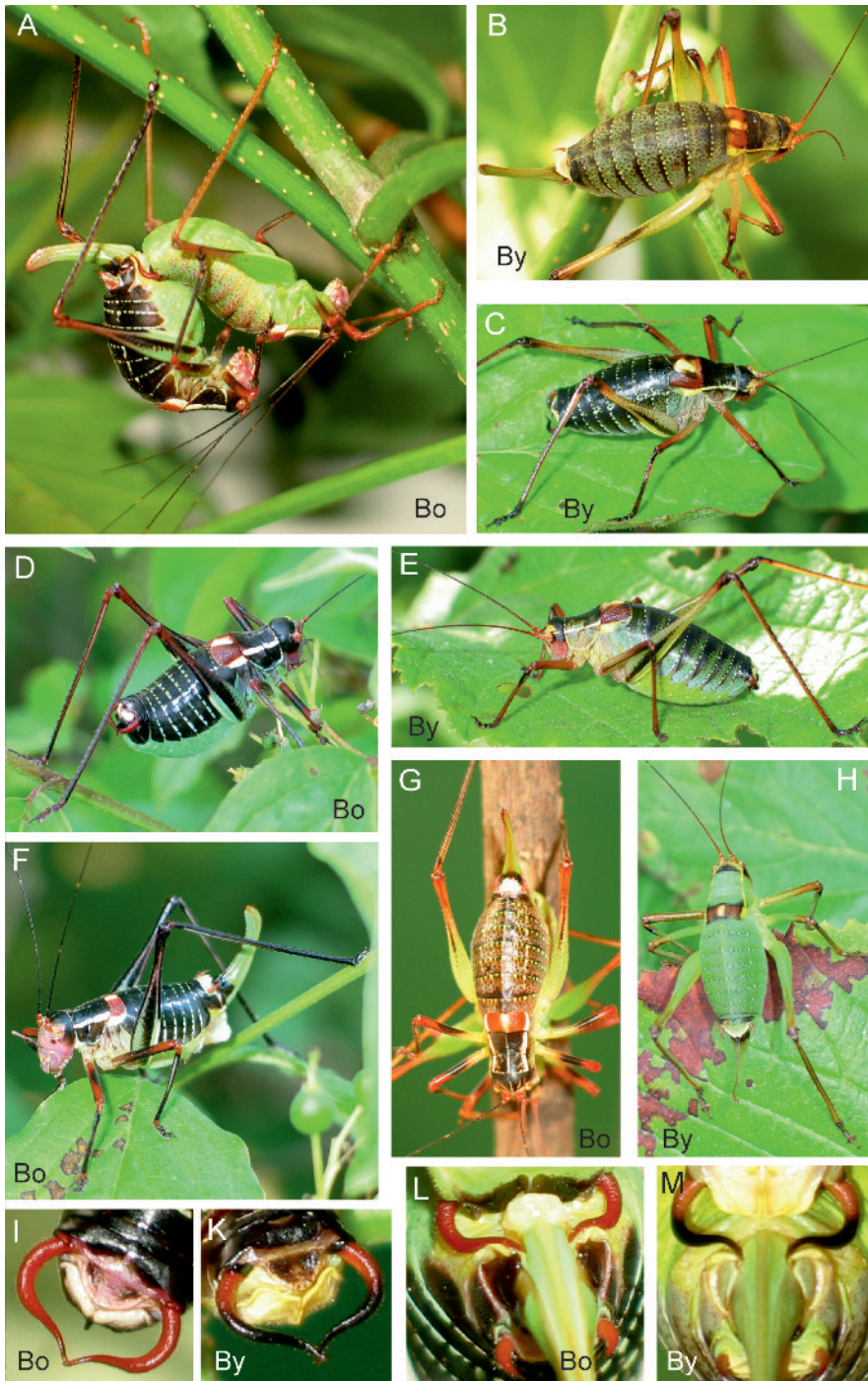


Fig. 4: Photos of *Barbitistes ocskayi* (Bo) and *B. yersini* (By) giving examples for typical differences in colouration, shape of male terminal segment and cerci. A) Precopulatory behaviour of *B. ocskayi*. The male cerci are attached to the female ovipositor and the male subgenital plate is introduced into the female genital opening. B) – E) Examples for different colouration. F) A dark *B. ocskayi* female with a spermatophore attached to its ventral base of the ovipositor. G) A light-coloured female *B. ocskayi* sitting on a male in the precopulatory phase. I), K) Tip of male abdomen with cerci (note the difference in colouration and the much more elevated protrusion on the subgenital plate in *B. ocskayi*). L), M) Attachment of the male cerci to the female base of the ovipositor in both species.

(Fig. 4I, K). This protrusion obviously has a function in precopulatory sperm removal, when the subgenital plate is introduced into the female genital opening (von Helversen and von Helversen 1991, see also Fig. 4A, L). The distal part of the male cerci, which are used for grabbing the female ovipositor at its base (see Fig. 4A, L, M), is less evenly curved on the outside in *B. ocskayi* than in *B. yersini*. In addition to the body shape and colouration (see below), the posterior margin of the hindwings differs in both sexes, being rather straight in *B. ocskayi* and more curved in *B. yersini* (Fig. 4 B-H). Both species vary extensively in colouration from nearly completely light green (only females) to mostly black or brown with dark green or red portions (Fig. 4 A-H). This general variation seems to be correlated with density, as in years with high density (distances of below about 1 m between individuals are frequent) darker individuals are more frequent, while in years with low density (often only single individuals are seen on one bush) lighter colours prevail (e.g. Applebaum and Heifertz 1999). This is corroborated by rearing tests with eggs collected from wild captures: these animals reared in the laboratory always were extremely dark. Nevertheless, there are some consistent differences in colouration between the two species. *B. ocskayi* always have a black ring or dorsal and ventral spot on the pro- and mesofemur. Proximal and distal of this spot, the femur is red in dark animals, proximally red or greenish in light animals (Fig. 4D, F, G). In mostly green individuals the dark spots may be reduced to minimal size on the ventral femur. In contrast, *B. yersini* does not have a separate dark spot, but the femur gets increasingly darker towards the knee. The proximal tibia is dark as well (Fig. 4B, C, E). In light green animals at least the area around the tympana is dark (Fig. 4H). Only in very dark *B. yersini* the femur may be dark up to the middle area where *B. ocskayi* has a dark spot. All in all, the colours of *B. ocskayi* are brighter and more brilliant, while those of *B. yersini* are more moderate. *B. ocskayi* may have artificially looking “plastic”-green colour, most strongly expressed on the ventral abdomen (see Fig. 4A, D), which is never seen in *B. yersini* whose abdomen usually is some shade of (greenish) yellow. The epiproct of *B. ocskayi* is distinctly lighter coloured as a whole than the surrounding cuticle, often nearly pure white, while the epiproct of *B. yersini* is often as dark as the neighbouring cuticle and lighter only at the edges; in light green animals it is more yellow to greenish (Fig. 4B, C, F-K). This is more obvious in females than in males. Light markings on wings have similar colouration as the epiproct, so that wings of *B. ocskayi* are more red with white, those of *B. yersini* are more brownish

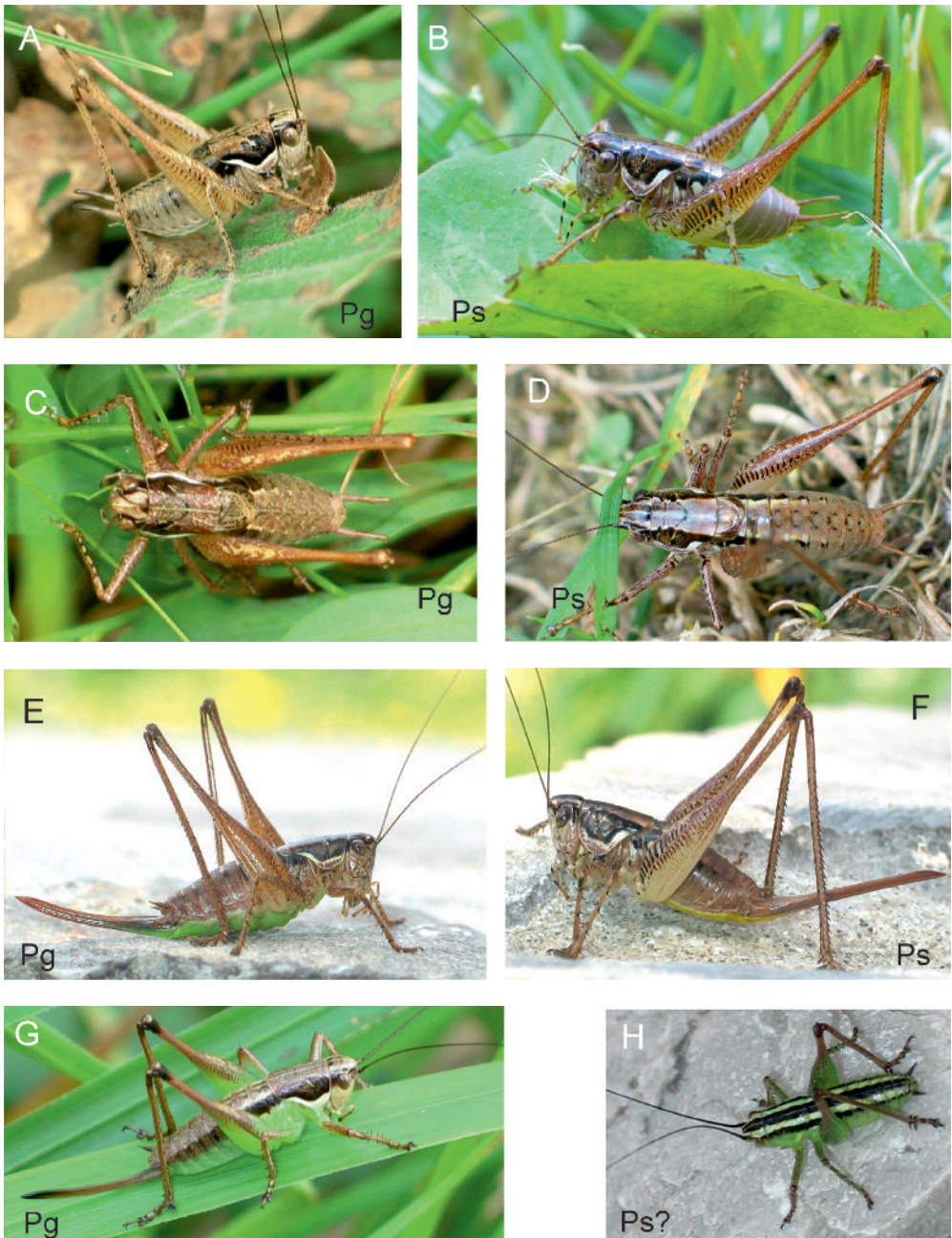


Fig. 5: *Pachytrachis gracilis* (Pg) male (A, C) and female (E, G) and *P. striolatus* (Ps) male (B, D) and female (F). H) A typically coloured smaller immature *Pachytrachis*, likely *P. striolatus*.

red with yellow (e.g. Fig. 4C, D). The antennae are annulated with alternating dark and lighter rings. In *B. ocskayi* the lighter rings are whitish (to reddish in very dark animals) and much smaller than the long darker rings. In *B. yersini* the lighter rings are always reddish and even smaller than in *B. ocskayi* and therefore less obvious.

- Phaneropteridae: Barbistini: *Poecilimon ornatus*/ *Polysarcus denticauda*

Males of the two large species have a number of obvious differences: The most prominent and eponymous for *P. denticauda* is the elongated subgenital plate standing up between the cerci. Females of the two species can more easily be confused. *P. denticauda* females are larger and have a long pronotum, which is longer than the fore tibiae. As a consequence, also the short forewings are nearly completely covered by the pronotum, while the distal part of the front wings is well visible in *P. ornatus* females. *P. denticauda* females (and males) in the study area have been always green (but are reported to vary widely with a tendency to be dark in populations of high density, e.g. Chobanov and Heller, 2010), while those of *P. ornatus* can be green to colourful green/yellow/brown to very dark (Fig. 3A-C).

- Tettigoniinae: Platycleidini: *Pachytrachis*

Two species of *Pachytrachis* are regularly found in the area, *P. gracilis* and *P. striolatus* (Fig. 5). There are some reliable morphological characters (see also Ingrisch and Pavičević 2010), mostly the shape of the male cerci (straight, slightly thickened at the tip in *P. gracilis*, but slightly curved, flattened in the middle in *P. striolatus*) and the shape of the female ovipositor (upwards curved in *P. gracilis*, but straight, with an oblique end – ventral tip longer – in *P. striolatus*) (see Fig. 5). Already Brunner von Wattenwyl (1861) mentioned some difference in colouration, with *P. gracilis* having a more yellowish margin on the pronotum and more uniformly coloured hind femora than *P. striolatus*. We, however, found that the easiest accessible and quite reliable character in adults is the colour of the ventral abdomen: green in *P. gracilis* and yellow in *P. striolatus*. Whether this is true also for instars, we do not know. At least larger instars of *P. gracilis* are green over most of the ventral body (see Fig. 5). Small instars of *Pachytrachis* are high-contrast striped green-black (Fig. 5), but we could not reveal their species identity.

