NAT. CROAT. | VOL. 23 | No 2 | 365–377 | ZAGREB | December 31, 2014

original scientific paper / izvorni znanstveni rad

THE FIRST FINDING OF THE *DRUSUS BOSNICUS* GROUP (INSECTA, TRICHOPTERA, LIMNEPHILIDAE) IN CROATIA WITH SOME NOTES ON DIVERSITY, TAXONOMY, DISTRIBUTION AND ECOLOGY OF GENUS *DRUSUS* IN CROATIA AND IN DINARIC KARST OF THE BALKAN PENINSULA

Mladen Kučinić[1]*, Ana Previšić[1], Iva Mihoci[2], Renata Ćuk[3], Antun Delić[4], Krešimir Žganec[5], Darko Cerjanec[6] & Ivan Vučković[7]

[1]Department of Biology (**Laboratory for Entomology*), Faculty of Science, University of Zagreb, Rooseveltov trg 6, 10 000 Zagreb, Croatia

[2]Croatian Natural History Museum, Demetrova 1, 10 000 Zagreb, Croatia

[3]Hrvatske Vode, Central Water Management Laboratory, Ulica grada Vukovara 220, 10 000 Zagreb, Croatia

[4]Faculty of Education, University of Zagreb, Trg Matice Hrvatske 12, 44 250 Petrinja, Croatia

[5]Department for Teachers Study in Gospić, University of Zadar, Ante Starčevića 12, 53 000 Gospić, Croatia

[6]Primary School Barilović, Barilović 96, 47252 Barilović, Croatia

[7]Elektroprojekt d.d., Civil and Architectural Engineering Department, Alexandera von Humboldta 4, 10 000 Zagreb, Croatia

Kučinić, M., Previšić, A., Mihoci, I., Ćuk, R., Delić, A., Žganec, K., Cerjanec, D. & Vučković, I.: The first finding of the *Drusus bosnicus* group (Insecta, Trichoptera) in Croatia with some notes on diversity, taxonomy, distribution and ecology of genus *Drusus* in Croatia and in Dinaric karst of the Balkan Peninsula. Nat. Croat., Vol. 23, No. 2, 365–377, 2014, Zagreb.

In the spring area of the Una River the caddisfly *Drusus vespertinus* Marinković-Gospodnetić, 1976, which belongs to the *Drusus bosnicus* group, was recorded for the first time in Croatia. This is the first finding of the *Drusus bosnicus* group species in Croatia. This paper presents the diversity, distribution and ecology of the genus *Drusus* in Croatia and in the Dinaric karst on the Balkan Peninsula. Additionally, in this paper we describe the female of *Drusus vespertinus*.

Ključne riječi: *Drusus*, *bosnicus* group, Croatia, Dinaric karst, Balkan Peninsula

Kučinić, M., Previšić, A., Mihoci, I., Ćuk, R., Delić, A., Žganec, K., Cerjanec, D. & Vučković, I.: Prvi nalaz *Drusus bosnicus* grupe (Insecta, Trichoptera) u Hrvatskoj s osvrtom na raznolikost, taksonomiju, rasprostranjenost i ekologiju roda *Drusus* u Hrvatskoj i dinaridskom kršu Balkanskog poluotoka. Nat. Croat., Vol. 23, No. 2, 365–377, 2014, Zagreb.

Na izvorišnom području rijeke Une zabilježena je u stadiju adulta i ličinke vrsta *Drusus vespertinus* Marinković-Gospodnetić, 1976, koja pripada *Drusus bosnicus* grupi. Ovo je prvi nalaz neke od vrsta *Drusus bosnicus* grupe u Hrvatskoj. U radu se prikazuje raznolikost, rasprostranjenost i ekologija roda *Drusus* u Hrvatskoj i u dinarskom kršu Balkanskog poluotoka. Također, u radu se daje opis ženke vrste *Drusus vespertinus*.

Ključne riječi: *Drusus*, *bosnicus* grupa, Hrvatska, dinarski krš, Balkanski poluotok

* corresponding author, e-mail: kucinic.mladen@biol.pmf.hr

INTRODUCTION

One of the most interesting genera within Trichoptera is the genus *Drusus* Stephens, 1837. With seven other genera (Pauls *et al.*, 2006) the genus *Drusus* belongs to a subfamily Drusinae Banks, 1916 (Waringer & Graf, 1997), family Limnephilidae Kolenati, 1848. The subfamily Drusinae has a total of 96 described species (Oláh & Kovács, 2013; Oláh, 2010, 2011; Malicky, 2004; Marinković-Gospodnetić, 1971a, 1971b). The genus with the highest diversity is *Drusus* with 80 described species (Oláh, 2010, 2011; Malicky, 2004). Species of the genus *Drusus* usually inhabit springs and crenal sections of mountain streams and rivers characterized by low water temperature with small annual variations (Graf *et al*., 2008). This important life history trait determines their distribution patterns, especially the isolation of mountain populations and high species diversity (e.g. Malicky 2004, 2005; Kumanski, 1988; Marinković-Gospodnetić 1976, 1978, 1979). One of the most interesting groups in the genus *Drusus* is the *Drusus bosnicus* group with high diversity and many endemic species. Numerous endemic species described from the Balkan Peninsula belong to the *Drusus bosnicus* group (e.g. Oláh & Kovács, 2013; Oláh 2010, 2011; Marinković-Gospodnetić 1971b; Klapálek, 1899). Therefore this group and the genus *Drusus* are very interesting for morphologic, taxonomic, phylogenetic, phylogeographic and evolutionary studies (e.g. Kučinić *et al.*, 2011a; Previšić *et al.*, 2009, 2014; Pauls *et al*., 2008; Waringer *et al*., 2007, 2008, 2013; Marinković-Gospodnetić, 1971a, 1971b). All species of the *Drusus bosnicus* group have some common morphological features like the shape of male genitalia, the dark coloration of adults (Schmid, 1956) and the daily activity patterns of adults.

