

THE STONEFLY FAUNA (Insecta: Plecoptera) OF THE MEDITERRANEAN RIVER CETINA, CROATIA

Aleksandar POPIJAC¹ & Ignac SIVEC²

¹Department of Zoology, Division of Biology, Faculty of Science, University of Zagreb,
Rooseveltovo trg 6, HR-10000 Zagreb, Croatia (apopijac@zg.biol.pmf.hr)

²Slovenian Museum of Natural History, Prešernova 20, PO Box 290, SI-1001 Ljubljana, Slovenia
(isivec@pms-lj.si)

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We present the first list of the stonefly fauna of the Mediterranean river the Cetina, comprising 14 species. During the period from August 2004 to September 2005, March and April 2006, June and October 2007 the first systematic study of the stoneflies of the Cetina River was carried out at 13 locations. Manually and with entomological net, we collected qualitative samples of adult Plecoptera, exuviae and larvae. Most of the species were documented by digital macro photography. The results are based mainly on identification of adult insects and only in some cases are larvae and exuviae taken into consideration. Ten different genera from six families were recorded, three of which belong to the family Nemouridae (*Amphinemura*, *Nemoura*, *Protonemura*), two to the family Perlidae (*Perla*, *Dinocras*), two to the family Perlodidae (*Besdolus*, *Isoperla*), one to the family Leuctridae (*Leuctra*), one to the family Chloroperlidae (*Siphonoperla*) and one to the family Taeniopterygidae (*Brachyptera*). Five stonefly species found along the Cetina River were recorded here for the first time in Croatia: *Protonemura autumnalis*, *Protonemura hrabei*, *Besdolus imhoffi*, *Leuctra fusca*, and *Leuctra mortoni*. These findings, together with 14 new species recently recorded from the Plitvice Lakes National Park, one new species from the Gorski kotar region, and two new species from the Entomological Department of the Varaždin Municipal Museum increased the number of stonefly species for Croatia from 28 to 50, and represent important new findings for the Croatian part of the Western Dinaric region.

Plecoptera, fauna, Cetina River, Mediterranean karstic river, Croatia

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Prikazali smo prvi popis faune obalčara mediteranske rijeke Cetine koji obuhvaća ukupno 14 vrsta. Ovo prvo sustavno istraživanje obalčara rijeke Cetine obavljano je na 13 lokacija u razdoblju od kolovoza 2004. do rujna 2005. godine, u ožujku i travnju 2006. te u lipnju i listopadu 2007. godine. Kvalitativni uzorci odraslih jedinki, svlakova i ličinki Plecoptera sakupljeni su ručno i pomoću entomološke mrežice. Većina vrsta dokumentirana je i pomoću digitalne makro fotografije. Rezultati su bazirani uglavnom na identifikaciji odraslih jedinki, a samo su u nekim slučajevima u obzir uzimani svlakovi i ličinke. Zabilježeno je deset različitih rodova obalčara iz šest porodica: tri iz porodice Nemouridae (*Amphinemura*, *Nemoura*, *Protonemura*), dva iz porodice Perlidae (*Perla*, *Dinocras*), dva iz porodice Perlodidae (*Besdolus*, *Isoperla*), jedan iz porodice Leuctridae (*Leuctra*), jedan iz porodice Chloroperlidae (*Siphonoperla*) i jedan iz porodice Taeniopterygidae (*Brachyptera*). Pet vrsta obalčara nađenih duž rijeke Cetine prvi puta je zabilježeno za faunu Hrvatske: *Protonemura autumnalis*, *Protonemura hrabei*, *Besdolus imhoffi*, *Leuctra fusca* i *Leuctra mortoni*. Ti nalazi, zajedno s 14 nedavno zabilježenih novih vrsta na području Nacionalnog parka Plitvička jezera, jednom novom vrstom iz Gorskog kotara te dvije nove vrste iz entomološke zbirke Franje Košćeca u Varaždinu, utjecali su za povećanje broja poznatih obalčara u Hrvatskoj s 28 na 50. Oni isto tako predstavljaju nove važne nalaze za hrvatski dio zapadne dinaridske regije.