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Table 1: List of Ensifera in the Western Karst region of Slovenia. The years in which the respective species was encountered, is indicated as grey box with lv = only larval stages found; on the right a more generalized abundance is indicated (r = rare, only single individuals encountered; + = few individuals, but seen on several locations; ++ = typically more than one individual seen on one spot; +++ = many individuals seen on one spot, interindividual distance often less than 50 cm. + to +++ = in some years only few individuals, in others many; ??? means: this species may be more abundant later in the year. R, V, E1, E2 following the species names are criteria for listing endangered species (red lists of endangered species of Slovenia; URRS, št. 82/2002) with R = rare, V = vulnerable, E1 = critically endangered, E2 = strongly endangered.

Crickets:	95	96	97	98	99	00	01	03	06	09	abundance
<i>Gryllotalpa gryllotalpa</i>											r
<i>Gryllus campestris</i>											++
<i>Melanogryllus desertus</i>											+++
<i>Modicogryllus</i> (<i>Tartarogryllus</i>) <i>burdigalensis</i>											+
<i>Oecanthus pellucens</i>											+
other Ensifera:	95	96	97	98	99	00	01	03	06	09	
<i>Acrometopa servillea</i> / <i>macropoda</i> (V)	lv		lv			lv			lv		+ to ++
<i>Barbitistes ocskayi</i>											r to +++
<i>Barbitistes yersini</i>											r to +++
<i>Bicolorana kuntzeni</i>											+++
<i>Cyrtaspis scutata</i>								lv			???
<i>Decticus albifrons</i>										lv	r
<i>Decticus verrucivorus</i>											+ to +++
<i>Ephippiger discoidalis</i>											r
<i>Eupholidoptera schmidtii</i> (= <i>Eupholidoptera</i> <i>chabrieri</i>)											++ to +++
<i>Leptophyes laticauda</i>			lv			lv					r to ++
<i>Meconema thalassinum</i>											r
<i>Pachytrachis gracilis</i>											+
<i>Pachytrachis striolatus</i>	lv					lv			lv		++
<i>Phaneroptera nana</i>							lv				r
<i>Pholidoptera fallax</i>											r
<i>Pholidoptera griseoaptera</i>											+
<i>Pholidoptera littoralis</i>											(+ to) +++
<i>Platycleis grisea</i> (<i>/albopunctata</i>)											r
<i>Platycleis</i> (undetermined)				lv	lv	lv					++
<i>Poecilimon elegans</i> (V)										lv	+
<i>Poecilimon ornatus</i> (V)											r to +++

<i>Polysarcus denticauda</i>											r to ++
<i>Rhacocleis germanica</i>											+
<i>Ruspolia nitidula</i>							lv			lv	+
<i>Saga pedo</i> (E1)			lv		lv						r
<i>Sepiana sepium</i>						lv			lv		+ to ++
<i>Tettigonia viridissima</i>											+++
<i>Troglophilus neglectus</i> *											r to +++
<i>Tylopsis liliifolia</i> (V)					lv	lv				lv	+
<i>Yersiniella raymondi</i>											r

* In case of *Troglophilus neglectus* (cave cricket) data relate mostly to detection of the species in an artificial tunnel close to Brje pri Komnu (about 200 m towards Gorjansko, left to the main road).

Table 2: List of Caelifera in the Western Karst region of Slovenia. For abbreviations see table 1.

Caelifera:	95	96	97	98	99	00	01	03	06	09	abundance
<i>Aiolopus strepens</i>											r
<i>Anacridium aegypticum</i> (R)											r
<i>Arcyptera fusca</i>											r to +
<i>Calliptamus italicus</i>				lv					lv		+ to +++
<i>Chrysochraon brachyptera</i> (many holopterous!)											++
<i>Chorthippus biguttulus</i>											+
<i>Chorthippus brunneus</i>											+
<i>Chorthippus dorsatus</i>											r
<i>Chorthippus parallelus</i>											r
<i>Euchorthippus declivus</i>											+++
<i>Gomphocerus rufus</i>											+
<i>Kisella irena</i> (= <i>Miramella irena</i>)											+
<i>Myrmeleotettix maculatus</i>											r
<i>Odontopodisma fallax</i>											r
<i>Odontopodisma schmidtii</i>											++
<i>Oedipoda caerulea</i>	lv								lv		+
<i>Omocestus haemorrhoidalis</i>											
<i>Omocestus rufipes</i>											+ to +++
<i>Pezotettix giornae</i>											r
<i>Prionotropis hystrix hystrix</i> (E2)											+
<i>Stenobothrus lineatus</i>											+ to ++
<i>Stenobothrus nigromaculatus</i> ssp. <i>istrianus</i>											r
<i>Stenobothrus rubicundus</i> (syn. <i>S. rubicundulus</i>)											++ to +++

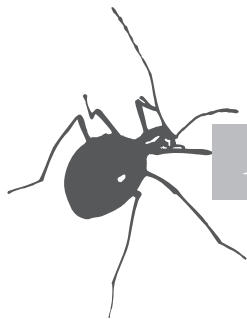
Supplementary material:

Table S1 gives a list of singing cicadas noted in the area

Species	in how many years detected (out of 10):
<i>Cicada orni</i>	5
<i>Cicadetta tibialis</i> (new: <i>Cicadivetta tibialis</i>)	1
<i>Lyrister plebejus</i>	5
<i>Tettigetta brullei</i> (new: <i>Tettigettula pygmea</i>)	5
<i>Tettigetta dimissa</i> (new: <i>Dimissalna dimissa</i>)	5
<i>Tettigetta argentata</i> (new: <i>Tettigettalna argentata</i>)	4
<i>Tibicina haematodes</i>	5

Table S2 gives a list of birds noted in the area

Species Non passerines	in how many years (out of 9):	Song birds	(no. of years):
<i>Buteo buteo</i>	8	<i>Sitta europaea</i>	3
<i>Pernis apivorus</i>	3	<i>Certhia brachydactyla</i>	1
<i>Accipiter nisus</i>	3	<i>Aegithalus caudatus</i>	2
<i>Streptopelia decaocto</i>	7	<i>Turdus merula</i>	6
<i>Streptopelia turtur</i>	6	<i>Turdus viscivorus</i>	1
<i>Columbus livia domestica</i>	2	<i>Erithacus rubecula</i>	7
<i>Caprimulgus europaeus</i>	9	<i>Muscicapa striata</i>	8
<i>Otus scops</i>	6	<i>Phoenicurus ochruros</i>	4
<i>Strix aluco</i>	1	<i>Luscinia megarhynchos</i>	5
<i>Upupa epops</i>	6	<i>Lanius collurio</i>	5
<i>Cuculus canorum</i>	5	<i>Silvia atricapilla</i>	6
<i>Apus apus</i>	7	<i>Hippolais polyglotta</i>	2
<i>Apus albus</i>	1	<i>Acrocephalus palustris</i>	1
<i>Dendrocopos major</i>	5	<i>Oriolus oriolus</i>	9
<i>Dendrocopos minor</i>	1	<i>Sturnus vulgaris</i>	4
<i>Picoides viridis</i>	3	<i>Corvus cornix</i>	5
<i>Jynx torquilla</i>	1	<i>Corvus corax</i>	7
		<i>Garrulus glandarius</i>	7
Song birds	(no. of years):	<i>Pica pica</i>	3
<i>Lullula arborea</i>	6	<i>Carduelis carduelis</i>	9
<i>Motacilla alba</i>	9	<i>Carduelis chloris</i>	6
<i>Motacilla cinerea</i>	1	<i>Serinus serinus</i>	8
<i>Delichon urbica</i>	8	<i>Fringilla coelebs</i>	8
<i>Hirundo rustica</i>	8	<i>Coccothraustes coccothraustes</i>	8
<i>Phylloscopus collybita</i>	7	<i>Emberiza cia</i>	7
<i>Phylloscopus trochilus</i>	1	<i>Emberiza cirulus</i>	9
<i>Parus major</i>	8	<i>Emberiza (Miliaria) calandra</i>	3
<i>Parus caeruleus</i>	8	<i>Passer domesticus</i>	6
<i>Parus palustris</i>	1	<i>Passer italiae</i> (?)	5
<i>Parus cristatus</i>	1	<i>Passer montanus</i>	2
<i>Parus ater</i>	3		



**CONTRIBUTION TO THE KNOWLEDGE
OF GREEN LACEWINGS OF CROATIA
(INSECTA: NEUROPTERIDA: CHRYSOPIDAE)**

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Abstract – We collected green lacewings in western Croatia by sweeping trees and edges, both at sea level and in more or less mountainous districts. Amongst the 11 occurring identified species, four are new to the Croatian fauna: *Nineta carinthiaca* (Hölzel, 1965) registered near the Lokve Lake, in the county of Gorski Kotar, *Pseudomallada ventralis* (Curtis, 1834) collected near Jezerce in the Plitvice National Park, *Ps. inornatus* (Navás, 1901) near Breze in Gorski Kotar and *Ps. venustus* (Hölzel, 1974) near Pirovac and Vrsine on the Dalmatian coast.

KEY WORDS: Lacewings, *Nineta carinthiaca*, *Pseudomallada inornatus*, *Ps ventralis*, *Ps. venustus*, fauna of Croatia.

Izveček – PRISPEVEK K POZNAVANJU TENČIČARIC HRVAŠKE (INSECTA: NEUROPTERIDA: CHRYSOPIDAE).

Na območju zahodne Hrvaške smo zbirali tenčičarice z drevja in robov, v obmorskih in gorskih predelih. Določili smo 11 vrst, od katerih so štiri nove za favno Hrvaške: *Nineta carinthiaca* (Hölzel, 1965) iz okolice jezera Lokve v Gorskem Kotarju, *Pseudomallada ventralis* (Curtis, 1834) iz bližine Jezerca v Narodnem parku Plitvice, *Ps. inornatus* (Navás, 1901) iz Breze v Gorskem Kotarju in *Ps. venustus* (Hölzel, 1974) blizu Pirovca in Vrsine na dalmatinski obali.

KLJUČNE BESEDE: tenčičarice, *Nineta carinthiaca*, *Pseudomallada inornatus*, *Ps ventralis*, *Ps. venustus*, favna Hrvaške.

Introduction

Samples of green lacewings were collected by the senior author in several places of western Croatia, near the sea shore and in more or less mountainous regions during the summers 1989 and 2008. Eleven species were registered not to mention the constituting species of the *Chrysoperla carnea* (Stephens, 1836) complex, i.e. *Ch. carnea* sensu stricto, *Ch. affinis* (Stephens, 1836), *Ch. pallida* Henry *et al.*, 2002, *Ch. agilis* Henry *et al.*, 2003, for want of a neuropterists' consensus in the matter. Four species are new to the fauna of Croatia (see below). It bears so to 24 the number of green lacewings occurring in Croatia as previously mentioned by DEVETAK (1992a,c) and ASPÖCK *et al.* (2001).

Method and sites

The insects were caught by hand net sweeping in the afternoon, on July 1989 and August 2008. Bushes and the canopy of edges of wooded places were sampled. All collected specimens were kept in alcohol and stored in the collection of D. THIERRY.

Ten places were investigated (Table I and Figure 1):

- 4 are on the sea shore: Vrsar (# 1) and Pula (# 2) in Istria, Pirovac (# 3) and Vrsine (# 4) on the Dalmatian coast ;
- 3 in hilly areas, at an altitude below 400 m asl: Rijeka (# 5), Bosanci (# 6), a more northern place and Slavonski-Brod (# 7) in the north-eastern part of the country,
- 3 others in various montane sites: near the Lokve lake (# 8) and Breze (# 9), and in the vicinity of Jezerce (# 10) in the Plitvice National Park.

Faunistical results and comments

The total sample contains 201 specimens of green lacewings, distributed in the various biotopes as registered in the Table II. It may be noted the lack of *Chrysopa* spp. and subsequently the prevalence of *Chrysoperla carnea* s.l. (42 % of the total collection) together with that of *Pseudomallada* spp., mainly *Ps. prasinus* (Burmeister, 1839) which is the dominant green lacewing (45 %). Amongst the other *Pseudomallada*, three species are new to the Croatian fauna.

Pseudomallada inornatus (Navàs, 1901) is considered by the authors as uncommon, so that the relative observations are rare also. Its distribution was first qualified polycentric. However, taking in account various data, it occurs continuously from West to East in the terminal part of the Iberic Peninsula: at Lugo (MONSERRAT, 1985) up to Ukraine and Crimea, cited by ZAKHARENKO & KRIVOKHATSKY (1993), and from North to South, the German Rhine valley (TRÖGER, 1990) and north-eastern France, in Moselle (CANARD & JACQUEMIN, 2013) up to southern Italy and Sicily (IORI *et al.*, 1995) ; but it never reaches the trans-Mediterranean countries. *Pseudomallada inornatus* is new to Croatian neuropterological fauna, although already registered very closely, at Osp (near Koper/Capodistria) in the

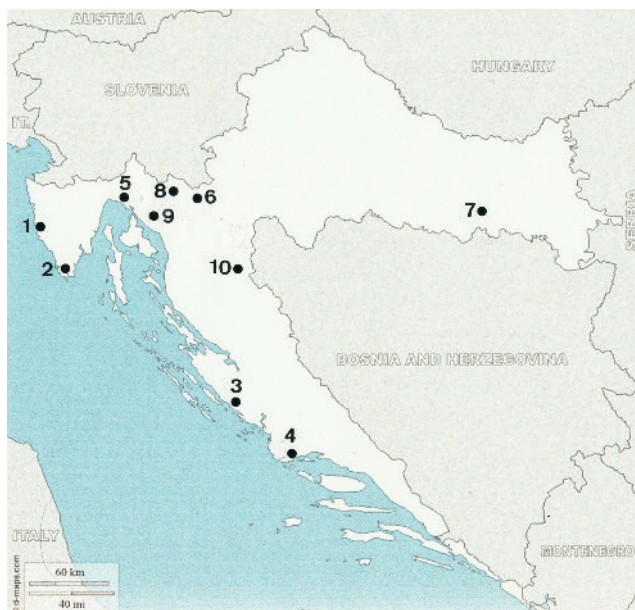


Fig. 1 – Collection places in Croatia.