The Dinaric karst is a 650 kilometres long and very diverse mountain area in the Balkan Peninsula, stretching from Slovenia (north-western border) to Albania (south-eastern border). This region harbours many endemic and relict species and subspecies of different animal groups (e.g. Bilandžija, *et al.*, 2013; Klobučar *et al.*, 2013; Kučinić *et al.*, 2013; Casale *et al*., 2012; Ivković *et al*., 2012; Murányi, 2011; Žganec *et al.*, 2011; Lukić *et al*., 2010; Bedek & Taiti, 2009; Lakota *et al*., 2009; Mustafić *et al*., 2008; Mihoci *et al*., 2007; Bedek *et al*., 2006; Mihoci & Šašić, 2005; Pavlek & Ozimec, 2005; Gottstein *et al*., 2002; Sket *et al*., 2001). The central and Mediterranean part of Croatia, Bosnia and Herzegovina and Montenegro belong to the Dinaric karst region, but also some smaller parts of Slovenia on the west, and Kosovo, Serbia and Albania on the southeast. The inland lowland part of Croatia does not belong to the Dinaric karst area of the Balkan Peninsula.

In this paper we present: 1. The first finding of *Drusus bosnicus* group in Croatia, 2. A description of the female of *Drusus vespertinus* Marinković-Gospodnetić, 1976, 3. Diversity and distribution of the genus *Drusus* in Croatia and in the Dinaric karst of the Balkan Peninsula, and 4. Comments on feeding ecology, emergence patterns and life cycle of the genus *Drusus* in the Dinaric karst.

MATERIAL AND METHODS

Research into caddisflies in the spring area of the Una River (Fig. 1) was conducted in the period 2005–2012. Within this period, caddisflies were sampled several times. Larvae were collected by handpicking while adults were collected with entomological nets during daytime and with UV light traps during the night. Specimens were stored in containers with 80% and 96% EtOH, for both morphological and molecular analysis. Collected specimens are deposited in the collections of M. Kučinić (Croatian Natural History Museum in Zagreb), Ana Previšić (Faculty of Science, Zagreb) and R. Ćuk (Hrvatske Vode).

Fig. 1. Spring of the Una River (photo: A. Delić).

Fig. 2. Male genitalia of *Drusus vespertinus* Marinković-Gospodnetić, 1976 collected in the spring of the Una River (photo: M. Franjević & M. Kučinić).

The female of *D. vespertinus* was drawn based on material collected on 23.06.2001 in the Bastašica spring, Drvar, Bosnia and Herzegovina (2 females, leg. M. Kučinić & A. Delić), in the Sanica River, Bosnia and Herzegovina (1 female, leg. P. Kružić & A. Previšić)

and on a specimen collected on 10.06.2010 in the spring of the Una River (2 females, leg. I. Mihoci & M. Kučinić).

Macrophotographing of larvae and adults was done at the Faculty of Forestry, University of Zagreb, using a Leica Wild MZ8 stereomicroscope and Olympus SP-500 UZ digital camera, processed with the computer program Olympus Quick Photo Camera 2.2. Photographing in the field (spring area of the Una River) was done with Olympus Photo camera EU 570. Taxonomic identification of the collected adults was conducted by Malicky (2004).

We have defined the area of the Dinaric karst according to Bilandžija *et al.* (2013) and the border of the Balkan Peninsula according to Reed *et al.* (2004). In our analyses we have included three species from the genus *Drusus* which live near or at the border of Dinaric karst: *D. bosnicus*, Klapálek, 1899, *D. botosaneanui* Kumanski, 1968 and *D. serbicus*. Marinković-Gospodnetić, 1971.

RESULTS AND DISCUSSION

Diversity and distribution of the genus *Drusus* in Croatia with description of the female of *Drusus vespertinus* Marinković-Gospodnetić, 1976

The finding of *Drusus vespertinus* Marinković-Gospodnetić, 1976 which belongs to the *Drusus bosnicus* group in the spring area of the Una River (Fig. 1) is the fifth species of the genus *Drusus* found in Croatia. In the spring area of the Una River (Fig. 1) adult and larval specimens of *D. vespertinus* were collected (leg. I. Mihoci, A. Delić, I. Vučković, M. Kučinić) while in Loskun only larval specimen were sampled (leg. R. Ćuk, K. Žganec). Analysis of morphological features of male genitalia of adult specimens collected in the spring area of the Una River confirms that they belong taxonomically to *Drusus vespertinus* Marinković-Gospodnetić, 1976 (Fig. 2). Before this finding in Croatia, this species was recorded only in the western part of Bosnia and Herzegovina at three localities: the spring areas of rivers Bastašica, Ribnik and Sanica (Marinković-Gospodnetić, 1979). Therefore, recent findings in Croatia represent the fourth and fifth localities where this species was found and the first finding of the *Drusus bosnicus* group in Croatia.

The female of *Drusus vespertinus* has not previously been described (Malicky, 2004; Marinković-Gospodnetić, 1976). Based on specimens collected in the Bosnia and Herzegovina and Croatian we present a description of the female of this species.

*Description***:** general appearance: dark brown; sclerites and tergites brown; cephalic and thoracic setal areas brown, abdominal setal areas light brown; body setation light brown; legs brown; haustellum and intersegmental teguments pale, whitish. Spur formula: 133 (N=3). Forewing length: 12.00 – 13.69 mm (N=3).

Female terminalia (Fig. 3 A-D): Lateral lobe of segment IX membraneous, triangular from lateral with a dorsal sclerotized setose part, the latter distinct and elongated from lateral and evenly rounded from dorsal and ventral. Segment X proximally wider than distally, from dorsal with 2 lateral lobes and a deep and round median excision leaving 2 distinct median protrusions in lateral, ventral and dorsal view; (Fig. 3 A-B, D); tips of lateral lobes sharp and distinct in dorsal and ventral view, approximately as long as supragenital plate; ventrally unsclerotized. Supragenital plate quadrangular in lateral, ventral and caudal view (Fig. 2 A-C). Vulvar scale with 2 lateral lobes in ventral view, lobes roundly oval with converging tips; median lobe reduced to a small triangular prominence (Fig. 3 D). The presented description enables identification of *D. vespertinus*