Plecoptera, fauna, Cetina, mediteranska krška rijeka, Hrvatska

Introduction

Plecoptera of the Mediterranean river the Cetina were completely unknown until recently. The situation for the whole of Croatia was not much better. Only 28 species of Plecoptera were officially recorded for Croatia (Sivec, 1980, 1985) until the last few years when we started vigorous studies on Plecoptera in Croatia. Currently, 50 stonefly species have been recorded (Popijač & Sivec, 2008, 2009a, b, c), based on determination of adult stages. Most likely, this number represents just a half of the species actually present in Croatia because e.g. for neighbouring Slovenia about 100 stonefly species are known (Sivec, 2001). The aim of this work was to study the diversity and the distribution of stoneflies along the Cetina River and its tributaries.

Materials and methods

The Cetina River is the longest Mediterranean river in Croatia (about 105 km) that belongs to a permanent hydrological system. For details on the study area in the Cetina system see Ivković et al. (2007). Figures 1-2 and Table 1 show the sampling sites in the study area.

Qualitative samples of adult Plecoptera, exuviae and larvae were collected from August 2004 to September 2005 at 11 different locations along the whole of the Cetina. Additionally, the spring area of its main tributary, the Ruda River, was sampled by hand picking and sweeping net. During March and April 2006, June and October 2007 and occasionally until recently we collected qualitative samples in the same locations, and at the springs of two other tributaries, the spring Sveti Spas and the spring of the Grab Stream (tributary of Ruda River) (Figure 1-2, Table 1).

Table 1. Sampling sites in the Cetina River system.

Tablica 1. Lokaliteti uzorkovanja na sustavu rijeke Cetine.

Abbr.	Locations	Elevation (m)	Distance from source (km)
CS	Cetina spring	386	0
SS	Cemetery (Sveti Spas) spring	385	0
PS	Preočani spring	378	0
PB	Preočani bridge	373	1.5
RB	Red bridge	369	2.5
OS	Obrovac Sinjski	300	39
T1	Trilj 1	297	55
T2	Trilj 2	296	56
ČL	Čikotina lađa	253	65
RM	Radmanove mlinice	5	99
RS	Ruda spring	341	0
R2	Ruda 2	315	0.2
GS	Grab spring	332	0



Figure 1. Terrain and watercourses map of Croatia with study area.
Slika 1. Karta Hrvatske s glavnim vodotocima i istraživano područje.

All samples were fixed in 80% ethyl alcohol. At the laboratory, we analyzed them with a stereomicroscope and stored them again in 80% ethyl alcohol. For identification of stonefly species we used available literature of the nearest regions (Illies, 1955; Aubert, 1959, 1963; Kačanski & Zwick, 1970; Tabacaru, 1971; Kis, 1974; Raušer, 1980; Ravizza, 2002; Ravizza & Vinçon, 1998; Sivec & Stark, 2002; Graf & Schmidt-Kloiber, 2003; Zwick, 2004). The results are based mainly on identification of adult insects and only in some cases are larvae and exuviae taken into consideration. Nomenclature and systematics are according to Zwick (1973) and DeWalt et al. (2009). The collected material is stored in the Plecoptera Collection of the Slovenian Museum of Natural History in Ljubljana and in the private “Popijač Plecoptera Collection”.