Slovenian part of the Istrian peninsula (DEVETAK, 1998 and *in lit.*) but without any more circumstantial details and near the Slovenian border, in Podčetrtek (Lower Styria) (DEVETAK, 1984).

Pseudomallada ventralis (Curtis, 1834) was collected in the mountainous biotopes of Jezerce (# 10) on isolated trees in a moist dale. Its occurrence does not show any surprise, excepted the absence of citation up to the present. *Pseudomallada ventralis* is common everywhere in Europe, from the Scandinavian region to the Iberian Peninsula and eastwards to Romania and Ukraine. It is known in the neighbouring countries: Slovenia, Hungary, Serbia, Bosnia-Herzegovina (ASPÖCK *et al.*, 2001).

Pseudomallada venustus (Hölzel, 1974) was captured in the vicinity of Pirovac (# 3) on an isolated plum-tree, and at Vrsine (# 4), near orchards of olive- and fig-trees. This green lacewing is known as a xerothermophilous species, discreet, never abundant in hand nets of neuropterists. Initially described from the south-eastern France (Alpes-Maritimes), it has a north Mediterranean distribution (TILLIER, 2008) including continental Italy: Liguria and Calabria (IORI *et al.* 1995), mainland of Greece: Peloponesus, Dytiki Ellas and Attiki (CANARD, 2001), island of Crete, Cyprus (CANARD, 2007), Corsica (LETARDI *et al.*, 2008), Montecristo (HÖLZEL, 1974), Pantelleria in the Sicily Canal (PANTALEONI & LO VALVO, 1995) and Sicily (NICOLI ALDINI *et al.*, 2012) (Figure 2). However, it may be more frequent than appearing at now due to a possible confusion with the closely related *Ps. venosus* (Rambur, 1842). The occurrence of *Ps. venustus* on the Dalmatian coast is not surprising with respect to its Mediterranean distribution.

Table I – Characters of the collection places in Croatia.

	#	Location	Latitude	Longitude	County	Biotope	Altitude	Comments
sea shore	1	Vrsar	45° 09' N	13° 36' E	Istria	sea shore	... 0-20 ...	on bushes
	2	Pula	44° 52' N	13° 50' E	Istria	oaks and pine trees		canopy
	3	Pirovac	43° 49' N	15° 40' E	Šibenik-Knin	peri-urban area		on an isolated plum tree
	4	Vrsine	43° 31' N	31° 16' E	Split-Dalmatia	orchard		olive and fig trees
hilly area	5	Rijeka	45° 19' N	14° 26' E	Primorje-Gorski Kotar	dry calcareous table-land	300	canopy
	6	Bosanci	45° 26' N	15° 16' E	Karlovačka	scattered trees on meadow	190	canopy
	7	Slavonski-Brod	45° 16' N	18° 01' E	Brod-Posavina	sub-urban area	80	canopy
mountainous area	8	Lokve	45° 21' N	14° 45' E	Primorje-Gorski Kotar	edge of coniferous and deciduous wood	700	canopy
	9	Breze	45° 11' N	14° 52' E	Primorje-Gorski Kotar	edge of coniferous wood	800	canopy
	10	Plitvice Lakes	44° 50' N	15° 39' E	Lika-Senj & Karlovac	wet wooded dale	600	canopy
						grassy table-land	650	on an isolated lime tree

Nineta carinthiaca (Hölzel, 1965) was caught near the Lake of Lokve, in the midst of the Velika Kapela massif, on the slope of a saddle for the road M 12, at more than 500 m up. Collections were done within the tree canopy vegetation on an open glade in a zone covered by both deciduous and coniferous trees.

Amongst the seven *Nineta* Navás, 1912 known in Europe, only *N. flava* (Scopoli, 1763) was already registered in Croatia. *Nineta carinthiaca* is thus new to the fauna

Table II – Green lacewing species and numbers of specimens collected in Croatia.

Sites of capture	1	2	3	4	5	6	7	8	9	10	Total
<i>Italochrysa italica</i> (Rossi, 1790)		1		1	1						3
<i>Nineta carinthiaca</i> (Hölzel, 1965)								2			2
<i>Pseudomallada flavifrons</i> (Brauer, 1850)		3								2	5
<i>Pseudomallada inornatus</i> (Navas, 1901)									1		1
<i>Pseudomallada prasinus</i> (Burmeister, 1839)		19	3		6	8	4			52	92
<i>Pseudomallada zelleri</i> (Schneider, 1851)				1							1
<i>Pseudomallada ventralis</i> (Curtis, 1834)										7	7
<i>Pseudomallada venustus</i> (Hölzel, 1974)			1	1							2
<i>Pseudomallada clathratus</i> (Schneider, 1845)										1	1
<i>Cunctochrysa albolineata</i> (Killington, 1935)										2	2
<i>Chrysoperla lucasina</i> (Lacroix, 1912)	5	7	9	12	3	3	4		3	6	52
<i>Chrysoperla carnea</i> (Stephens, 1836) s.l.		4	11		1	3	5			9	33
Total	5	34	24	15	11	14	13	2	4	79	201

of the country. It is a green lacewing everywhere considered rare because most often absent or casual in samples, considered endangered as in Slovenia (DEVETAK, 1992b).

It is of great size: its forewing measures 20 to 26 mm, the body is about 16-17 mm long. It is associated with *Fagus*, *Quercus* and other deciduous trees, on-wings in July and August, its life cycle is univoltine (ZELENY, 1984) overwintering probably as prepupae within the cocoon. It is easily separated from the other European *Nineta* species by means of the following characters:

1) from ***vittata***: scape bulbous, more or less square, slightly longer than broad (*vs* cylindrical, narrow, at least twice longer than wide)

– axial extension of sternite 9 strongly curved forwards with a large brush (*vs* up-turned or slightly curved, with small brush)

2) from ***flava***, ***guadarramensis*** and ***principiae***: anterior margin of the forewing straight or convex (*vs* concave, sinuous)

– cross veins of the costal space and gradates $\pm$ black (*vs* green)

3) from ***pallida***: Pseudomedian vein green (*vs* black)

– thorax green with a yellow axial stripe (*vs* lateral brown reddish marks)

– associated with deciduous trees (*vs* coniferous)

4) from ***inpunctata***: longitudinal veins green (*vs* black)

– internal gradates' line parallel to Rs (*vs* converging with)

Nineta carinthiaca was first found in Carinthia, south Austria, in 1965. It was collected later successively in Anatolia (HÖLZEL, 1973), in Slovenia (SAURE, 1989), in the north eastern part of Hungary near the Ukrainian and Romanian frontier lines (SZIRÁKI, 1990 and *in lit.*), in the south eastern Switzerland (DUELLI *et al.*, 2006), at in farthest north east of Italy (LETARDI *et al.*, 2010), in the north eastern Czech Republic (Rymarov) by S. KREJCIK (web ref., 2011), and now in Croatia (Fig. 2).

The occurrence of *Nineta carinthiaca* in Croatia is not surprising if we consider its distribution as above mentioned, i.e. mainly in Central Europe and in the Anatolian

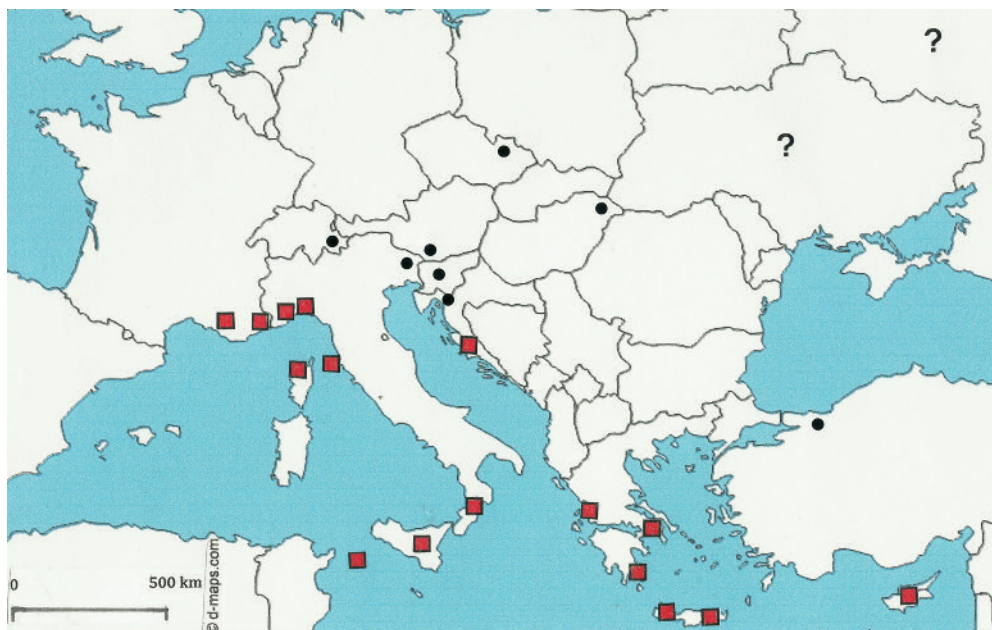


Fig. 2 – Distribution of *Nineta carinthiaca* (round black spots) and *Pseudomallada venustus* (square red spots) in Europe.

district closest to Europe. Besides, it dwells also in the far east of Anatolia, near the Armenian border (ARI *et al.*, 2007), in Ukraine where precise locations were not indicated, and in numerous sites of Russia, as well the occidental part (ZAKHARENKO, unpubl. and *in lit.*) as far-eastern (MAKARKIN, 1985), in Kazakhstan, Korea and Japan. Nevertheless, Asian observations may be doubtful because of a possible confusion with another species previously described from Japan: *Nineta alpicola* (Kuwayama, 1956) (CANARD, 2004), proposed as synonym by TSUKAGUCHI (1995).

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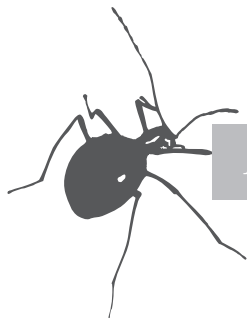
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**BUTTERFLY (LEPIDOPTERA: RHOPALOCERA) DIVERSITY AND
AGRICULTURAL LAND USE IN SOLČAVA AREA, N SLOVENIA**

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Abstract - The article presents a contribution to the knowledge of butterfly diversity (Lepidoptera: Rhopalocera) of the Solčavsko, an important area for nature conservation in Slovenia. Survey took place from June to August 2014 at six localities. Field observations were performed twice per month. The localities are characterised by different agricultural land use: pastures and meadows. Altogether 50 butterfly species were recorded at the surveyed localities. Eight species are reported for this area for the first time, two of them threatened and/or protected in Slovenia: *Boloria selene* and *Lycaena alciphron*. The study shows that surveyed pastures have predominantly higher butterfly diversity than meadows.

KEY WORDS: butterflies, diversity, agriculture, Solčava, Slovenia

Izveček - PESTROST METULJEV (LEPIDOPTERA: RHOPALOCERA) IN KMETIJSKA RABA ZEMLJIŠČ NA SOLČAVSKEM, SLOVENIJA.

Članek predstavlja prispevek k poznavanju pestrosti dnevnih metuljev (Lepidoptera: Rhopalocera) na Solčavskem, ki je pomembno območje ohranjanja narave v Sloveniji. Podatki so bili zbrani v obdobju med junijem in avgustom 2014 na šestih lokacijah, in sicer dvakrat mesečno. Na vzorčenih lokacijah je prisotna različna kmetijska raba:

pašniki in travniki. Skupaj je bilo opaženih 50 vrst metuljev. Med njimi je bilo 8 vrst metuljev prvič opaženih na tem območju; od tega sta dve ogroženi in/ali zavarovani vrsti v Sloveniji: *Boloria selene* in *Lycaena alciphron*. Ugotovili smo, da je bila na vzorčenih pašnikih pestrost metuljev večinoma večja kot na travnikih.

KLJUČNE BESEDE: metulji, pestrost, kmetijstvo, Solčava, Slovenija

Introduction

Altogether, 180 butterfly species (Lepidoptera: Rhopalocera) are known from Slovenia, and 59 species were recorded in the Solčavsko area (Verovnik et al., 2012; Russel et al., 2014). Solčavsko lies below the summits of the Kamnik-Savinja Alps and is an important nature conservation area within Slovenia. Almost 80 % of the area is inside Natura 2000 sites. Two Landscape parks (IUCN category V) are located in the area: Robanov kot and Logarska dolina (Nature Conservation Atlas, 2014; ARSO, 2014). Geographically, Solčavsko is situated in the border area with Austria at the headwaters of Savinja River. The special features of Solčavsko are three parallel alpine glacial valleys: Logarska dolina, Robanov kot and Matkov kot (TIC Solčava, 2014).