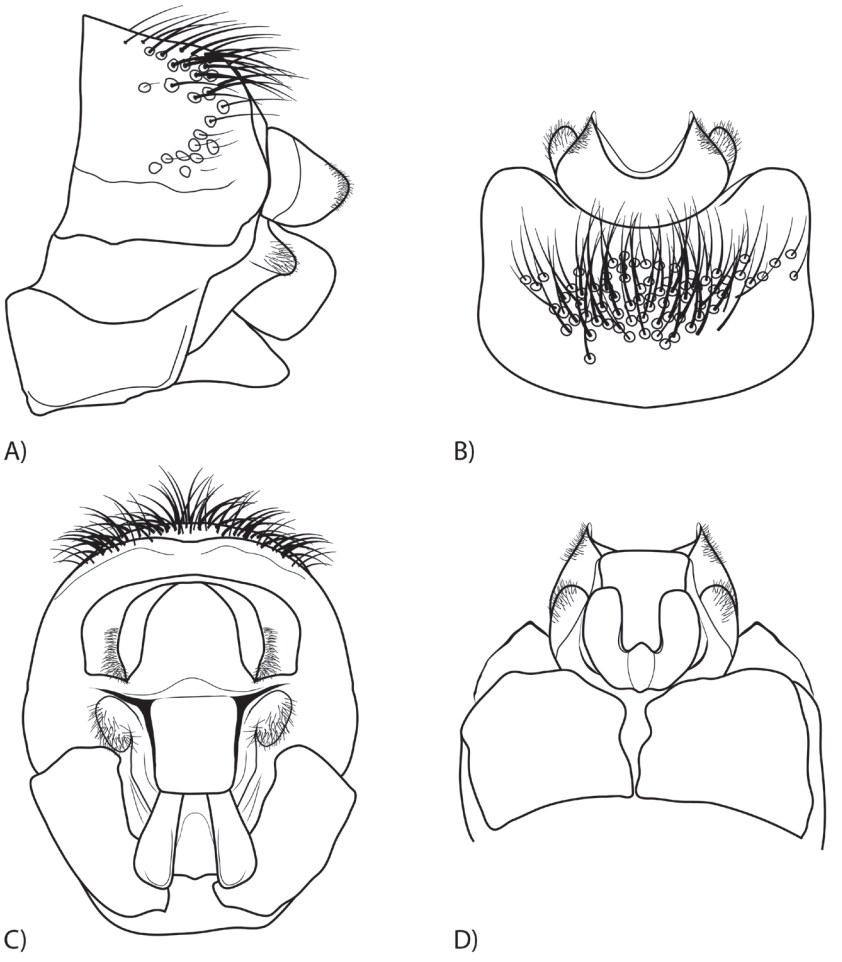

Fig. 3. A-D. Morphological features of female genitalia of *Drusus vespertinus*: A) lateral view; B) dorsal view; C) caudal view; D) ventral view.

females. So far, among the *D. bosnicus* group species occurring in the Dinaric karst area only females of *D. bosnicus*, *D. plicatus* and *D. krusniki* are described (Radovanović, 1942; Klapálek, 1899) and depicted in Malicky (2004).

However, in order to separate females of various species of the *D. bosnicus* group, a detailed revision and comparative analysis of morphological features of females of all *D. bosnicus* group species is necessary.

In the previous studies four species of the genus *Drusus* were recorded in Croatia: *D. croaticus* Marinković-Gospodnetić, 1971, *D. chrysotus* (Rambur, 1842), *D. discolor* (Rambur, 1842) and *D. schmidi* Botosaneanui, 1960 (e.g. Cerjanec, 2012; Previšić *et al.*, 2012, 2013; Habdija, 1979; Marinković-Gospodnetić, 1971a, 1979) (Fig. 4, Tab. 1). *Drusus croaticus* is the most common species of the genus *Drusus* in Croatia, recorded in approximately 20 springs and spring areas (Cerjanec, 2012; Previšić & Popijač 2010; Previšić *et*

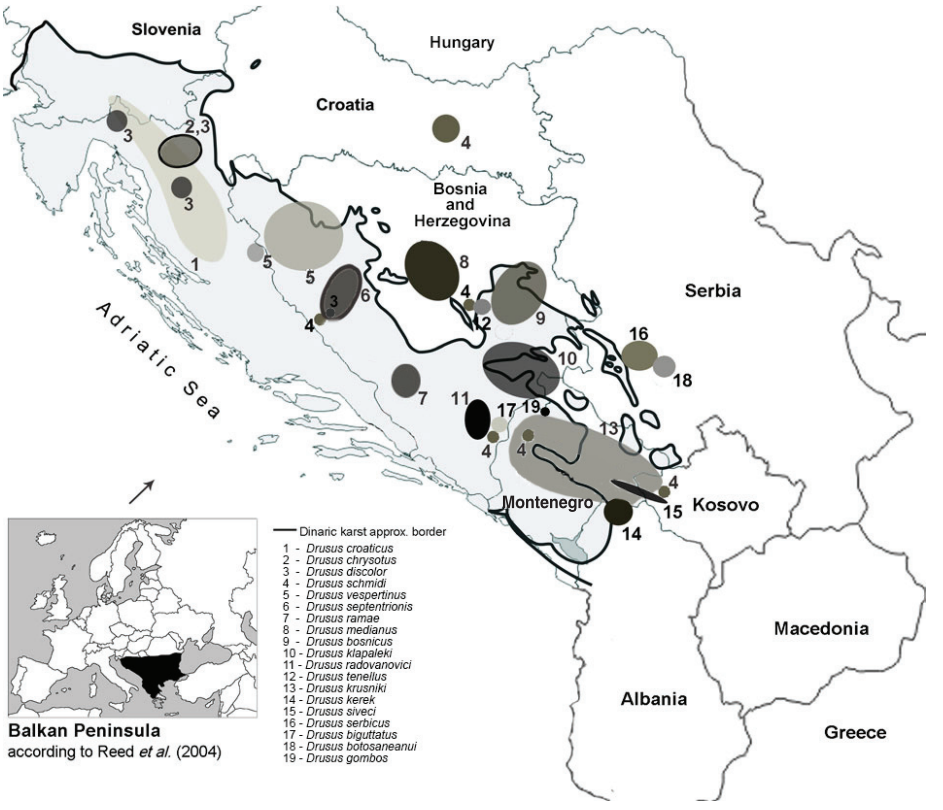

Fig. 4. Distribution of genus *Drusus* in Croatia and in the Dinaric karst of the Balkan Peninsula.

al., 2009, 2014; Marinković-Gospodnetić, 1971a, 1979; unpublished data M. Kučinić). According to literature data *D. croaticus* and *D. krusniki* are among the most frequent species of this genus in the Dinaric karst of the Balkan Peninsula (e.g. Ibrahimi, 2011; Oláh, 2010; Previšić *et al.*, 2009, 2014; Marinković-Gospodnetić, 1979; M. Kučinić, A. Previšić unpublished data). *Drusus croaticus* was also found in the Dinaric karst in Slovenia (Urbanič, 2004), an area that does not belong to the Balkan Peninsula.