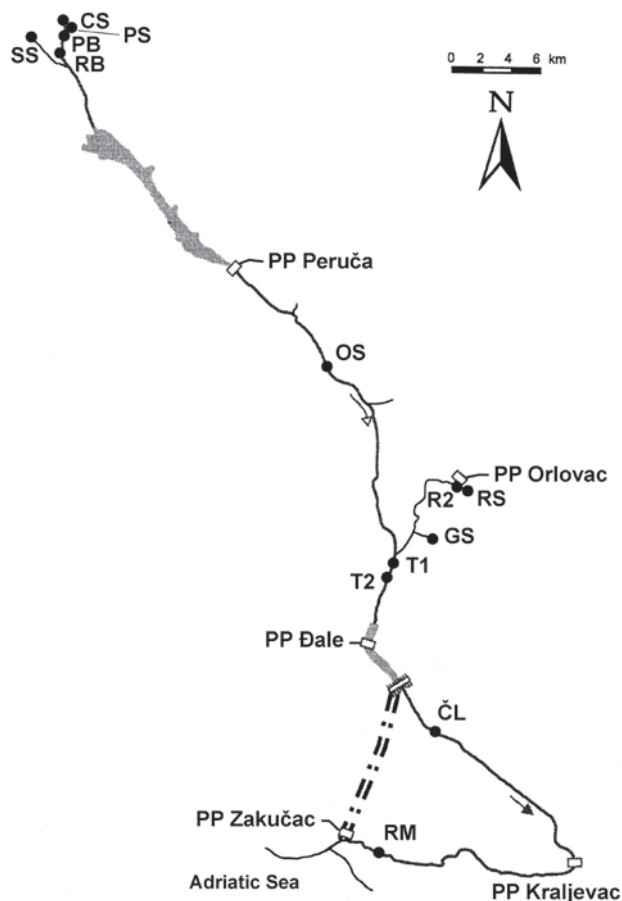


Figure 2. Map of the study area with sampling sites in the Cetina River system.

Slika 2. Karta istraživanog područja s lokalitetima uzorkovanja na sustavu rijeke Cetine.

Results and discussion

Our samplings along the Cetina River included 14 stonefly species. Ten different genera from six families were recorded, three of which belong to the family Nemouridae (*Amphinemura*, *Nemoura*, *Protonemura*), two to the family Perlidae (*Perla*, *Dinocras*), two to the family Perlodidae (*Besdolus*, *Isoperla*), one to the family Leuctridae (*Leuctra*), one to the family Chloroperlidae

(*Siphonoperla*) and one to the family Taeniopterygidae (*Brachyptera*).

The locations with the highest diversity in the Cetina River system (with eight stonefly species recorded) are the main Cetina spring, the small spring at Preočani village (about 1.5 km downstream) and the site Ruda 2 (about 200 m downstream the Ruda spring) (Table 2).

Table 2. Distribution of recorded stonefly species across sampling sites in the Cetina River system (5 species recorded for the first time for stonefly fauna of Croatia are highlighted in bold).

Tablica 2. Distribucije obalčara na istraživanim lokalitetima sustava rijeke Cetine. (vrste pod rednim brojem 2., 3., 6., 7. i 10. su nove za faune Hrvatske)

Species/Locations	RS	R2	GS	SS	CS	PS	PB	RB	OS	T1	T2	ČL	RM
1. <i>Siphonoperla</i> sp. (female)	x												
2. <i>Leuctra fusca</i>									x			x	x
3. <i>Leuctra mortoni</i>					x	x	x	x					
<i>Leuctra</i> sp. (larvae)		x			(x)	(x)	(x)	(x)	(x)			(x)	(x)
4. <i>Amphinemura triangularis</i>	x	x	x										
5. <i>Nemoura cinerea</i>		x		x	x	x	x	x					
6. <i>Protonemura autumnalis</i>					x								
7. <i>Protonemura hrabei</i>				x	x	x							
<i>Protonemura</i> sp. (larvae)					(x)								x
8. <i>Dinocras megacephala</i>	x	x											
9. <i>Perla pallida</i>	x	x	x	x		x		x				x	x
10. <i>Besdolus imhoffi</i>												x	x
11. <i>Isoperla illyrica</i>	x	x	x		x	x	x	x	x				
12. <i>Isoperla inermis</i>	x	x	x	x	x	x	x	x	x		x		
13. <i>Isoperla tripartita</i>				x	x	x		x					
<i>Isoperla</i> sp. (larvae)											(x)	x	x
14. <i>Brachyptera tristis</i>	x	x	x	x	x	x	x	x	x	x			
Number of species:	7	8	5	6	8	8	5	7	4	1	1	4	5

Systematic list of stoneflies along the Cetina River and its tributaries

Order **PLECOPTERA**

Suborder **ARCTOPERLARIA**

Superfamily group **EUHOLOGNATHA**

Superfamily **NEMOUROIDEA** Newman, 1853

Family **LEUCTRIDAE** Klapálek, 1905

Subfamily **LEUCTRINAE** Klapálek, 1905

Genus *Leuctra* Stephens, 1836

1. *Leuctra fusca* (Linnaeus, 1758)

MATERIAL COLLECTED. Radmanove Mlinice, 24.09.2005, 2 ♂, 3 ♀, leg. A. Popijač, B. Horvat & I. Sivec; Obrovac Sinjski, 14.10.2007, 9 ♂, 5 ♀, leg. A. Popijač & I. Sivec; Ruda 2, 14.10.2007, 1 ♂, 4 ♀, leg. A. Popijač; Čikotina lađa, 14.10.2007, 2 ♂, leg. A. Popijač. First records for Croatia (Popijač & Sivec, 2009b). - COMMENTS. One of the most common stonefly species in all types of streams and rivers. It is very tolerant to organic pollution. Least Concern (LC) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Not protected species in Croatia.