The average temperature of the coldest month is -3°C and the temperature of the warmest is above 10°C . The average annual rainfall of the area is between 1600 and 3000 mm, with intense rainfall between October and May (Ogrin, 1996). Forest cover in Solčavsko reaches 80% of the area. The dominant types of forest are fir-beech forest, mountain forest and Alpine beech forest. At higher altitudes spruce forest is dominant although there are also pine forests on steep slopes. The timberline is around 1600 meters high, varying locally because of the orientation or orographic obstacles (Lipnik et al., 2009). Farming, forestry and tourism are the main human activities in the area. During industrialization alpine cattle grazing decreased and many areas were subjected to afforestation, however, due to modern day livestock farming many of the pastures and meadows still remain active (Muri, 2005). Intensification in more productive regions and concurrent abandonment of less accessible and populated ones are the major threat in reducing biological diversity in agricultural landscapes (Stoate et al., 2009). Nilsson et al. (2008) revealed that decline in butterfly diversity coincided with the loss of flower-rich open habitats that had been maintained by late cutting.

The aim of this article is to contribute to a better knowledge of butterfly fauna in the Solčavsko area. Furthermore, the article tries to survey the impacts of agricultural land use on diversity of butterflies in this highly valuable area for nature conservation.

Materials and Methods

The survey was carried out from June to August 2014 (dates of the field trips (FT): 7.6.2014, 29.6.2014, 12.7.2014, 24.7.2014, 9.8.2014, 29.8.2014). Field observations were performed twice per month (in the first and second half), between 10:00 AM and 4:00 PM in the sunny or partly cloudy weather. Six observation localities were spread across the Solčava area. The localities have different agricultural land use.

Two researchers surveyed butterfly fauna at each location for 30 minutes using the linear transect method. Butterflies were caught using butterfly nets (35 cm diameter), determined by field guides (Polak, 2009; Tolman & Lewington, 2008) and immediately released. Only unknown or interesting specimens were collected, photographed and deposited in a private collection of co-author J. Debets.

Vegetation from five quadrants (1 square meter) was randomly sampled each time on each location. A number of entomophilous blossoming flowers in each quadrant were counted. The results were ranged into four class intervals (1: 0-10, 2: 10-20, 3: 20-30, 4: more than 30 blossoming flowers). Because of looseness of the classes, the median of results was used. A number of entomophilous blossoming plant species was also defined using the same method. Number of species and arithmetic mean for each location were calculated. Spearman rank correlation was used to determine if the number of entomophilous blossoming plant species and total number of entomophilous blossoming flowers have any impact on butterfly diversity and their abundance.

Shanon-Wiener Diversity Index was calculated to compare diversity on the locations. This Index measures species diversity in a given community. It is a commonly used diversity index that takes into consideration both abundance and evenness of species present in the community (Henderson, 2003; Tome, 2006).

The list of localities and a short description of the habitat, coordinates and latitude:

Gočova pustota: The meadow is located in the Robanov kot valley. The meadow is fertilized with liquid manure every three to five years. The location is used for mowing twice per year and for cattle grazing at the end of summer. Y: 477631.2, X: 138879.9, 651 m.

Bevska pustota: The pasture is located in the Robanov kot valley. It is used for cattle grazing (cows). Y: 477631.2, X: 138879.9, 651 m.

Klemenče njive: The meadow is located near panoramic road above Logarska dolina. The site is fertilized with liquid manure once annually. The location is annually used for mowing and for cattle grazing. Y: 472589.4, X: 142563.1, 1153 m.

Logarjeve njive: The meadow is located by the entry in the Logarska dolina valley. The area is fertilized with liquid manure every three years. The location is used for mowing (twice annually). Y: 472790.6, X: 141570.9, Z: 732 m.

Polanc: The pasture is located in the Logarska dolina valley. The site is fertilized with liquid manure every three years. The location is usually used for cattle grazing and at times for mowing. Y: 472205.2, X: 140120.3, 738 m.

Logarski kot: The pasture is located in the Logarska dolina valley. The area is not fertilized. The location is used only for grazing (donkeys). Y: 470590.6, X: 136717.7, 905 m.

Results and Discussion

Altogether 50 butterfly species were recorded at six locations in Solčava. Tab. 1 presents a list of observed species, their locations and abundance at each location.



Fig. 1. Map of six studied locations (marked with red spots) in the Solčava area.

Fig. 2. The Logarjeve njive meadow (Locality D) (Foto: Neža Orel, July, 2014)



Fig. 3. The pasture at Polanc (Locality E) (Foto: Neža Orel, June, 2014)

According to the Atlas of butterflies (Lepidoptera: Rhopalocera) of Slovenia (Verovnik et al., 2012) 59 butterfly species were expected in the Solčava area. Species that we did not find were: *Carterocephalus palaemon*, *Hesperia comma*, *Parnassius mnemosyne*, *Iphiolides podalirius*, *Leptidea reali*, *Colis alfacariensis*, *Lycaena virgaurea*, *Cupido minimus*, *Phengaris alcon*, *Aricia agestis*, *Aricia artaxerxes*, *Polyommatus coridon*, *Araschnia levana*, *Melitaea athalia*, *Neptis rivularis*, *Apatura iris*, *Erebia euryale* and *Brintesia circe*. However, eight new species, not recorded in this area in the Atlas, were observed (marked with * in Tab. 1). Out of these, two are endangered and/or protected (*Boloria selene* and *Lycaena alciphron*). In total, 5 endangered and/or protected species were observed. They are described briefly below.

Lycaena alciphron

This protected species was observed at 29.6.2014 at the locality Logarjeve njive meadow. The species is common at the middle altitudes (Verovnik et al., 2012). It is univoltine and adults can be seen from June until the end of July. Larvae feed on *Rumex acetosa* and *Rumex acetosella*. The species is on the Red list of endangered butterflies in Slovenia.

Lycaena hippothoe

This protected species was common at location Logarski kot at the end of June and at the beginning of July. This butterfly is usually common in damp meadows and hillside bogs. Species has two generations annually from May till June and from June till August. Larvae feed on *Rumex* spp. and *Polygonum* spp. The species is on the Red list of endangered butterflies in Slovenia.

Boloria selene

We found this protected species in Logarski kot at 24.7.2014. The species usually lives in extensive damp meadows and moist headlands (Polak, 2009). Adults can be seen in two generations; first from May till June and second from July till September. Larvae feed on *Viola* spp. The species is on the Red list of endangered butterflies in Slovenia.

Nymphalis antiopa

This species was observed several times in August 2014 at different locations (Gočova pustota meadow, Klemenče njive and Polanc). It was observed on the meadows, which are surrounded by forest. This species of butterfly has strong migratory behaviour; usually migrates immediately after hatching from pupae (Polak, 2009). Adults can be seen as one generation from June to July. Larvae feed on *Salix* spp. and *Populus* spp.

Melitaea diamina

This protected species was found only at Polanc on 29.6. 2014 and 12.7.2014. It is common in wet meadows and is rarely found on dry meadows (Polak, 2009). It is univoltine and adults can be found from May till July. Larvae feed on *Valeriana officinalis*. Species is listed in the Red list of endangered butterflies in Slovenia.

Tab. 1. The list of butterfly species and localities with the abundance (Fauna Europaea, 2014).

Family	Species	Locality					
		A	B	C	D	E	F
Hesperiidae	<i>Erynnis tages</i> (Linnaeus 1758)						1
	<i>Thymelicus lineola</i> (Ochsenheimer 1808)		1	4	1		1
	<i>Thymelicus sylvestris</i> (Poda 1761)		1	11	2		2
	<i>Ochlodes venata</i> (Bremer & Grey 1853)		4		3	1	5
Papilionidae	<i>Papilio machaon</i> (Linnaeus 1758)		1	1	3	1	
Pieridae	<i>Leptidea sinapis</i> (Linnaeus 1758)	3	4	1	1	2	2
	<i>Anthocharis cardamines</i> (Linnaeus 1758)		1				1
	<i>Pieris brassicae</i> (Linnaeus 1758)			3	4	3	11
	<i>Pieris rapae</i> (Linnaeus 1758)	5	7	8	48	12	56
	<i>Pieris napi</i> (Linnaeus 1758)	2	7	1	5	3	5
	<i>Colias croceus</i> (Fuerst 1785)			1	1		
	<i>Gonepteryx rhamni</i> (Linnaeus 1758)	3	3	18	8	7	40
	<i>Hamearis lucina</i> (Linnaeus 1758)		2				1
Lycaenidae	<i>Lycaena tityrus</i> (Poda 1761)				1		1
	<i>Lycaena alciphron</i> * (Rottemburg 1775)				1		
	<i>Lycaena hippothoe</i> (Linnaeus 1761)				2		14
	<i>Lycaena phlaeas</i> * (Linnaeus 1761)	1		1			
	<i>Callophrys rubi</i> * (Linnaeus 1758)						1
	<i>Satyrion spini</i> (Denis & Schiffermüller 1775)				1		
	<i>Plebejus argus</i> (Linnaeus 1758)		1			7	
	<i>Cyaniris semiargus</i> (Rottemburg 1775)				1	1	3
	<i>Polyommatus amandus</i> (Schneider 1792)	1					
	<i>Polyommatus icarus</i> (Rottemburg 1775)	3	2	7	10	12	2
	<i>Celastrina argiolus</i> * (Linnaeus 1758)					1	
	<i>Polyommatus bellargus</i> * (Rottemburg 1775)				1	1	1
	<i>Argynnis paphia</i> (Linnaeus 1758)	5	7	3	1	8	29
Nymphalidae	<i>Argynnis aglaja</i> (Linnaeus 1758)		1	3	1	5	
	<i>Argynnis adippe</i> (Denis & Schiffermüller 1775)					1	
	<i>Issoria lathonia</i> (Linnaeus 1758)			6		1	
	<i>Boloria euphrosyne</i> (Linnaeus 1758)		1			1	3
	<i>Boloria selene</i> * (Denis & Schiffermüller 1775)						1
	<i>Vanessa atalanta</i> (Linnaeus 1758)	3	8	7	1	4	3
	<i>Vanessa cardui</i> (Linnaeus 1758)	1					3
	<i>Aglais io</i> (Linnaeus 1758)	1	1	3	1		34
	<i>Aglais urticae</i> (Linnaeus 1758)		2	13	1	1	
	<i>Polygonia c-album</i> (Linnaeus 1758)		4			1	3
	<i>Nymphalis antiopa</i> (Linnaeus 1758)	1		1		1	
	<i>Melitaea diamina</i> (Lang 1789)					3	
	<i>Limenitis camilla</i> (Linnaeus 1764)		5				3
	<i>Pararge aegeria</i> (Linnaeus 1758)		1				1
	<i>Lasiommata maera</i> (Linnaeus 1758)	2	3	2	2		3
	<i>Coenonympha arcania</i> (Linnaeus 1761)	1	9	1		2	4
	<i>Coenonympha pamphilus</i> (Linnaeus 1758)	7	2	19	21	25	3
	<i>Aphantopus hyperantus</i> (Linnaeus 1758)	2	12		15	6	
	<i>Maniola jurtina</i> * (Linnaeus 1758)	5	8	91	114	27	1
	<i>Erebia ligea</i> (Linnaeus 1758)	1	1			3	8
	<i>Erebia stirius</i> (Godart 1824)	1				1	1
	<i>Erebia pronoe</i> (Esper 1780)						1
	<i>Erebia medusa</i> * (Denis & Schiffermüller 1775)		1				
	<i>Melanargia galathea</i> (Linnaeus 1758)			2			
Number of species		19	27	22	26	29	33
Number of specimens		48	99	205	250	141	248
Shannon-Wiener Index (<i>H'</i>)		2.72	3.00	2.08	1.95	2.77	2.57

The number of butterfly species found was higher on observed pastures: Bevska pustota (Locality B), Polanc (Locality E) and Logarski kot (Locality F). On the other hand, abundance of specimens was the highest at Logarjeve njive meadow, Klemenče njive meadow and Logarski kot pasture. The Shannon-Wiener Diversity Index was calculated in order to compare diversity of the localities. Calculated values show that pastures had predominantly higher diversity than meadows (Tab. 1).

The aim of the study was also to determine if the number of entomophilous blossoming plant species and total number of entomophilous blossoming flowers have any impact on butterfly diversity and their abundance. Spearman rank correlation was used but no significant correlations were found. There are several possible reasons why the correlation between described variables cannot be confirmed. First, there are other environmental factors with influence on the behaviour of butterflies, such as air temperature and wind speed. Next, habitats surrounding the sampled locations were not systematically compared or clustered, because of their diversity. There is also one methodological limitation that could have affected the results, i.e. the relatively long time period of daily census of butterflies between 10 am and 4 pm, due especially to the mountain climate with warmest monthly temperature just above 10 °C.

However, as expected, there are significant positive correlations between number and diversity of entomophilous flowering plants ($\rho = 0.484$, $p < .01$, $n = 36$) and between number and diversity of butterflies ($\rho = 0.502$, $p < .01$, $n = 36$).