The second species, *D. discolor* was found in Croatia for the first time, in the larval stage in one locality in the Mrežnica River, by Habdija (1979). In further studies *D. discolor* was recorded in adult stages at two localities in Croatia, in the springs of the Čabranka River and the Dobra River (Cerjanec, 2012; Previšić & Popijač, 2010) (Fig. 4). *Drusus discolor* is a widely distributed European species, ranging from Central Europe, the Pyrenees, Alps and Carpathians to the Balkan Peninsula (Pauls *et al.*, 2006).

The third species of the genus *Drusus* recorded in Croatia is *D. chrysotus* founded only in the spring of the Dobra River near the town of Skrad, in the mountain region Gorski kotar (Cerjanec, 2012; Previšić *et al*, 2012) (Fig. 4). Previously, *D. chrysotus* was found only in the Alps; therefore, the finding in Croatia indicates a disjunct population of this species and the easternmost point in the distribution area of *D. chrysotus*, distributed now also in the Dinaric karst of the Balkan Peninsula (Previšić *et al.*, 2012).

The last species from the genus *Drusus* recorded in Croatia is *D. schmidi* (Previšić *et al.*, 2013) and this is very interesting information. This species was found in the Dubočanka Stream and Jankovac Spring on Mt Papuk in eastern Croatia, the Slavonia region (Previšić *et al.*, 2013) (Fig. 4). This is the first finding of this species in the area lying outside of the Balkan Peninsula and the Dinaric karst. *Drusus schmidi* was also found in several locations in Bosnia and Herzegovina and Montenegro and in two locations on Kosovo (Previšić *et al.*, 2014; Ibrahimi, 2011; Stanić-Koštroman, 2009; Marinković-Gospodnetić, 1979). The population on Mt Papuk is the northernmost point in the distribution area of this species. Some additional species from the genus *Drusus* could possibly be found in the future in Croatia, like the widely distributed European species *D. biguttatus* (Pictet, 1834) or some species from the *D. bosnicus* group distributed in Bosnia and Herzegovina.

Diversity and distribution of the genus *Drusus* in Dinaric karst of the Balkan Peninsula

In the area of the Balkan Peninsula 40 species from genus *Drusus* are recorded (e.g. Oláh & Kovács, 2013; Oláh, 2010, 2011; Malicky, 2004, 2005; Krušnik, 1997; Kumanski, 1988; Marinković-Gospodnetić, 1971c, 1976, 1978, 1979). This area is the centre of diversity of this genus with 33 endemic species. Seven species are distributed also in other areas*: D. discolor* and *D. biguttatus* have wider European ranges, *D. botosaneanui* is also recorded in Turkey, *D. tenellus* (Klapálek, 1898) in the Carpathians (Kumanski, 1988; Malicky, 2004), *D. schmidi* in continental lowland part of Croatia, *D. chrysotus* in the Alps and *D. croaticus* in Slovenia (Previšić *et al.*, 2013) (Tab. 1).

Most of the endemic *Drusus* species in the Balkan Peninsula belong to the *D. bosnicus* Group. *Drusus bosnicus* group is also distributed in some other area e.g. the Alps

Tab. 1. Species of the genus *Drusus* in the Dinaric karst of the Balkan Peninsula with: distributional data, belonging or not to the *Drusus bosnicus* group, described or undescribed larvae and diet pattern (B & H = Bosnia and Herzegovina; MNG = Montenegro).

Species	Distribution	*D. bosnicus* group	Larva	Diet pattern
Drusus biguttatus	European species	no	described	grazers
Drusus bosnicus	B & H	yes	described	grazers
Drusus botosaneanui	Euro-Asian species	no	undescribed	?
Drusus chrysotus	Croatia, Alps	no	described	carnivorous filterers
Drusus croaticus	Croatia, Slovenia	no	described	grazers
Drusus discolor	European species	no	described	carnivorous filterers
Drusus gombos	MNG	yes	undescribed	?
Drusus kerek	Albania	yes	undescribed	?
Drusus krusniki	Albania, Kosovo, MNG	yes	undescribed	?
Drusus klapaleki	B & H	yes	described	grazers
Drusus medianus	B & H	yes	described	grazers
Drusus radovanovici	B & H	yes	described	grazers
Drusus ramae	B & H	yes	described	grazers
Drusus schmidi	B & H, Croatia, Kosovo, MNG	no	undescribed	?
Drusus serbicus	Serbia	no	undescribed	?
Drusus septentrionis	B & H	yes	described	grazers
Drusus siveci	MNG, Kosovo	no	undescribed	?
Drusus vespertinus	B & H, Croatia	yes	undescribed	grazers
Drusus tenellus	B & H, Macedonia, Romania	no	undescribed	?

(Waringer *et al.*, 2007). In the Dinaric karst there are 19 species of the genus *Drusus*, out of which 10 species of the *D. bosnicus* group were recorded: seven in Bosnia and Herzegovina *D. gombos* Oláh, 2013 in Montenegro, *Drusus krusniki* Malicky, 1981 in Kosovo, Montenegro and Albania and *Drusus kerek* Oláh, 2011 in Albania (Oláh & Kovács, 2013; Oláh, 2010, 2011; Kučinić *et al.*, 2008, 2010, 2011a, 2011b; Malicky, 1981; Marinković-Gospodnetić, 1979) (Tab. 1). As adults the *Drusus bosnicus* group species have limited dispersal abilities. They are active diurnally and are mostly restricted to spring areas and small zones of nearby streams/rivers resulting in disconnected populations and allopatric distribution. These biological features are the most important reasons for the high diversity and endemism of this group, as well as some geological and hydrological features (e.g. Previšić *et al.*, 2014; Kučinić *et al.*, 2011). Some other, nocturnal species from this genus with higher dispersal abilities of adults have larger distribution areas, e.g. species *D. schmidi*. Within the distribution area of *D. schmidi* (Bosnia and Herzegovina and Kosovo) eight endemic species of the *Drusus bosnicus* group have been recognized, but with smaller distribution areas and higher diversity. On the east, the *Drusus bosnicus* group is distributed in the areas of Albania and Macedonia and possibly in Bulgaria and Greece that are not a part of Dinaric karst. The western distribution border of the *Drusus bosnicus* group in the Balkan Peninsula is the area of Bosnia and Herzegovina, reaching Croatian territory only at a small and isolated part, in the spring area of the Una River. In other parts of Dinaric karst, in the central Croatia the *Drusus bosnicus* group was not found.