2. *Leuctra mortoni* Kempny, 1899

MATERIAL COLLECTED. Cetina spring, 15.01.2005, 4 ♀, leg. A. Popijač; Preočani spring, 23.09.2005, 1 ♀, leg. A. Popijač; Preočani bridge, 23.09.2005, 4 ♂, leg. A. Popijač; Red bridge, 23.09.2005, 1 ♂, 3 ♀, leg. A. Popijač; Red bridge, 13.10.2007, 4 ♂, 7 ♀, leg. A. Popijač; Cemetery (Sveti Spas) spring, 14.10.2007, 1 ♂, 1 ♀, leg. I. Sivec; Preočani spring, 14.10.2007, 1 ♂, 3 ♀, 1 exuvia, leg. I. Sivec; Red bridge, 14.10.2007, 2 ♂, 1 ♀, leg. I. Sivec. First records for Croatia (Popijač & Sivec, 2009b). - COMMENTS. Near Threatened (NT) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Protected species in Croatia (Narodne novine, No. 99/2009).

Family **NEMOURIDAE** Newman, 1853

Subfamily **AMPHINEMURINAE** Baumann, 1975

Genus *Amphinemura* Ris, 1902

3. *Amphinemura triangularis* (Ris, 1902)

MATERIAL COLLECTED. Ruda spring, 31.05.2005, 2 ♂, 35 ♀, leg. A. Popijač, I. Sivec & B. Horvat; Grab spring, 01.06.2005, 1 ♂ leg. I. Sivec; Ruda spring, 22.06.2005, 2 ♀, leg. A. Popijač. - COMMENTS. Least Concern (LC) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Not protected species in Croatia.

Genus *Protonemura* Kempny, 1898

4. *Protonemura autumnalis* Raušer, 1956

MATERIAL COLLECTED. Cetina spring, 23.09.2005, 1 ♂, leg. I. Sivec; Preočani spring, 07.06.2007, 1 ♂, 8 ♀, leg. A. Previšić & W. Graf; Red bridge, 13.10.2007, 1 ♂, leg. A. Popijač; Cemetery (Sveti Spas) spring, 14.10.2007, 1 ♂, leg. I. Sivec; Preočani spring, 14.10.2007, 1 ♂, leg. I. Sivec. First records for Croatia (Popijač & Sivec, 2009b). - COMMENTS. Data Deficient (DD) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Protected species in Croatia (Narodne novine, No. 99/2009).

5. *Protonemura hrabei* Raušer, 1956 (Figure 3)

MATERIAL COLLECTED. Cetina spring, 31.05.2005, 1 ♂, 1 ♀, leg. I. Sivec & B. Horvat; Cemetery (Sveti Spas) spring, 31.05.2005, 16 ♂, 22 ♀, leg. B. Horvat; Preočani spring, 31.05.2005, 27 ♂, 88 ♀, leg. A. Popijač & I. Sivec; Preočani bridge, 31.05.2005, 2 ♀, leg. M. Kučinić; Cetina spring, 22.06.2005, 1 ♀, leg. B. Horvat; Cetina spring, 07.06.2007, 9 ♂, 13 ♀, leg. W. Graf; Preočani spring, 07.06.2007, 16 ♂, 43 ♀, leg. A. Popijač & I. Sivec. First records for Croatia (Popijač & Sivec, 2009b). - COMMENTS. Data Deficient (DD) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Protected species in Croatia (Narodne novine, No. 99/2009).

Subfamily **NEMOURINAE** Newman, 1853

Genus *Nemoura* Latreille, 1796

6. *Nemoura cinerea* (Retzius, 1783)

MATERIAL COLLECTED. Preočani bridge, 07.05.2005, 2 ♂, 1 ♀, leg. M. Kučinić; Red bridge, 07.05.2005, 19 ♂, 14 ♀, leg. M. Kučinić; Cetina spring, 31.05.2005, 40 ♂, 37 ♀,



Figure 3. *Protonemura hrabei* - Preočani spring, 07.06.2007, 1 ♀ (Photo: I. Sivec). Data Deficient (DD) and protected species in Croatia (Popijač, 2008; Narodne novine, No. 99/2009)