Conclusions

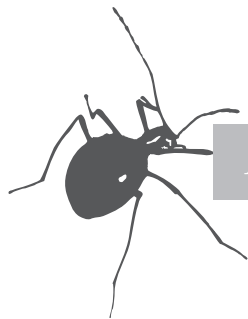
Solčavsko is an important nature conservation area in Slovenia, therefore surveying butterfly fauna is valuable for planning nature conservation related activities in the area. In this study nine additional butterfly species were reported for the Solčava area, with two of them threatened and/or protected in Slovenia: *Boloria selene* and *Lycaena alciphron*. The study also confirmed that surveyed pastures had predominantly higher butterfly diversity than meadows.

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**CONTRIBUTION TO THE KNOWLEDGE OF THE BUTTERFLY FAUNA
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Abstract - During the years 2009 to 2013, three visits to Montenegro were made to study the spring and early summer butterfly fauna. The focus of our study was on the south-western part of the country, especially the coastal region. A total of 31 localities were visited and some interesting observations were made. Altogether 112 species were recorded, confirming high diversity of the butterfly fauna of this country. Among the observed species, the following are rare or local in Montenegro: *Papilio alexanor*, *Gonepteryx cleopatra*, *Brenthis ino*, *Apatura metis*, *Coenonympha orientalis*, *Pyrgus sidae*, while *Cupido osiris* is reported for the first time for the country. Based on available literature information the butterfly fauna of Montenegro now includes 168 species.

KEY WORDS: butterflies, distribution, conservation, rare species, *Cupido osiris*

**Izveleček – PRISPEVEK K POZNAVANJU FAVNE METULJEV ČRNE GORE
(LEPIDOPTERA: RHOPALOCERA)**

V letih 2009 do 2013 smo opravili tri raziskave dnevnih metuljev v Črni gori predvsem v pomladanskem in zgodnjem poletnem času. Glavni del raziskav je bil usmerjen v jugozahodni obalni del države. Skupno smo obiskali 31 lokacij in zabeležili 112 vrst metuljev, med njimi je tudi nekaj zanimivih najdb. Med opaženimi vrstami se naslednje redko ali lokalno pojavljajo v Črni gori: *Papilio alexanor*, *Gonepteryx cleopatra*, *Brenthis ino*, *Apatura metis*, *Coenonympha orientalis*, *Pyrgus sidae*. Prvič sploh pa smo za Črno goro zabeležili modrina *Cupido osiris*. Na osnovi pregledane literature vključuje favna dnevnih metuljev Črne gore sedaj 168 vrst.

KLJUČNE BESEDE: dnevni metulji, razširjenost, varstvo, redke vrste, *Cupido osiris*

Introduction

Butterflies are one of the most attractive and recognisable groups of insects, therefore their distribution is usually well known. In Montenegro, first reports of butterfly fauna were made at the end of 19th century (Nicholl 1899 – 1902), followed by the more comprehensive studies published by Rebel (1913) and Rebel & Zerny (1931). After a long gap without surveys caused by political instability and war the next contribution dealing with the fauna of the south-western part of the country was published in 1958 (Carnelutti & Michieli 1958). The authors list 79 species of butterflies, most notably *Papilio alexanor* (Esper, 1800) for Stari Bar. Also the next study was centred on the butterfly fauna of the coastal part of Montenegro (Sijarić & Mihljević 1972). However, in 1984 the butterfly fauna of the Durmitor Mts. was published (Sijarić et al. 1984), providing by far the most detailed study of butterflies in Montenegro. Even now we can say that Durmitor is the best studied part of the country. Last overview of the butterfly fauna of Montenegro followed in the same year (Sijarić, 1984) with a total of 160 species listed. Since then no additional faunistic papers were published, but the provisional distribution maps published by Jakšić (1988) indicate presence of several additional species for Montenegro, however without traceable background information.

Given the size of the country, relatively large number of butterfly species is known from Montenegro, owing mainly to very diverse and highly structured landscape, large altitudinal span and variable climate. These factors provide a multitude of different habitats important for both habitat generalist and specialist species. Additionally most parts of the country are little affected by human activity and extensive farming is still prevailing. Besides intensively cultivated areas around Podgorica and Skadar Lake, the habitats of coastal area are most disturbed due to large scale building of tourist infrastructure.

In recent years, no new data about fauna of butterflies were published for Montenegro. The main goal of our overview is therefore to contribute new and more detailed data about distribution of Montenegrin butterflies, especially species flying in spring, with the spring aspect of fauna being commonly neglected in previous butterfly studies.

Materials and Methods

Butterflies were observed during three surveys in Montenegro. The first survey took place from 26.4.2009 until 2.5.2009 covering the south-western part of the country. The second visit was between 29.6.2011 and 3.7.2011 in Durmitor Mts. and Skadar Lake. The final visit was carried out from 28.4.2013 until 4.5.2013 in the coastal part including Podgorica region. In total, 31 localities were visited. The selection of localities with potential interesting habitats was based on investigation of Google Earth satellite images. Adult butterflies were netted using entomological nets and released after identification. Butterflies were identified in the field by field guide Butterflies of Britain and Europe (Tolman & Lewington, 1997).



Fig. 1: Map of sampling sites for butterflies during the surveys in Montenegro. The numbers correspond to the list of localities in the Materials and Methods section.

Sl. 1: Zemljevid lokacij s podatki o dnevnih metuljih v Črni gori. Številke lokacij ustrezajo seznamu lokacij v Materialih in metodah.

List of localities

The list of localities contains the relevant toponyms, a short description of the habitat, altitude, coordinates and date of the visit. The localities are arranged in chronological order.

1. Bar, Tomba, meadows and bushes 12 km S of Bar, 45m, 42° 3'54.02"; 19° 7'35.75"; 26.4.2009
2. Bar, Stari Bar, rocky slopes bellow the fortress, 95 m, 42° 5'26.24"; 19° 7'56.47"; 26.4.2009, 29.4.2013
3. Bar, Pečurice, Mrkovsko polje, meadows and pastures SE of the village, 230 m, 42° 1'27.46"; 19°11'30.03"; 27.4.2009
4. Ulcinj, Donja Klezna, Briško polje, bushes and pastures SE of the village, 10 m, 41°59'0.64"; 19°17'33.48"; 27.4.2009
5. Ulcinj, Velika plaža, pastures by the beach, 5 m, 41°54'32.60"; 19°15'28.01"; 25.4.2009 and 27.4.2009
6. Ulcinj, Šas, Šaško Lake, meadows and bushes N of the lake, 5 m, 41°58'48.15"; 19°20'18.36"; 25.4.2009 and 29.4.2009
7. Virpazar, Donji Murići, Skadarsko Lake, rocky slopes by the road to Virpazar, 250 m, 42° 9'15.34"; 19°12'46.92"; 30.4.2009
8. Virpazar, Godinje, Skadarsko lake, rocky slopes and bushes by the road to Virpazar, 90 m, 42°13'51.77"; 19° 6'11.50"; 30.4.2009
9. Virpazar, Boljevici, meadows E of the village; 15 m, 42°13'26.01"; 19° 5'2.39"; 30.4.2009, 30.4.2013

10. Virpazar, Gluhi Do, Crmničko polje, meadows S of the village, 10 m, 42°13'46.91"; 19° 4'19.06"; 30.4.2009
11. Petrovac, Buljarica, meadows and bushes S of the village; 5 m, 42°11'34.57"; 18°58'16.46"; 2.5.2009, 28.4.2013
12. Pivska Planina, Unač, grassy slopes along the road from Piva to Durmitor S of the village, 1110 m, 43°10'48.03"; 18°52'12.49"; 29.6.2011
13. Durmitor, Mt. Stožina, southern slopes above the road at Suva lokva, 1700 m, 43° 5'29.22"; 19° 4'53.36"; 29.6.2011
14. Durmitor, Žugića Bara, rocky slopes S of the bogs, 1400 m; 43° 6'11.81"; 19°10'33.39"; 29.6.2011
15. Durmitor, Žabljak, meadows at Barno Lake, 1500 m, 43° 9'18.08"; 19° 5'28.77"; 30.6.2011
16. Durmitor, Žabljak, meadows W of Riblje Lake; 1410 m; 43° 5'32.89"; 19° 8'55.87"; 30.6.2011
17. Durmitor, Njegovuđa, meadows SE of the Zminičko Lake; 1310 m; 43° 5'59.66"; 19°14'57.36"; 30.6.2011
18. Skadar, Dodoši, along the river S of the village; 5 m; 42°19'30.51"; 19° 8'1.22"; 1.7.2011
19. Podgorica, Dinoša, rocky slopes along the Cijevna River E of the village; 90 m; 42°24'28.01"; 19°20'55.83"; 3.7.2011, 1.5.2013
20. Podgorica, Dinoša, pastures on the N side of Cijevna River at the first bridge E of the village; 95 m; 42°23'47.67"; 19°22'49.70"; 3.7.2011, 1.5.2013
21. Podgorica, Cijevna, above the gorge of the Cijevna River W of the village; 170 m; 42°25'26.85"; 19°27'40.03"; 3.7.2011
22. Petrovac, Lučice, meadows and bushes in the village, forest pathway, 10 m, 42°12'4.67"; 18°57'9.29"; 28.4.2013
23. Bar, Sutomore, grassy slopes and bushes SE from town; 60 m, 42° 8'27.01"; 19° 2'33.96"; 29.4.2013
24. Petrovac, Novoselje, meadows by the road to Petrovac; 660 m, 42°13'4.04"; 18°58'22.88"; 30.4.2013
25. Virpazar, rocky slopes and forest pathway SE from town; 40 m, 42°14'43.69"; 19° 5'30.78"; 30.4.2013
26. Komarno, meadows around village; 240 m, 42°17'16.10"; 19° 3'37.02"; 30.4.2013
27. Rijeka Crnojevića, meadows E from village; 25m, 42°21'20.86"; 19° 1'26.75"; 30.4.2013
28. Kotor, grassy slopes on the W of the town ; 220 m, 42°25'29.03"; 18°46'19.63"; 3.5.2013
29. Lastva Grbaljska, Glavati, meadows around the village; 210m, 42°18'19.61"; 18°46'7.23"; 3.5.2013
30. Kotor, Njeguši, rocky slopes and meadows S of the village; 915 m, 42°25'40.88"; 18°48'19.40"; 4.5.2013
31. Cetinje, Bjeloši, meadows by the road to Cetinje; 990 m, 42°21'56.66"; 18°52'48.95"; 4.5.2013

Results

Table 1: The distribution of recorded butterfly species in Montenegro. The numbering of localities corresponds to the list of localities in Materials and Methods section. Nomenclature follows Van Swaay et al. 2010, and Fauna Europaea (2014).

Species	Localities
Papilionidae	
<i>Papillio machaon</i> Linnaeus, 1758	2, 5, 7, 8, 11, 19, 21, 22, 23, 25, 26, 28, 30
<i>Papillio alexanor</i> Esper, 1800	2
<i>Iphiclides podalirius</i> (Linnaeus, 1758)	2, 3, 6, 8, 9, 11, 19, 20, 21, 22, 23, 24, 26, 27, 19, 30
<i>Zerynthia polyxena</i> (Dennis & Schiffermuller, 1775)	1, 3, 9, 10, 11, 19, 20, 23, 26, 30, 31
<i>Parnassius apollo</i> (Linnaeus, 1758)	13
<i>Parnassius mnemosyne</i> (Linnaeus, 1758)	12
Pieridae	
<i>Aporia crategi</i> (Linnaeus, 1758)	12
<i>Pieris brassicae</i> (Linnaeus, 1758)	4, 11, 24, 25, 30
<i>Pieris balcana</i> Lorković, 1968	12
<i>Pieris rapae</i> (Linnaeus, 1758)	2, 11, 18, 23, 27, 28
<i>Pieris mannii</i> (Mayer, 1851)	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 13, 19, 20, 21, 24, 26, 27, 30
<i>Pieris napi</i> (Linnaeus, 1758)	9, 11, 18, 30
<i>Pieris ergane</i> (Geyer, 1828)	13, 20, 21
<i>Pontia edusa</i> (Fabricius, 1777)	1, 23
<i>Euchloe ausonia</i> (Hübner, 1804)	2, 5, 23, 26, 27, 29, 30
<i>Antiocharis cardamines</i> (Linnaeus, 1758)	2, 3, 7, 8, 9, 11, 19, 24, 25, 26, 27, 28, 29, 30
<i>Colias alfacariensis</i> Ribbe, 1905	16
<i>Colias croceus</i> (Geoffroy, 1785)	1, 2, 3, 5, 9, 10, 11, 12, 13, 18, 20, 23, 24, 25, 26, 27, 29
<i>Gonepteryx rhamni</i> (Linnaeus, 1758)	2, 3, 8, 19, 20, 21, 24, 26, 29, 30
<i>Gonepteryx cleopatra</i> (Linnaeus, 1767)	11
<i>Leptidea sinapis/juvernica</i>	1, 2, 3, 4, 7, 8, 10, 11, 19, 20, 21, 23, 24, 28, 29, 30
Lycaenidae	
<i>Satyrrium ilicis</i> (Esper, 1779)	12
<i>Callophrys rubi</i> (Linnaeus, 1758)	1, 2, 3, 8, 9, 11, 20, 22, 23, 24, 26, 31
<i>Lycaena phleas</i> (Linnaeus, 1761)	1, 2, 3, 11, 20, 24, 27, 30
<i>Lycaena ottomana</i> (Lefebvre, 1830)	3, 9, 11, 19, 22, 26, 37, 29
<i>Lycaena tytirus</i> (Poda, 1761)	12
<i>Lycaena candens</i> (Herrich-Schaffer, 1844)	13, 15
<i>Tarucus balkanicus</i> (Freyer, 1844)	19, 20
<i>Celestrina argiolus</i> (Linnaeus, 1758)	1, 3, 5, 11, 18, 22, 23
<i>Cupido argiades</i> (Pallas, 1771)	22
<i>Cupido minimus</i> (Fuessly, 1775)	12, 17, 20
<i>Cupido osiris</i> (Meigen, 1829)	29
<i>Glaucopsyche alexis</i> (Poda, 1761)	1, 2, 3, 5, 6, 9, 11, 20, 22, 23, 24, 29, 30, 31
<i>Phengaris alcon</i> (Dennis & Schiffermuller, 1775)	12, 17
<i>Phengaris arion</i> (Linnaeus, 1758)	12
<i>Iolana iolas</i> (Ochsenheimer, 1816)	21
<i>Scolitantides orion</i> (Pallas, 1771)	6, 8, 19, 20, 22, 24, 27, 29, 30
<i>Pseudophilotes vicrama</i> (Moore, 1865)	11, 24
<i>Plebejus argus</i> (Linnaeus, 1758)	12, 13, 14, 17
<i>Plebejus idas</i> (Linnaeus, 1761)	12, 13
<i>Aricia eumedon</i> (Esper, 1780)	12, 15
<i>Aricia agestis</i> (Dennis & Schiffermuller, 1775)	1, 2, 3, 5, 7, 9, 10, 11, 19, 20, 21, 22, 23, 25, 27, 28, 30
<i>Aricia artaxerxes</i> (Fabricius, 1793)	12, 15, 17
<i>Aricia anteros</i> (Freyer, 1838)	12, 15
<i>Cyaniris semiargus</i> (Rottemburg, 1775)	12, 13, 14, 15, 17
<i>Polyommatus amandus</i> (Schneider, 1792)	12, 13, 17