The spring of the Una River (Fig. 1) is situated at the eastern side of Mt Lička Plješivica. The border is bounded by the mountains among which the biggest are Lička Plješivica and Dinara which lie northwest to southeast, 130 km in length. These two mountains represent a natural border that prevents teh dispersal of the *Drusus bosnicus* group further to the west. At the west side of these mountains *Drusus croaticus*, which does not belong to the *Drusus bosnicus* group, is distributed. Species of the *Drusus bosnicus* group and *D. croaticus* have never been recorded as co-occurring species in one spring area, and neither have two different species from the *Drusus bosnicus* group. This pattern was observed for some other *Drusus* species; e.g. *D. discolor* – *D. septentrionis*, *D. chrysotus* – *D. discolor*, *D. croaticus* – *D. discolor*, *D. botosaneanui* – *D. plicatus*, (Cerjanec, 2012; Previšić & Popijač, 2010; Marinković-Gospodnetić, 1979). An explanation for the *Drusus bosnicus* group can be found in the possibility that the taxa of this group were separated in different periods during the Pleistocene (due to allopathic fragmentation), probably from a single, common ancestor with a large area of distribution in the Balkan Peninsula, which resulted in high diversity with numerous different, endemic taxa with small distribution areas (Kučinić *et al.*, 2011a; Marinković-Gospodnetić 1976, 1978). Recent phylogeographic study showed that two different *Drusus* species of the *Drusus bosnicus* group inhabit the spring of the Bosna River (Previšić *et al., 2014).* This is possibly an indication of a more complex distribution pattern and evolutionary history of the *Drusus bosnicus* group than previously recognised (e.g. Kučinić *et al.*, 2011a). Thus, full understanding of the latter remains a challenge for the future. Very likely *D. croaticus* had a different process of speciation in the separate area than the *Drusus bosnicus* group. In the future, some new *Drusus* species might be found in the Dinaric karst and the Balkan Peninsula; recently seven new species were described from Albania, one from Greece and one from Montenegro (Oláh & Kovács, 2013; Oláh, 2010, 2011). Possibly, some of them belong to the *Drusus bosnicus* group according to morphology of adults and larvae, and ethology (daily activity). For these species, belonging to the *Drusus bosnicus* group will be defined in the future.

Ecological notes on the genus *Drusus* in Dinaric karst of the Balkan Peninsula

The most important ecological features of aquatic insects include the feeding ecology of larvae, emergence patterns of adults and characters of life cycle.

Information on larval morphology (e.g. mandible, head, legs) enables knowledge of feeding ecology. All described and recorded larvae of the *Drusus bosnicus* group in Dinaric karst of the Balkan Peninsula belong to a group of grazers (Kučinić *et al.* 2008, 2010, 2011a, 2011b) (Tab. 1). Preliminary data indicate the same diet pattern for *Drusus vespertinus* larva (Previšić *et al.*, 2009; unpublished data A. Previšić, M. Kučinić). Because phylogenetically related species within the genus *Drusus* have the same feeding ecology (Pauls *et al.*, 2008), we believe that all species from the *D. bosnicus* Group belong to the group of grazers. Larval diet is known for three out of four Drusus species occurring in Croatia: the larvae of *D. croaticus* are grazers, while the larvae of *D. chrysotus* and *D. discolor* belong to the group of carnivorous filterers (Previšić *et al.*, 2012; Kučinić *et al.*, 2008; Pauls *et al.*, 2008). Diet pattern is very important for evolutionary processes and for diversity of the genus *Drusus* in general (Pauls *et al.* 2008).

In general, species from the genus *Drusus* usually inhabit rheocrene and limnocrene-type karst springs and crenal sections of mountain streams. In the Balkan Peninsula, species from the genus *Drusus* emerge in different periods, from spring to autumn (e.g. Previšić *et al.*, 2007; Kučinić, 2002). Some species, like *D. tenellus* or *D. botosaneanui* emerge in summer and autumn (Ibrahimi *et al.*, 2012; Stanić-Koštroman, 2009; unpublished data, M. Kučinić), while many other species, especially from the *Drusus bosnicus* group emerge in spring and then in the late summer and autumn. According to the literature data and our investigation, in the Dinaric karst of the Balkan Peninsula, only one species from the *Drusus bosnicus* group, *D. ramae*, emerges in spring alone and has a typical univoltine life cycle (Kučinić *et al.*, 2010; Stanić-Koštroman, 2009). All other species emerge from spring to autumn (bivoltine life cycle). Investigation of *D. septentrionis* and *D. croaticus* showed the possibility that both generations, the vernal and the autumnal, have a one year life cycle (Kučinić *et al.*, 2008). This type of a life cycle is also possible for some other species from the *Drusus bosnicus* group. Adults of different species from the *Drusus bosnicus* group are on the wing from April to November (e.g., Ibrahimi, 2011; Oláh, 2010; Previšić *et al*. 2007; Marinković-Gospodnetić, 1971c).

ACKNOWLEDGEMENTS

We are very grateful to Professor Boris Hrašovec and Dr Milivoj Franjević (Faculty of Forestry, University of Zagreb) for their assistance in macrophotography. This research was supported by the Austrian Science Fund (FWF) as a part of the Projects P 23687–B17 grant to Johann Waringer and Croatian Ministry of Science, Education and Sports as a part of the Projects No 119-1193080-3076 grant to Mladen Kerovec and No. 119–1193080–1206 grant to Mladen Kučinić and University of Zagreb funding (No. 202310 and No. 202307). We thank two anonymous reviewers for their valuable comments.