Slika 3. *Protonemura hrabei* - izvor Preočani, 07.06.2007, 1 ♀ (foto: I. Sivec). Podatci nedostadni, vrsta zaštićena u Hrvatskoj (Popijač, 2008; Narodne novine, Br. 99/2009)

leg. B. Horvat, I. Sivec & A. Popijač; Cemetery (Sveti Spas) spring, 31.05.2005, 9 ♂, 5 ♀, leg. B. Horvat; Preočani spring, 31.05.2005, 11 ♂, 4 ♀, leg. I. Sivec; Preočani bridge, 31.05.2005, 4 ♂, 5 ♀, leg. M. Kučinić; Red bridge, 31.05.2005, 6 ♂, 8 ♀, leg. A. Popijač; Cetina spring, 20.06.2005, 14 ♀, leg. A. Popijač; Cetina spring, 22.06.2005, 19 ♂, 52 ♀, leg. B. Horvat; Cemetery (Sveti Spas) spring, 22.06.2005, 22 ♂, 38 ♀, leg. B. Horvat; Red bridge, 22.06.2005, 73 ♀, leg. I. Sivec & B. Horvat; Red bridge, 18.07.2005, 1 ♂, leg. M. Kučinić; Cetina spring, 07.06.2007, 1 ♂, 3 ♀, leg. W. Graf; Preočani spring, 07.06.2007, 8 ♂, 1 ♀, leg. A. Popijač. - COMMENTS. One of most common stonefly species. It is very tolerant to organic pollution. In addition, it is one of the few stonefly species to live in standing water habitats in addition to streams and rivers. Least Concern (LC) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Not protected species in Croatia.

Family TAENIOPTERYGIDAE Klapálek, 1905

Subfamily BRACHYPTERAINAE Zwick, 1973

Genus *Brachyptera* Newport, 1848

7. *Brachyptera tristis* (Klapálek, 1901)

MATERIAL COLLECTED. Red bridge, 07.05.2005, 1 ♂, 2 ♀, leg. M. Kučinić; Ruda spring, 07.05.2005, 27 ♂, 21 ♀, leg. I. Zrinski; Obrovac Sinjski, 09.05.2005, 1 ♂, leg. A. Popijač; Cemetery (Sveti Spas) spring, 31.05.2005, 2 ♂, 2 ♀, leg. B. Horvat; Preočani spring, 31.05.2005, 3 larvae, leg. I. Sivec; Ruda spring, 31.05.2005, 1 ♀, leg. A. Popijač; Cetina

spring, 16.03.2006, 28 (♂) larvae, 59 (♀) larvae, leg. A. Popijač; Preočani spring, 16.03.2006, 6 (♂) larvae, 18 (♀) larvae, leg. A. Popijač; Ruda spring, 17.03.2006, 18 (♂) larvae, 21 (♀) larvae, leg. A. Popijač; Red bridge, 26.04.2006, 1 ♂, 26 (♂) exuviae, 22 (♀) exuviae, leg. A. Popijač; Trilj 1, 27.04.2006, 1 ♂, leg. B. Horvat; Obrovac Sinjski, 28.04.2006, 2 ♂, leg. M. Ivković; Grab spring, 28.04.2006, 1 ♂, 1 ♀, 1 exuvia, leg. A. Popijač & M. Ivković; Ruda spring, 06.06.2007, 2 ♂, 1 ♀, 4 exuviae, leg. W. Graf & A. Popijač; Ruda 2, 06.06.2007, 1 ♀, leg. A. Popijač; Grab spring, 06.06.2007, 1 ♂, leg. A. Popijač; Preočani spring, 07.06.2007, 1 ♀, leg. M. Ivković. - COMMENTS. Least Concern (LC) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Strictly protected species in Croatia (Narodne novine, No. 99/2009).

Superfamily group **SYSTELLOGNATHA**

Superfamily **PERLOIDEA** Latreille, 1802

Family **CHLOROPERLIDAE** Okamoto, 1912

Subfamily **CHLOROPERLINAE** Okamoto, 1912

Tribe **CHLOROPERLINI** Okamoto, 1912

Genus *Siphonoperla* Zwick, 1967

8. *Siphonoperla* sp.