<i>Polyommatus dorylas</i> (Dennis & Schiffermuller, 1775)	14
<i>Polyommatus icarus</i> (Rottemburg, 1775)	2, 3, 5, 7, 8, 9, 10, 11, 13, 15, 16, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29
<i>Polyommatus eros</i> (Ochsenheimer, 1808)	13
Libytheidae	
<i>Libythea celtis</i> (Laicharting, 1782)	11, 19, 26, 33
Nymphalidae	
<i>Apatura metis</i> Freyer, 1829	18
<i>Limenitis reducta</i> (Staudinger, 1901)	12, 19, 20, 21
<i>Limenitis camilla</i> (Linnaeus, 1764)	12
<i>Nymphalis antiopa</i> (Linnaeus, 1758)	9, 19, 25, 27
<i>Aglais io</i> (Linnaeus, 1758)	6, 9, 16,
<i>Aglais urticae</i> (Linnaeus, 1758)	9, 15, 16, 27
<i>Nymphalis polychloros</i> (Linnaeus, 1758)	31
<i>Vanessa atalanta</i> (Linnaeus, 1758)	2, 15, 19, 24, 25, 28, 31
<i>Vanessa cardui</i> (Linnaeus, 1758)	5, 11, 15, 29, 31
<i>Issoria lathonia</i> (Linnaeus, 1758)	2, 19, 20, 26, 30
<i>Polygonia c-album</i> (Linnaeus, 1758)	17
<i>Polygonia egea</i> (Cramer, 1775)	18
<i>Argynnis paphia</i> (Linnaeus, 1758)	21
<i>Argynnis aglaja</i> (Linnaeus, 1758)	15
<i>Argynnis niobe</i> (Linnaeus, 1758)	21
<i>Brenthis hecate</i> (Dennis & Schiffermuller, 1775)	12
<i>Brenthis daphne</i> (Bergstrasser, 1780)	12, 15
<i>Brenthis ino</i> (Rottemburg, 1775)	12, 15
<i>Boloria titania</i> (Esper, 1793)	15
<i>Boloria euphrosyne</i> (Linnaeus, 1758)	15
<i>Melitaea cinxia</i> (Linnaeus, 1758)	1, 3, 9, 12, 14, 17, 25, 29
<i>Melitaea phoebe</i> (Dennis & Schiffermuller, 1775)	12
<i>Melitaea diamina</i> (Lang, 1789)	15
<i>Melitaea didyma</i> (Esper, 1778)	12, 17, 21
<i>Melitaea athalia</i> (Rottemburg, 1775)	12, 15, 17
<i>Melitaea aurelia</i> Nickerl, 1850	12
<i>Euphydryas maturna</i> (Linnaeus, 1758)	12
<i>Euphydryas aurinia</i> (Rottemburg, 1775)	2, 12, 15, 19, 29
<i>Melanargia galathea</i> (Linnaeus, 1758)	12
<i>Melanargia larissa</i> (Geyer, 1828)	19, 20
<i>Hypparchia syriaca</i> (Staudinger, 1871)	18, 20
<i>Hypparchia fagi</i> (Scopoli, 1763)	12
<i>Satyrus ferula</i> (Fabricius, 1793)	21
<i>Brintesia circe</i> (Fabricius, 1775)	20
<i>Erebia medusa</i> (Dennis & Schiffermuller, 1775)	13
<i>Erebia ottomana</i> Herrich-Schaffer, 1847	13, 16
<i>Erebia oeme</i> (Hübner, 1804)	13, 14
<i>Maniola jurtina</i> (Linnaeus, 1758)	12
<i>Coenonympha rhodopensis</i> Elwes, 1900	13, 14
<i>Coenonympha pamphilus</i> (Linnaeus, 1758)	1, 2, 3, 5, 8, 11, 19, 20, 22, 23, 24, 28, 29
<i>Coenonympha arcania</i> (Linnaeus, 1761)	15, 17, 21
<i>Coenonympha orientalis</i> Rebel, 1910	17
<i>Coenonympha glycerion</i> (Borkhausen, 1788)	12, 14, 16
<i>Pararge aegeria</i> (Linnaeus, 1758)	1, 2, 3, 4, 11, 18, 22
<i>Lasiommata megera</i> (Linnaeus, 1767)	1, 2, 5, 7, 8, 10, 11, 19, 20, 22, 24, 27, 28, 29, 30
<i>Lasiommata maera</i> (Linnaeus, 1758)	11, 12, 15, 28
Hesperiidae	
<i>Pyrgus malvae</i> (Linnaeus, 1758)	3, 12, 30
<i>Pyrgus alveus</i> (Hubner, 1803)	14
<i>Pyrgus armoricanus</i> (Oberthur, 1910)	16
<i>Pyrgus serratulae</i> (Rambur, 1839)	14

<i>Pyrgus sidae</i> (Esper, 1784)	2, 12
<i>Spialia orbifer</i> (Hubner, 1823)	12, 16, 20
<i>Carcharodus alcae</i> (Esper, 1780)	18, 24
<i>Carcharodus floccifera</i> (Zeller, 1847)	15
<i>Carcharodus orientalis</i> Reverdin, 1913	2
<i>Erynnis tages</i> (Linnaeus, 1758)	3, 17, 20, 24
<i>Carterocephalus palaemon</i> (Pallas, 1771)	17
<i>Heteropterus morpheus</i> (Pallas, 1771)	12
<i>Thymelicus acteon</i> (Rottemburg, 1775)	21
<i>Thymelicus lineola</i> (Ochsenheimer, 1808)	12
<i>Thymelicus sylvestris</i> (Poda, 1761)	12
<i>Ochlodes sylvanus</i> (Esper, 1777)	12

A total of 112 species were observed during our surveys, representing approximately 70% of all known species for the country (Sijarić, 1984). As no specimens were collected we could not examine the genitalia of *Leptidea* sp., and have therefore listed them as *L. sinapis/juvernica*, the first being much more likely widespread in Montenegro. The most common species was *P. icarus*, which occurred at 21 sites, followed by *I. podalirius*, *P. mannii*, *A. cardamines*, *C. croceus*, *L. sinapis/juvernica*, *G. alexis*, *A. agestis*, *L. megera*, all observed at 14 or more localities. Mostly due to single short summer visit to the mountainous interior part of Montenegro 48 species were observed only at a single location.

Discussion

Due to lack of recent publications we can compare our results only to historical records published thirty or more years ago. Based on these published records we selected some of the rare and local species in Montenegro and for them we provide a more detailed discussion:

Papilio alexanor - the species was reported from Montenegro for the first time by Nicholl (1899) for surroundings of Cetinje. Interestingly Rebel quotes Nicholl, but mentions village Boljevići as the location where she observed *P. alexanor*. One additional observation is reported by Cernelutti & Michieli (1958) for Stari Bar. Since then, there was one additional record from Montenegro for Kotor (Bollino & Sala 2004), however without any additional information on location and date of observation. A photograph of an adult specimen from Njeguši village just above Kotor in May 2008 corroborates this record (Chirs Dowson, pers. comm.). The species was considered extinct in Yugoslavia (Collins & Morris, 1985). We have observed several specimens flying on steep slopes below the Stari Bar fortress confirming its presence at one of the historical sites after more than half a century. The larval host plant *Opopanax chironium* was also observed on the site. *P. alexanor* is protected in Montenegro (Službeni list RCG, 2006) and we hope this possibly extremely isolated population will not be targeted by collectors.

Gonepteryx cleopatra – the species was reported from Montenegro only in 1950's from the vicinity of Sutorman (Cernelutti & Michieli 1958). It is widespread along the Adriatic coast in Dalmatia (Jakšić 1988, Withrington & Verovnik 2008) and also in Greece (Pamperis 2009), but there is an evident gap in the distribution in



Fig. 2: Habitat (a) and adult (b) photo of *Papilio alexanor* from Stari Bar in Montenegro (photo Vid Švara).

Sl. 2: Habitat (a) in odrasli osebek (b) *Papilio alexanor* iz okolice Starega Bara v Črni gori (foto Vid Švara).

Montenegro and possibly northern Albania. During our surveys only a single male was observed patrolling over bushy vegetation near Buljarica village.

Cupido osiris – this species is not mentioned in any of the historical publications, therefore we consider it as a new species record for Montenegro. It is known from all neighbouring countries (Rebel 1913, Lelo 2000, Popović & Đurić 2011), therefore its discovery was anticipated. A single male was observed flying over rough grassy terrain near Glavati village.

Brenthis ino – no previous published records, but indicated as present in Montenegro in the bordering area to Bosnia and Hercegovina in distribution maps by Jakšić (1988). This species has been found in low numbers below Pivska planina in dry grasslands and more commonly on wet meadows at Barno Lake near Žabljak, both in Durmitor Mts. The species possibly expanded its range recently, as it was not observed during the detailed surveys in the past century (Sijarić et al. 1984).

Apatura metis – another species with no published records, but indicated as present in Montenegro at Skadar Lake according to distribution maps by Jakšić (1988). Indeed, this species has been found at several sites around Skadar Lake by Filip Franeta (pers. comm.). We observed several males imbibing minerals on muddy shores of Biševina River near Dodoši village (Skadar Lake area), while females were perching on trees.

Coenonympha orientalis – the species was first mentioned for Montenegro by Nicholl (1902) for Durmitor Mts. however it has not been found there again during



Fig. 3: *Cupido osiris* male from vicinity of Glavati village in Montenegro (photo Vid Švara).

Sl. 3: Samec *Cupido osiris* iz okolice vasi Glavati v Črni gori (foto Vid Švara).

intensive surveys in the past century (Sijarić et al. 1984). Unexpectedly, it was found at much lower altitude (800 m) in Tara River canyon near Gornje Dobrilovine. Authors also mention its presence on Mt. Goleš and Mt. Sjekirica further eastwards (Sijarić et al. 1984). We found the species at Zminičko Lake, where it was flying together with its much more abundant close relative *C. arcania*. Their behaviour was markedly different with *C. orientalis* almost exclusively staying among juniper bushes, while *C. arcania* commonly ventured into glades visiting flowers.

Pyrgus sidae – so far only reported for Lovćen (Sijarić, 1984) and Cetinje area (Rebel, 1913). The species is possibly more widespread as it was found in Durmitor region at Pivska planina (several specimens) and near Sutomore at the coast (single fresh specimen).

In the absence of any recent checklists of Montenegrin butterflies Sijarić's list (Sijarić 1984) could be considered as baseline source for a comparison. He lists 160 species, but omitted three previously published records by Rebel & Zerny (1931): *Gonepteryx farinosa* (Zeller, 1847) mentioned for Bar and *Erebia triaria* (De Pruner, 1798) from Volujak and Rikavac, and possibly by mistake also very common *Glaucopsyche alexis* first recorded from Cetinje. He also does not include *Pieris balcana*, which he recorded in Durmitor (Sijarić et al. 1984). The only subsequent published addition is *Danaus chrysippus* recorded from Budva, Boka Kotorska and Risan by Jakšić & Ristić (1999). The species count becomes more complicated when taking into account distribution maps of Jakšić (1988) who indicates the presence of several additional species: *Leptidea duponcheli* (Staudinger, 1871), *Satyrrium w-album* (Knoch, 1782), *Lycaena thersamon* (Esper, 1784), *Polyommatus escheri* (Hübner, 1923), *Charaxes jasius* (Linnaeus, 1767), *Apatura ilia* (Dennis & Schiffermüller, 1775), *Apatura metis*, *Brenthis ino*, and *Hipparchia fatua* (Freyer, 1884). Although these records are not entirely unlikely, they remain anonymous as no additional literature source indicating the presence of these species could be found. We have, however, confirmed the presence of *Apatura metis* and *Brenthis ino*, and together with *Cupido osiris*, bring the total number of observed species in Montenegro to 168. The list is by far not complete, as several records remain unpublished (Filip Franeta, pers. comm.) and the north-eastern mountainous part of the country has hardly been surveyed.