Received December 13, 2013

REFERENCES

Bedek, J., Gottstein Matočec, S., Jalžić, B., Ozimec, R. & Štamol, V., 2006: Katalog tipskih špiljskih lokaliteta faune Hrvatske, Catalogue of cave type localities of Croatian fauna. Natura Croatica **15** (Supl. 1), 1–154.

Bedek, J. & Taiti, S., 2009: A new species of *Strouhaloniscellus* Tabacaru, 1993 (Crustacea: Isopoda: Oniscidea) from a cave in Mt Biokovo, Croatia Zootaxa **2196**, 59–64.

Bilandžija, H, Morton, B., Podnar, M. & Ćetković, H., 2013: Evolutionary history of relict *Congeria* (Divalvia: Dreissenidae): Unearthing the subterranean biodiversity of Dinaric Karts. Frontiers in Zoology **10** (5), 1–17.

Casale A., Jalžić, B., Lohaj R. & Mlejnek, R., 2012: Two new highly specialised subterranean beetles from the Velebit massif (Croatia): *Velebitaphaenops* (new genus) *giganteus* Casale & Jalžić, new species (Coleoptera: Carabidae: Trechini) and *Velebitodromus ozrenlukici* Lohaj, Mlejnek & Jalžić, new species (Coleoptera: Cholevidae: Leptodirini). Natura Croatica **21** (1), 129–153.

Cerjanec, D., 2012: Ecological and biogeographical features of caddisflies (Insecta: Trichoptera) in different types of habitats in drainage of the Dobra River. PhD–Thesis (in Croatian), University of Zagreb, pp 226, Zagreb.

Gottstein Matočec, S., Bakran-Petricoli, T., Bedek, J., Bukovec, D., Buzjak, S., Franičević, M., Jalžić, B., Kerovec, M, Kletečki, E., Kovačić, M., Kralj, J., Kružić, P., Kučinić, M., Kuhta, M., Matočec, N., Ozimec, R., Rađa, T., Štamol, V., Ternjej, I. & Tvrtković, N., 2002: An overview of the cave and interstitial biota of Croatia. Natura Croatica **11** (Suppl. 1), 1–112.

Graf, W., Murphy, J., Dahl, J., Zamora-Muñoz, C. & López Rodríguez, M. J., 2008: Distribution & ecological preferences of European freshwater organisms. Vol. 1: Trichoptera. Pensoft, Sofia-Moscow, 388 pp.

Habdija, I., 1979: Ličinke Trichoptera kao indikatori ekologijskih prilika u bentosu krških voda. In: Rauš (ed.), Drugi kongres Ekologa Jugoslavije (Second Congress of Ecologists of Yugoslavia). Savez društava ekologa Jugoslavije, Zagreb, pp. 1433–1446.

Ibrahimi, H. 2011: Faunal, ecological and biogeographical features of caddisflies (Insecta: Trichoptera) Kosova (on Croatian). University of Zagreb, pp.183, Zagreb.

Ibrahimi, H., Kučinić, M**.,** Gashi, A. & Grapci-Kotori, L. 2012: The caddisfly fauna (Insecta, Trichoptera) of the rivers of the Black Sea basin in Kosovo with distributional data for some rare species. Zookeys **182**, 71–85.

Ivković, M., Plant A. & Horvat, B., 2012: A new species of *Wiedemannia* (Diptera: Empididae: Clinocerinae) from Balkan Peninsula. Zootaxa **3478**, 581–585.

Klapálek, F., 1899: Prilozi k poznavanju faune trichoptera i neuroptera Bosne i Hercegovine. Glasnik zemaljskog muzeja u Sarajevu **11**, 323–327.

Klobučar, G: I.V., Podnar, M., Jelić, M., Franjević, D., Faller, M., Štambuk, A., Gottstein, S., Simić, V. & Maguire, I., 2013: Role of the Dinaric Karst (western Balkans) in shaping the phylogeographic structure of the threatened crayfish *Austropotamobius torrentium*. *Freshwater biology* **58** (6), 1089–1105.

Krušnik c., 1987: Trichoptera. *Fauna Durmitora* 2, 201–224.

Kučinić, M., 2002: Diversity and distribution of caddisflies (Insecta, Trichoptera). PhD–Thesis, (in Croatian). University of Zagreb, 138 pp. Zagreb.

Kučinić, M., Previšić, A., Gottstein, S., Hrašovec, B., Stanić–Koštroman, S., Pernek, M. & Delić, A., 2008: Description of the larvae of *Drusus radovanovici septentrionis* Marinkovićš-Gospodnetić, 1976 and *Drusus croaticus* Marinković-Gospodnetić, 1971 (Trichoptera: Limnephilidae) from Bosnia and Herzegovina, and Croatia. Zootaxa **1783**, 1–17.

Kučinić, M., Previšić, A., Stanić-Koštroman, S., Franjević, M., Šerić Jelaska, L., Delić, A. & Posilović, H., 2010: Description of the larvae of *Drusus ramae* Marinković-Gospodnetić and *Drusus medianus* Marinković-Gospodnetić (Trichoptera: Limnephilidae) with some genetic, distributional, ecological, faunal and conservation notes. Zootaxa **2484**, 1–24.

Kučinić, M., Previšić, A., Graf, W., Šerić Jelaska L., Stanić-Koštroman, S. & Waringer, J., 2011a: Larval description, genetic and ecological features of *Drusus radovanovici radovanovici* Marinković-Gospodnetić, 1971 (Trichoptera: Limnephilidae) with some phylogenetic and taxonomic data on the *bosnicus* Group in the Balkan Peninsula. Deutsche Entomologische Zeitschrift **58**, 1 135–153.

Kučinić, M., Previšić, A., Stanić-Koštroman, S., Graf, W., Franjević, M., Posilović, H. & Waringer, J., 2011b: Morphological and ecological features of *Drusus* larvae from the *D. bosnicus* Group on the Balkan Peninsula with description of the larva of *Drusus klapaleki* Marinković-Gospodnetić, 1971. Zoosymposia **5**, 244–1543.

Kučinić, M., Szivák, I., Pauls, S.U., Bálint, M., Delić, A. & Vučković, I., 2013: *Chaetopteryx bucari* sp. n. a new species from the *Chaetopteryx rugulosa* group from Croatia (Insecta, Trichoptera) with some molecular, taxonomical and ecological notes on the group. Zookeys **320**, 1–28.