MATERIAL COLLECTED. Ruda spring, 06.06.2007, 1 ♀, leg. W. Graf. - COMMENTS. Reliable identification of the species from this family and this genus is possible only by the analysis of male genitalia, which were not available. All recorded species of family Chloroperlidae are strictly protected in Croatia (Narodne novine, No. 99/2009). All recorded *Siphonoperla* species are Vulnerable (VU) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008).

Family **PERLIDAE** Latreille, 1802

Subfamily **PERLINAE** Latreille, 1802

Tribe **PERLINI** Latreille, 1802

Genus *Dinocras* Klapálek, 1907

9. *Dinocras megacephala* (Klapálek, 1907)

MATERIAL COLLECTED. Ruda 2, 18.04.2005, 3 larvae, leg. A. Popijač; Ruda spring, 31.05.2005, 4 ♀, leg. A. Popijač; Ruda 2, 11.07.2005, 1 larva, leg. A. Popijač; Ruda 2, 26.08.2005, 1 larva, leg. A. Popijač. - COMMENTS. It is the only *Dinocras* species in Croatia, abundant and widely distributed over a large part of northern and central Croatia, and in the Dalmatian hinterland. In Bavaria in the South of Germany it is considered a critically endangered (CR) species (Weinzierl, 2003), because this is the northern border of its distribution area. On the other hand, in Austria, Slovenia and Croatia, it is not considered an endangered species, but as a Least Concern (LC) species (Graf & Konar, 1999; Sivec, 2002; Popijač, 2008). Protected species in Croatia (Narodne novine, No. 99/2009). Genus *Perla* Geoffroy, 1762

10. *Perla pallida* Guérin-Méneville, 1838

MATERIAL COLLECTED. Ruda 2, 26.08.2004, 1 larva, leg. A. Popijač; Ruda 2, 16.10.2004, 1 larva, leg. A. Popijač; Cemetery (Sveti Spas) spring, 31.05.2005, 1 ♂, leg. B. Horvat; Preočani spring, 31.05.2005, 1 ♂, leg. I. Sivec; Red bridge, 31.05.2005, 1 ♂, leg. I. Sivec; Ruda spring, 31.05.2005, 2 ♀, leg. A. Popijač & I. Sivec; Čikotina lada, 01.06.2005, 4 ♂, 2 ♀, 1 exuvia, leg. I. Sivec, B. Horvat & M. Kučinić; Čikotina lada, 21.06.2005, 2 ♂, 1 ♀, leg. B. Horvat; Ruda spring, 22.06.2005, 12 ♂, 18 ♀, leg. A. Popijač, I. Sivec & B. Horvat; Ruda 2, 22.06.2005, 1 ♂, 1 exuvia, leg. A. Popijač; Red bridge, 16.03.2006, 1 larva, leg. A. Popijač; Ruda 2, 17.03.2006, 1 larva, leg. B. Horvat; Čikotina lada, 27.04.2006, 3 larvae, leg. A. Popijač; Radmanove mlinice, 27.04.2006, 1 larva, leg. A. Popijač; Ruda 2, 28.04.2006, 4 larvae, leg. B. Horvat; Ruda spring, 06.06.2007, 2 ♂, 2 ♀ (with eggs), leg. A. Popijač; Grab spring, 06.06.2007, 1 ♀ (with eggs), leg. A. Previšić; Čikotina lada, 06.06.2007, 1 ♂, 1 ♀, leg. W. Graf; Radmanove mlinice, 06.06.2007, 1 ♂, leg. W. Graf. - COMMENTS. Easily confused with sibling species *Perla marginata* (Panzer, 1799) during identification of larval and adult stages. Both Vulnerable (VU) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008) and both strictly protected species in Croatia (Narodne novine, No. 99/2009).

Family **PERLODIDAE** Klapálek, 1909

Subfamily **ISOPERLINAЕ** Frison, 1942

Tribe **ISOPERLINI** Frison, 1942

Genus *Isoperla* Banks, 1906

11. *Isoperla illyrica* Tabacaru, 1971

MATERIAL COLLECTED. Preočani spring, 31.05.2005, 1 ♂, leg. A. Popijač; Preočani bridge, 31.05.2005, 1 ♂, leg. M. Kučinić; Grab spring, 01.06.2005, 6 ♂, 10 ♀, leg. I. Sivec, B.