Based on our surveys and incomplete geographic coverage it is hard to judge the endangerment of particular species. However some of the EC Habitat directive species are still widespread in Montenegro and should be taken into consideration for establishment of Emerald network of protected sites in this country. In particularly *Zerynthia polyxena* is widespread in coastal part of the country and possibly threatened by habitat degradation caused by building of tourist infrastructure. *Apatura metis* is another species with an important stronghold around Skadar Lake which is of high conservation importance in general. In addition *Parnassius apollo*, *P. mnemosyne*, *Phengaris arion*, *Euphydryas maturna* could have important strongholds in the Montenegro mountains, but further studies are required. European Red List of Butterflies (Van Swaay et al. 2010) includes some additional species of conservation importance among which *Coenonympha orientalis* is considered vulnerable (VU).

The legislative part of butterfly conservation in Montenegro is at present almost non-existent, as only four species from family Papilionidae are protected. Interestingly, the possibly threatened *Zerynthia polyxena* is not included, while common and widespread *Papilio machaon* and *Iphiclides podalirius* are. *Papilio alexanor*, included also in Annex IV of the EC Habitat directive, is probably the most threatened butterfly species in Montenegro due to general habitat degradation along the coast and possible isolation of the single known population.

In many respects Montenegro is still an uncharted territory and certainly holds many important new discoveries. We hope that our publication will contribute to the beginning of a more systematic research of butterflies in Montenegro and hopefully also to conservation of its rich flora and fauna.

Acknowledgments

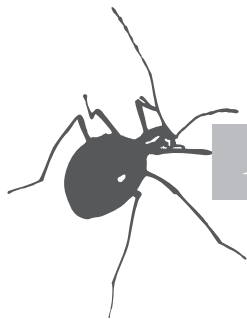
We are thankful to Milan Đurić, Miloš Popović, Matjaž Bedjanič, Sanja Behrič, Mateja Delač, Nika Kogovšek, Bia Rakar, Katja Zeme, Anže Suhadolnik, Anja Štular, Tajda Gredar, Andrej Peternel, Luka Šturm and Blaž Vončina for their company during field work and Chirs Dowson for sharing his observation of *Papilio alexanor*. We are especially grateful to Filip Franeta who kindly commented the first version of the manuscript and for his help during field work. Surveys in 2009 and 2013 were part of student research camps organized by Biology Students' Society from Slovenia.

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**A CONTRIBUTION TO THE FAUNA OF NEUROPTERA (INSECTA)
OF THE KAHRAMANMARAŞ PROVINCE, TURKEY**

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Abstract - Neuroptera specimens were collected between June and September in the years of 2010-2014 in the Kahramanmaraş province, Turkey. Collected specimens were determined to belong to 34 species, 22 genera, and 7 families, which is 16 percentage of the number of neuropteroids recorded in Turkey. The existence of 7 species previously reported from the area has not been confirmed during the fieldwork. 22 species are the first records for the Neuroptera fauna of Kahramanmaraş.

KEY WORDS: Neuroptera, Fauna, Kahramanmaraş, Turkey.

**Izveček – PRISPEVEK K FAVNI MREŽEKRIŁCEV (INSECTA: NEUROPTERA)
PROVINCE KAHRAMANMARAŞ, TURČIJA**

Primerki mrežekrilcev so bili zbirani med junijem in septembrom v letih 2010 – 2014 v provinci Kahramanmaraş, Turčija. Zbrani primerki so bili določeni in pripadajo 34 vrstam, 22 rodovom in 7 družinam, kar je 16 odstotkov števila nevropteroidov, zabeleženih v Turčiji. Prisotnost sedmih vrst, predhodno zabeleženih v območju, med terenskim delom ni bila potrjena. 22 vrst je prvič zabeleženih v favni mrežekrilcev Kahramanmaraşa.

KLJUČNE BESEDE: Neuroptera, favna, Kahramanmaraş, Turčija.

Introduction

Most adults of neuropteran insects are predaceous. They feed on aphids, mites, and several other agricultural pests, and these insects can be used in integrated pest management (Ghahari et al., 2010). The Neuroptera includes 687 species and 17

subspecies in the Palaearctic region and about 6000 species in the world (Aspöck, et al., 2001).

The first Turkish faunal data on Neuroptera was published in the paper by Schneider (1845). After 1960, the exploration of the local fauna in Turkey was increased dramatically. In the ensuing years, the new species and faunistic records from Turkey were given (Aistleitner, 1982; Aspöck, 1987, 1989, 1996; Aspöck & Aspöck 1965a, 1965b, 1966, 1969a, 1969b, 1979, 1980, 1994; Aspöck et al., 1978, 1984; Gepp, 1974; Hölzel, 1965, 1966, 1967a, 1967b, 1968, 1969, 1972a, 1972b, 1978, 1987; Hölzel & Ohm, 1986; Kačirek, 1998; Koçak, 1976; Meinander, 1972; Monserrat & Hölzel, 1987; Rausch & Aspöck, 1978; Rausch et al., 1978; Şengonca, 1978, 1979, 1980a, 1980b, 1981a 1981b).

Turkish and European neuropterologists have started to increase the works on the Neuroptera since 2000. These researchers have provided new records to Turkish neuropteran fauna and new species to the world neuroptean fauna (Abrahám & Mészáros, 2002; Ari, 2014; Ari et al., 2007a, 2007b; Ari & Kiyak, 2000, 2003; Berber & Canbulat, 2009; Canbulat, 2007a, 2007b, 2013; Canbulat & Kiyak, 2002a 2002b, 2003a, 2003b, 2005; Dobosz & Abraham, 2009; Kemal & Koçak, 2006; Kiyak & Özdikmen, 1993; Koçak & Kemal, 2008; Kovanci & Canbulat, 2007; Kovanci et.al., 2014; Ohl, 2009; Onar, 2007; Özgen, et al., 2012; Satar, 2005; Satar & Özbay, 2002, 2003; Rausch & Weißmair, 2007).

By 2015, as a result of Neuroptera researches above, The Neuroptera order is represented by 11 families, 210 species, and 4 subspecies in Turkey (Table 1). In the present study, 34 species are listed for the Kahramanmaraş province.

Family	Number of species	Number of subspecies	Family	Number of species	Number of subspecies
Ascalaphidae	12	2	Mantispidae	5	
Berothidae	2		Myrmeleontidae	55	1
Chrysopidae	56		Nemopteridae	13	
Coniopterygidae	27		Osmylidae	4	
Dilaridae	2		Sisyridae	3	
Hemerobiidae	31	1			

Table 1: The number of species and subspecies of each family in Turkey.

The neuropterid fauna of Kahramanmaraş was insufficiently investigated up to now, and only sporadic papers on species occurrence in the province existed. To date, 20 Neuroptera species have been recorded from Kahramanmaraş (for review, see

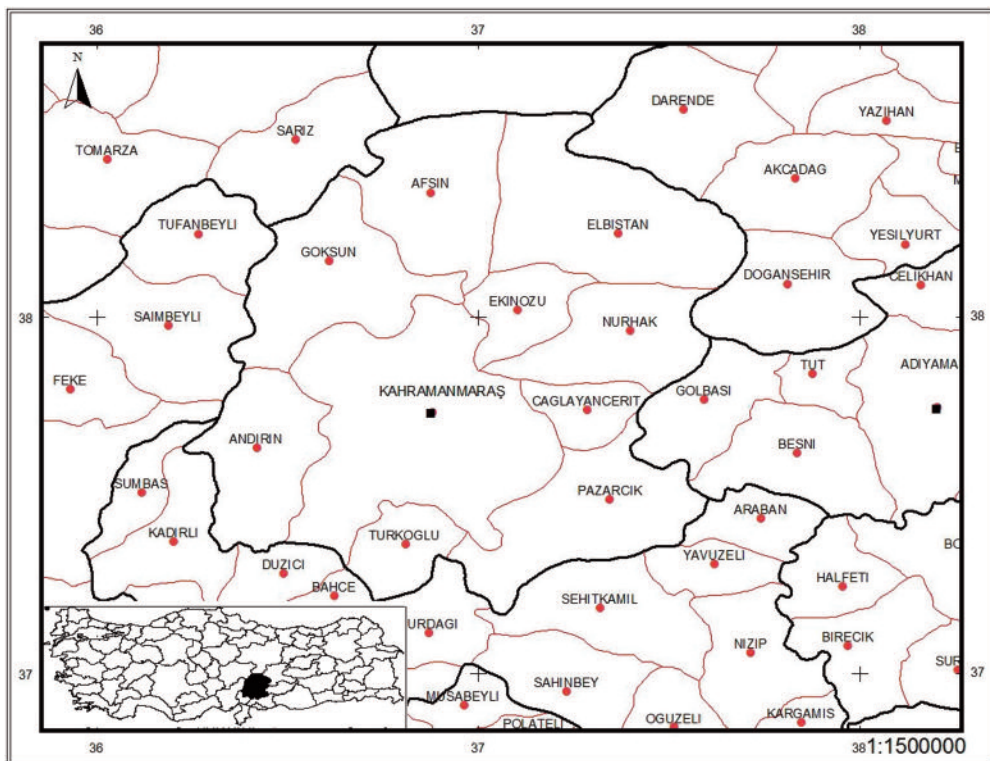


Fig. 1: Map of Kahramanmaraş, Turkey

Hölzel, 1967a, 1968; Şengonca, 1978, 1979, 1980a, and 1981a, 1981b; Kaçirek, 1998; Ari & Kiyak, 2000; Bahadıroğlu & Daymaz, 2001).

Kahramanmaraş is located in the south part of Turkey. The province is characterized by mountains, plains, plateaus, and various forest types. The north part of Amanos Mountains, Başkonuş Kubalı Mountain, Ahır Mountain, and Kartal Kaya Mountains exist in the west part of Kahramanmaraş. A big part of surface area of the province is constituted by plains namely Narlı, Sağlık, and Maraş and plateaus, including Erkenez, Aksu, Imalı, Büyükmine, and Karacasu. Majority of Kahramanmaraş is covered with various forest types, including deciduous, coniferous, and mixed forests.

The objective of this study is to provide detailed information about the Neuropteran fauna and their distribution in the Kahramanmaraş province.

Materials and Methods

The specimens examined in this study were collected from 23 randomly located sampling sites in the Kahramanmaraş province. A total of 165 specimens of 34 species

belonging to 22 genera and 7 families were collected by sweep net and light trap between June and September in the years of 2010-2014.

Specimens were killed in jars with ethyl acetate. After that they were prepared, labeled according to the standard procedures for museum materials. Then they were stored in the Biology Department of Faculty of Arts and Sciences at Kilis 7 Aralık University.

To determine the species of the samples, the diagnostic keys and descriptions in the literature were used (Aspöck, et al., 1980; Bozsik, 2010; Gruppe, 2006; Hölzel, 1972a; Şengonca, 1980a, 1980b, 1981b).

Results

List of species

Family: Ascalaphidae Lefébvre, 1842

***Deleproctophylla dusmeti* Navás, 1914**

Materials examined: 1♀, 1♂, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 24.07.2011.

***Libelloides macaronius* (Scopoli, 1763)**

Material examined: 1♂, Çağlayancerit County (Vicinity of Ağbeyli Village), 37°44'03"N 37°13'48"E, 1600m., 21.07.2011.

Family: Berothidae Handlirsch, 1908

***Isoscelipteron fulvum* Costa, 1863**

Materials examined: 1♀, 1♂, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 13.09. 2014.

Family: Chrysopidae Schneider, 1851

***Brinckochrysa amseli* (Hölzel, 1967)**

Material examined: 1♂, Nurhak County (Gövdeli Village), 37°58'54"N 37°38'08"E, 1103m., 20.07. 2011.

***Chrysopa abbreviata* Curtis, 1834**

Material examined: 1♂, Vicinity of Tekir County, 37°54'24"N 36°35'58"E, 1125m., 23.07.2011.

***Chrysopa dorsalis* Burmeister, 1839**

Material examined: 1♂, Vicinity of Fatih District, 37°23'24"N 36°40'55"E, 1012m., 21.08.2010.

***Chrysopa formosa* Brauer, 1851**

Material examined: 1♀, Vicinity of Tekir County, 37°54'24"N 36°35'58"E, 1125m., 23.07.2011;

***Chrysopa perla* (Linnaeus, 1758)**

Material examined: 3♀♀, Başkonuş, 37°34'11"N 36°34'52"E, 1348m., 20.07.2010.

***Chrysopa viridana* Schneider, 1845**

Material examined: 2♀♀1♂, Vicinty of Fatih District, 37° 23'24"N 36°40'55"E, 1012m., 21.08. 2010; 1♀, Topçalı Village –Andırın, 37°33'35"N 36°34'46"E, 14499 m, 01.09. 2011; 1♂, Vicinty of Çağlayancerit District, 37° 44'26"N 37°15'43"E, 1274m., 21.07.2011; 1♀2♂♂, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 13.09. 2014.