Kumanski, K. P., 1988: Trichoptera, Integripalpia. Fauna Bulgarica 19. Bulgarska Akademi na Naukite, Sofia.

Lakota, J., Jalžić, B. & Moravec, J., 2009: *Neolovricia ozimeci* n. gen. et n. sp., a new genus and new species of subterranean trechine carabid from Central Dalmatia (Coleoptera: Carabidae, Anillina) with notes on distribution of *Lovricia aenigmatica*. Natura Croatica **18** (1), 1–13.

Lukić, M., Houssin, C. & Deharveng, L., 2010: A new relictual and highly troglomorphic species of *Tomoceridae* (Collembola) from a deep Croatian cave. Zookeys **69**, 1–16.

Malicky, H., 1981: Weiteres Neues über Köcherfliegen aus dem Mittelmeergebiet (Trichoptera). *Entomofauna*, 2, 335–356.

Malicky, H., 2004: Atlas of European Trichoptera. Springer, pp. 359, Dordrecht.

Malicky, H., 2005: Die Köcherfliegen Griechenlands. *Denisia* **17**, 1–240.

Marinković-Gospodnetić, M., 1971a: The species of genus *Drusus* in Yugoslavia. Godišnjak Biološkog Instituta Univerziteta (Annual of the Institute of Biology – University of Sarajevo) **23**, 105–109.

Marinković-Gospodnetić, M., 1971b: New species of Trichoptera from Bosnia and Herzegovina. – Bulletin Scientifique (Section A) **15**, 144–145.

Marinković-Gospodnetić, M., 1971c: Fauna Trichoptera područja Maglića, Volujka i Zelengore. Glasnik Zemaljskog muzeja Bosne i Hercegovine u Sarajevu (Bulletin du musée de la Républiqu Socialiste de Bosnie-Herzégovine á Sarajevo) **9**, 107–119.

Marinković-Gospodnetić, M., 1976: The differentiation of *Drusus* species of the group *bosnicus*. In: Malicky, H. (Ed.), *Proceedings of the First International Symposium on Trichoptera*, Dr. W. Junk Publishers, The Hague, Netherland, 77–85 pp.

Marinković-Gospodnetić, M., 1978: Some characteristics of the Yugoslav fauna of Trichoptera. In Crichton, M. I. (ed.). Proceedings of the Second International Symposium on Trichoptera, Dr. W. Junk Publishers, Hague, pp. 35–40.

Marinković-Gospodnetić, M., 1979: Trichoptera (Insecta) velikih karstnih izvora u Dinaridima. In Rauš, Đ. (ed.). Drugi kongres Ekologa Jugoslavije (Second Congress of Ecologists of Yugoslavia). Savez društava ekologa Jugoslavije, Zagreb. pp. 1837–1849.

Mihoci, I. & Šašić, M., 2005: New findings of butterfly Dalmatian Ringlet, *Protoerebia afra dalmata* (Godart, [1824]) (Lepidoptera, Satyriane) in Croatia. Natura Croatica **14**, 121–129.

Mihoci, I., Šašić, M. & Tvrtković, N., 2007: New data on the distribution of the Croatian endemic butterfly *Erebia stirius kleki* Lorković, 1995 (Papilionidea, Nymphalidae, Satyrinae). Natura Croatica **16**: 139–146.

Murányi, D., 2011: Balkanian species of the genus *Isoperla* Banks, 1906 (Plecoptera: Perlodidae). Zootaxa **3000**, 49–58.

Mustafić, P., Marčić, Z., Duplić, A., Mrakovčić, A., Čaleta, M., Zanella, D., Buj, I., Podnar, M. & Dolenc, Z., 2008: A new loach species of the genus *Cobitis* in Croatia. Folia Zoologica **57** (1–2), 4–9.

Oláh J., 2010: New species and new records of Palearctic Trichoptera in the material of the Hungarian Natural History Museum. Annales Historico-Naturales Musei Nationalis Hungarici **102**, 65–117.

Oláh, J., 2011: New species and records of Balkan Trichoptera. Folia Historico Naturalia Musei Matraensis **35**, 111–121.

Oláh J. & Kovács, T., 2013: New species and records of Balkan Trichoptera II. Folia Historico Naturalia Musei Matraensis **37**, 109–121.

Pauls, S. U., Lumbsch, H. T. & Haase, P., 2006: Phylogeography of the montane caddisfly *Drusus discolor*: evidence for multiple refugia and periglacial survival. Molecular Ecology **15**, 2153–2169.

Pauls, S. U., Graf, W., Haase, P., Lumbsch, H. T. & Waringer, J., 2008: Grazers, shredders and filtering carnivores – The evolution of feeding ecology in Drusinae (Trichoptera: Limnephilidae): insights from molecular phylogeny. Molecular Phylogenetics and Evolution **46**, 776–791.

Pavlek, M. & Ozimec, R., 2005: New cave-dwelling species of the genus troglohyphantes (Araneae, linyphiidae) for the Croatian fauna. Natura Croatica **14** (3), 161–174.

Previšić A., Kerovec, M. & Kučinić, M., 2007: Emergence and Composition of Trichoptera from Karst Habitans, Plitvice lakes Region, Croatia. International Review of Hydrobiology, **92** (1), 61–83.

Previšić, A., Walton, C., Kučinić, M., Mitrikeski, P. T. & Kerovec, M., 2009: Pleistocene divergence of Dinaric *Drusus* endemics (Trichoptera, Limnephilidae) in multiple microrefugia within the Balkan Peninsula. Molecular Ecology **18** (4), 634–647.

Previšić, A. & Popijač, A., 2010: Fauna tulara (Insecta: Trichoptera) Kupe, Čabranke i njihovih pritoka (Gorski kotar, zapadna Hrvatska). Natura Croatia **19** (2), 357–368.

Previšić, A., Cerjanec, D., Graf, W. & Kučinić, M., 2012: *Drusus chrysotus* (Rambur, 1842) (Trichoptera: Limnephilidae: Drusinae): a new caddisfly species in the Croatian fauna. Natura Croatica **22** (2), 419–425.