***Chrysoperla carnea* (Stephens, 1836) sensu lato**

Material examined: 1♂, Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°27'23"N 37°05'32"E, 722m., 14.06.2010; 2♂♂, Başkonuş, 37°34'11"N 36°34'52"E, 1348m., 20.07.2010; 1♀, Vicinty of the thermal power plant in Afşin, 38°23'28"N 36°58'23 E" 1249m., 19.07.2011; 2♀♀, Vicinty of the thermal power plant in Afşin, 38°12'08"N 37°06'48 E" 1128m., 19.07.2011; 1♀, Elbistan–Nurhak road (Hırsızpınarı Cemetery), 38°02'14"N 37°18'32 E" 1520m., 20.07.2011; 1♀, Nurhak–Gölbaşı road (Gövdeli Village), 37°58'54"N 37°38'08"E, 1103m., 20.07.2011; 1♀, 10 km. to Çağlayancerit from Gölbaşı, 37°44'00"N 37°21'37 E" 964m., 21.07.2011; 2♀♀, Çağlayancerit (Ağbeyli Village), 37°44'03"N 37°13'48 E" 1600m., 21.07.2011; 2♀♀, Vicinty of Tekir County, 37°54'24"N 36°35'58"E, 1117m., 23.07.2011; 1♀, Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 24.07.2011; 2♀♀1♂, Başkonuş, 37°33'57"N 36°35'45"E, 1410m., 01.09.2011; 2♀♀1♂, Suluyayla–Andırın, 37°34'07"N 36°31'38"E, 1128m., 02.09.2011; 3♀♀2♂♂, Başkonuş, 37°34'05"N 36°35'09"E, 1348m., 03.09.2011.

***Italochrysa italica* (Rossi, 1790)**

Material examined: 3♀♀3♂♂, 10 km to Çağlayancerit from Pazarcık, 37°39'15"N 37°28'02"E, 964m., 21.07.2011; 3♀♀, 1♂, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 20.08. 2014.

***Nineta guadarramensis* (Pictet, 1865)**

Material examined: 2♂♂, Nurhak–Gölbaşı road (Vicinity of Tatlar Village), 37°57'50"N 37°35'22"E, 1129m., 20.7.2011.

***Peyerimhoffina gracilis* (Schneider, 1851)**

Material examined: 5♀♀3♂♂, Başkonuş, 37°34'03"N 36°35'14"E, 1323m., 20.07.2010.

***Pseudomallada flavifrons* (Brauer, 1850)**

Material examined: 2♀♀, Nurhak (Gövdeli Village), 37° 58'54"N 37°38'08"E, 1103m., 20.07. 2011; 1♀2♂♂, Vicinity of Çağlayancerit (The Murat Mountain), 997m., 21.7.2011; 2♀, Vicinity of Tekir County, 37°54'24"N 36° 35'58"E, 1125m.,

23.07.2011; 3♀♀4♂♂, Başkonuş, 37°34'11"N 36°34'52"E, 1348m., 19.07.2011; 3♀♀2♂♂, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 13.09. 2014.

***Pseudomallada prasinus* (Burmeister, 1839)**

Material examined: 3♀♀1♂, Nurhak (Gövdeli Village), 37° 04'07"N 36°31'38"E, 1103m., 20.07. 2011.

***Pseudomallada subflavifrons* (Tjeder, 1949)**

Material examined: 2♀♀1♂, Suluyayla Village-Andırın, 37° 58'54"N 37°38'08"E, 1128m., 02.09. 2011.

***Pseudomallada zelleri* (Schneider, 1851)**

Material examined: 1♂, Afşin (Tanır District), 38° 26'02"N 36°55'34"E, 1239m., 19.07.2011.

Family: Hemerobiidae Latreille, 1802

***Wesmaelius* (Kimminsia) *subnebulosus* (Stephens, 1836)**

Material examined: 1♂, Başkonuş, 37°34'11"N 36°34'52"E, 1348m., 20.07.2010.

Family: Mantispidae Leach in Brewster, 1815

***Mantispa aphavexelte* H. Aspöck & U. Aspöck, 1944**

Materials examined: 1♀2♂♂, Topçalı village – Andırın, 37°33'35"N 36°34'46"E, 1449m, 01.09. 2011; 1♀1♂, Nurhak (Gövdeli Village), 37° 58'54"N 37°38'08"E, 1103m., 20.07. 2011.

***Mantispa scabricollis* McLachlan, 1875**

Material examined: 1♂, Nurhak (Gövdeli Village), 37° 58'54"N 37°38'08"E, 1103m., 20.07. 2011.

***Mantispa styriaca* (Poda, 1761)**

Material examined: 1♀, Nurhak (Gövdeli Village), 37° 38'54"N 37°38'08"E, 1120m., 20.07. 2011.

Family: Myrmeleontidae Latreille, 1802

***Creoleon plumbeus* (Olivier, 1811)**

Materials examined : 1♀2♂♂, Vicinity of thermal power plant in Afşin, 38° 23'28"N 36°58'23"E, 1249m., 19.07. 2011; 1♂, 20 km to Çağlayancerit From Pazarcık, 37°37'52"N 37°29'08"E, 963m., 21.7.2011; 1♀, Vicinity of Elbistan County (Cemetery), 38°02'14"N 37°18'32"E, 1519m., 20.07.2011; 1♀, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 24.07.2011.

***Dendroleon pantherinus* (Fabricus, 1787)**

Materials examined: 1♀1♂, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 29.8.2014; 1♀, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 24.07.2011.

***Distoleon tetragrammicus* (Fabricus, 1798)**

Material examined: 1♀, Topçalı Village – Andırın, 37°33'35"N 36°34'46"E, 1449m., 01.09. 2011; 2♀♀, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 12.09.2014.

***Myrmecaelurus major* McLachlan, 1875**

Material examined: 1♀, Nurhak (Boyalıceylanlar Village), 38° 04'28"N 37°09'37"E, 1120m., 20.07. 2011.

***Myrmecaelurus trigrammus* (Pallas, 1771)**

Materials examined: 2♀♀, Vicinity of thermal power plant in Afşin, 38° 23'28"N 36°58'23"E, 1249m., 19.07. 2011; 1♀, Nurhak (Tatlar Village), 37° 57'50"N 37°35'22"E, 1203m., 20.07. 2011; 1♂, 20 km to Çağlayancerit from Pazarcık, 37°37'52"N 37°29'08"E, 963m., 21.7.2011; 2♂♂, Vicinity of Çağlayancerit, 37°39'15"N 37°28'02"E, 997m., 21.7.2011.

***Neuroleon (Ganussa) tenellus* (Klug, 1834)**

Material examined: 1♂, Nurhak (Gövdeli Village), 37° 58'54"N 37°38'08"E, 1113m., 20.07. 2011.

***Neuroleon (Neuroleon) assimilis* (Navás, 1914)**

Materials examined: 21♀♀3♂♂, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 38°04'40"N 37°13'01"E, 687m., between 25.08.2014 and 13.09.2014.

***Neuroleon (Neuroleon) egenus* (Navás, 1914)**

Materials examined: 2♂♂, Ekinözü (Akpınar Vicinity), 38°04'40"N 37°13'01"E, 1339m., 20.07.2011.

***Nicarinus poecilopterus* (Stein, 1863)**

Materials examined: 2♂♂, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 37°26'57"N 37°05'43"E, 687m., 11.9.214.

***Palpares libelluloides* (Linnaeus, 1764)**

Materials examined: 1♀1♂, 37°23'24"N 36°40'55"E, Fatih District, 1012m., 20.7.2010; 2♀♀1♂, 37°23'24"N 36°40'55"E, Bank of Elbistan-Nurhak road, 1519m., 20.7.2011; 2♀♀, 37° 54'24"N 36° 35'58"E, Vicinity of Tekir, 1117m., 23.07.2011.

***Solter ledereri* Navás, 1912**

Material examined: 1♂, Bank of Kahramanmaraş-Narlı road (Hukukçular Ormanı), 38°04'40"N 37°13'01"E, 680m., 20.07. 2011.

Family: Nemopteridae Burmeister, 1839***Lertha extensa* (Olivier, 1811)**

Material examined: 1♀, Bank of Ekinozu-Elbistan road, 37°26'57"N 37°05'43"E, 687m., 14.09.2011.

***Nemoptera sinuata* Olivier, 1811**

Materials examined: 1♂, Vicinity of Fatih District, 37°23'24"N 36°40'5"E, 1012m., 20.06.2010; 2♀♀, 5♂♂, Firniz, 37°42'29"N 36°41'23"E, 1012m., 29.06.2010.

Discussion

In previous studies, 20 species belonging to 5 families, namely Berothidae, Chrysopidae, Hemerobiidae, Myrmeleontidae, and Nemopteridae, were recorded from Kahramanmaraş (Hölzel, 1967a, 1968; Şengonca, 1978, 1979, 1980a, and 1981a, 1981b; Kačirek, 1998; Ari & Kiyak, 2000; Bahadıroğlu & Daymaz, 2001). In this work, existence of *Chrysopa pallens*, *Chrysotropia ciliata*, *Chrysopa dubitans*, *Chrysopa hungarica*, *Chrysopa nigricostata*, *Italochrysa vartianorum* of Chrysopidae, and *Symphorobius* (*Symphorobius*) *pygmaeus* has not been confirmed. There was no species belonging to Ascalaphidae and Mantispidae in previous studies; however 5 species of both families have been recorded in this study. Total of 34 species belonging to 22 genera and 7 families have been determined. Of 34 species, 12 (*Isoscelipteron fulvum*, *Brinckochrysa amseli*, *Chrysopa formosa*, *Chrysopa viridana*, *Chrysoperla carnea*, *Italochrysa italica*, *Pseudomallada flavifrons*, *Pseudomallada prasinus*, *Pseudomallada subflavifrons*, *Palpares libelluloides*, *Lertha extensa*, and *Nemoptera sinuata*) were recorded in previous documents. The rest of 34 species have been added to Kahramanmaraş neuropterid fauna by this study.

Chrysopa dorsalis and *Peyerimhoffina gracilis* are confined to coniferous trees, and *Mantispa aphavexelte*, *Mantispa scabricollis*, *Mantispa styriaca*, *Nineta guadarraensis*, *Italochrysa italica*, *Chrysopa viridana*, *Chrysopa abbreviata*, *Brinckochrysa amseli*, and *Neuroleon* (*Ganussa*) *tenellus* were captured from deciduous trees. *Lertha extensa*, *Deleproctophylla dusmeti*, *Myrmecaelurus major* and *Libelloides macaronius* are common in steppe habitats. Specimens belonging to *Palpares libelluloides*, *Myrmecaelurus trigrammus*, *Creoleon plumbeus*, *Distoleon tetragrammicus*, *Pseudomallada subflavifrons*, *Pseudomallada prasinus*, *Pseudomallada flavifrons*, *Chrysoperla carnea* are commonly found on broad-leaved trees such as oak, poplar, plum, pear, and coniferous trees such as *Pinus brutia*, *Pinus nigra*, *Cedrus libani*, *Abies cilicica*, herbaceous plants, shrubs, and steppe. In table 2, collecting methods of specimens are presented.

Name of the Species	Capturing Methods		Name of the Species	Capturing Methods	
	Insect Net	Light Trap		Insect Net	Light Trap
<i>Deleproctophylla dusmeti</i>	+	-	<i>Pseudomallada zelleri</i>	+	-
<i>Libelloides macaronius</i>	+	-	<i>Mantispa aphavexelte</i>	+	-
<i>Isoscelipteron fulvum</i>	-	+	<i>Mantispa scabricollis</i>	+	-
<i>Wesmaelius (K.) subnebulosus</i>	+	-	<i>Mantispa styriaca</i>	+	-
<i>Brinckochrysa amseli</i>	+	-	<i>Creoleon plumbeus</i>	+	+
<i>Chrysopa abbreviata</i>	+	-	<i>Dendroleon pantherinus</i>	-	+
<i>Chrysopa dorsalis</i>	+	-	<i>Distoleon tetragrammicus</i>	+	+
<i>Chrysopa formosa</i>	+	-	<i>Myrmecaelurus major</i>	+	-
<i>Chrysopa perla</i>	+	+	<i>Myrmecaelurus trigrammus</i>	+	+
<i>Chrysopa viridana</i>	+	-	<i>Neuroleon (Ganussa) tenellus</i>	+	-
<i>Chrisoperla carnea</i>	+	+	<i>Neuroleon (N.) assimilis</i>	-	+
<i>Italochrysa italica</i>	+	+	<i>Neuroleon (N.) egenus</i>	-	+
<i>Nineta guadarrensis</i>	+	-	<i>Nicarinus poecilopterus</i>	-	+
<i>Peyerimhoffia gracilis</i>	+	-	<i>Palpares libelluloides</i>	+	+
<i>Pseudomallada flavifrons</i>	+	+	<i>Solter ledereri</i>	-	+
<i>Pseudomallada prasinus</i>	+	-	<i>Lertha extensa</i>	+	-
<i>Pseudomallada subflavifrons</i>	+	-	<i>Nemoptera sinuata</i>	+	-

Table 2: Collecting methods of species. Plus (+) indicates the method used to capture species.

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