Previšić, A., Ivković, M., Miliša, M. & Kerovec, M., 2013: Caddisfly (Insecta: Trichoptera) fauna of the Papuk Nature Park, Croatia. *Natura Croatica* **22** *(1), 1–13.*

Previšić, A., Schnitzler, J., Kučinić, M., Graf, W., Ibrahimi, H., Kerovec, M. & Paulus, S.U., 2014: Microscale vicariance and diversification of Western Balkan caddisflies linked to karstification. Freshwater Science **33** (1) 250–262.

Radovanović, M. (1942) Über zwei neue Trichopteren-Arten aus Mazedonien. *Zoologischer Anzeiger* **140**, 183–190.

Reed, J.M., 2004: Balkan Biodiversity, Paterrn and Proces in the European Hotspot (eds. Griffiths, H.I., Krystufeg B. & Reed, J.M.). Kluwer Academic Publisher. Dordrecht.

Schmid, F., 1956: La sous-famille des Drusinae (Trichoptera, Limnephilidae). Memoires Institut Royal des Sciences Naturelles de Belgique 2eme Series **55**, 1–92.

Sket, B., Dovč, P., Jalžić, B., Kerovec, M., Kučinić, M. & Trontelj, P., 2001: A cave leech (Hirudinea, Erpobdellidae) from Croatia with unique morphological features. Zoologica Scripta **30** (3), 223–229.

Stanić-Koštroman, S., 2009: Faunal, ecological and biogeographical features of caddisflies (Insecta: Trichoptera) in the Bosnia and Herzegovina. PhD–Thesis (in Croatian), University of Zagreb. 151 pp, Zagreb.

Urbanič, G., 2004: Ecology and distribution of caddisflies (Insecta: Trichoptera) in some watercourses in Slovenia. Doctoral Thesis (on Slovenian), Biotehnical Faculty, University of Ljubljana, 188 pp, Ljubljana.

Waringer, J. & Graf, W., 1997: Atlas der österreichischen Köcherfliegenlarven. Facultas Universitätsverlag, Wien, 286 pp.

Waringer, J., Graf, W., Pauls, S. & Lubin, V., 2007. The larva of *Drusus nigrescens* Meyer-Dür, 1875 (Trichoptera: Limnephilidae: Drusinae) with notes on its ecology, genetic differentiation and systematic position. Annales de Limnologie – International Journal of Limnology **43** (3), 161–166.

Waringer, J., Graf, W., Pauls, S. U., Vicentini H. & Lubini, V., 2008: DNA based association and description of the larval stage of *Drusus melanchaetes* McLachlan, 1876 (Trichoptera: Limnephilidae: Drusinae) with notes on ecology and zoogeography. – Limnologica **38** (1), 34–42.

Waringer, J., Graf, W., Bálint, M., Kučinić, M., Pauls, S.U., Previšić, A., Keresztes, L., & Vitecek, S., 2013: The larvae of *Drusus franzressli* Malicky 1974 and *Drusus spelaeus* (Ulmer 1920) (Trichoptera: Limnephilidae: Drusinae) with notes of ecology and zoogeography. Zootaxa **3637** (1), 1–16.

Žganec, K., Đurić, P. & Gottstein, S., 2011: Life history traits of the endangered endemic amphipod *Echinogammarus cari* (Crustacea, Gammaridae) from the Dinaric Karst. International Review of Hydrobiology **96** (6), 686–708.

SAŽETAK

Prvi nalaz *Drusus bosnicus* grupe (Insecta, Trichoptera) u Hrvatskoj s osvrtom na raznolikost, taksonomiju, rasprostranjenost i ekologiju roda *Drusus* u Hrvatskoj i dinaridskom kršu Balkanskog poluotoka

M. Kučinić, A. Previšić, I. Mihoci, R. Ćuk, A. Delić, K. Žganec, D. Cerjanec & I. Vučković

Na području Balkanskog poluotoka zabilježeno je 40 vrsta iz roda *Drusus*, od toga 19 na području Dinarskog krša. Vrste roda *Drusus* u pravilu naseljavaju izvore i izvorišna područja planinskih tekućica što uvjetuje alopatrijski tip rasprostranjenosti, procese specijacije i nastanak većeg broja vrsta, najčešće s malim područjem rasprostranjenosti. Zbog velike raznolikosti i intenzivnih procesa specijacije jedna od najzanimljivijih skupina unutar roda

Drusus je *Drusus bosnicus* grupa, koja se odlikuje prepoznatljivim morfološkim značajkama (tamna boja krila) i danjom aktivnošću odraslih oblika. Na području Dinarskog krša zabilježeno je 10 vrsta *Drusus bosnicus* grupe, od kojih je po prvi puta ova grupa zabilježena vrstom *Drusus vespertinus* Marinković-Gospodnetić, 1976 na području Hrvatske. Lička Plješevica i Dinara prirodne su zapadne granice rasprostranjenosti *Drusus bosnicus* grupe koja je na istok rasprostranjena na području većeg dijela Balkanskog poluotoka. Na istočnoj strani Ličke Plješevice na području Korenice i Plitvičkih jezera zabilježena je vrsta *Drusus croaticus* čiji areal dopire do dijelova Dinarskog krša u Sloveniji. Ova vrsta pronađena je na 20-tak izvora što je uz vrstu *D. krusniki* najveći broj nalaza neke vrste roda *Drusus* na Dinarskom kršu Balkanskog poluotoka. Osim ove dvije vrste u fauni Hrvatske iz roda *Drusus* zabilježene su vrste: *D. discolor*, *D. chrysotus* i *D. schmidi*. *D. schmidi* je prva vrsta ovoga roda koja u Hrvatskoj nije utvrđena na području krša, nego je zabilježena na Papuku, u kontinentalnom dijelu Hrvatske, što je izuzetno zanimljivi nalaz ove vrste. U budućim istraživanjima roda *Drusus* na području Hrvatske moguće je očekivati i nalaze nekih novih vrsta iz ovoga roda, npr. široko raspostranjene vrste *D. biguttatus* ili neke još nezabilježene vrste *Drusus bosnicus* grupe. U radu su prikazana najvažnija morfološka obilježja i dan je opis genitalija ženke vrste *Drusus vespertinus* s primjeraka prikupljenih u Hrvatskoj i Bosni i Hercegovini.