Horvat, A. Previšić & A. Popijač; Cetina spring, 22.06.2005, 1 ♀, leg. B. Horvat; Ruda spring, 22.06.2005, 13 ♂, 11 ♀, leg. B. Horvat; Ruda 2, 22.06.2005, 7 ♂, 12 ♀, leg. A. Popijač; Obrovac Sinjski, 22.06.2005, 3 ♂, 4 ♀, leg. A. Popijač; Preočani bridge, 18.07.2005, 1 ♂, 1 ♀, leg. M. Kučinić; Red bridge, 18.07.2005, 1 ♀, leg. M. Kučinić; Obrovac Sinjski, 20.07.2005, 1 ♂, leg. M. Kučinić; Grab spring, 06.06.2007, 6 ♂, 2 ♀, leg. A. Previšić, W. Graf & A. Popijač. - COMMENTS. Near Threatened (NT) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Strictly protected species in Croatia (Narodne novine, No. 99/2009).

12. *Isoperla inermis* Kačanski & Zwick, 1970

MATERIAL COLLECTED. Trilj 2, 08.05.2005, 5 ♂, 1 ♀, leg. M. Kučinić; Cetina spring, 31.05.2005, 2 ♂, 4 ♀, leg. I. Sivec & B. Horvat; Cemetery (Sveti Spas) spring, 31.05.2005, 115 ♂, 67 ♀, leg. B. Horvat & A. Popijač; Preočani spring, 31.05.2005, 16 ♂, 38 ♀, leg. I. Sivec & A. Popijač; Preočani bridge, 31.05.2005, 8 ♂, 11 ♀, leg. M. Kučinić; Red bridge, 31.05.2005, 8 ♂, 3 ♀, leg. A. Popijač; Ruda spring, 31.05.2005, 84 ♂, 125 ♀, leg. B. Horvat, I. Sivec & A. Popijač; Grab spring, 01.06.2005, 17 ♂, 21 ♀, leg. I. Sivec, B. Horvat, A. Previšić & A. Popijač; Cetina spring, 20.06.2005, 1 ♂, 1 ♀, leg. A. Popijač; Cetina spring, 22.06.2005, 1 ♂, 1 ♀, leg. B. Horvat; Cemetery (Sveti Spas) spring, 22.06.2005, 23 ♂, 59 ♀, leg. B. Horvat; Red bridge, 22.06.2005, 30 ♂, 37 ♀, leg. I. Sivec & B. Horvat; Obrovac Sinjski, 22.06.2005, 1 ♀, leg. A. Popijač; Ruda spring, 22.06.2005, 1 ♀, leg. B. Horvat; Preočani bridge, 18.07.2005, 1 ♂, 10 ♀, leg. M. Kučinić; Red bridge, 18.07.2005, 7 ♂, 37 ♀, leg. M. Kučinić; Obrovac Sinjski, 20.07.2005, 1 ♂, leg. M. Kučinić; Red bridge, 16.03.2006, 3 larvae, leg. K. Žganec; Ruda 2, 28.04.2006, 1 ♂, leg. M. Ivković; Ruda spring, 06.06.2007, 26 ♂, 23 ♀, leg. W. Graf, A. Popijač, A. Previšić & M. Ivković; Ruda 2, 06.06.2007, 15 ♂, 6 ♀, leg. A. Popijač; Grab spring, 06.06.2007, 5 ♂, 12 ♀, leg. A. Previšić, W. Graf, M. Ivković & A. Popijač; Preočani spring, 07.06.2007, 18 ♂, 20 ♀, leg. A. Popijač, A. Previšić & M. Ivković. - COMMENTS. Least Concern (LC) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Strictly protected species in Croatia (Narodne novine, No. 99/2009).

13. *Isoperla tripartita* Illies, 1954

MATERIAL COLLECTED. Cetina spring, 31.05.2005, 4 ♀, leg. I. Sivec & B. Horvat; Cemetery (Sveti Spas) spring, 31.05.2005, 1 ♂, 4 ♀, leg. B. Horvat; Preočani spring, 31.05.2005, 1 ♂, 4 ♀, leg. I. Sivec; Red bridge, 31.05.2005, 2 ♂, leg. A. Popijač; Cetina spring, 20.06.2005, 1 ♀, leg. A. Popijač; Cetina spring, 22.06.2005, 6 ♂, 5 ♀, leg. B. Horvat; Cemetery (Sveti Spas) spring, 22.06.2005, 4 ♂, 22 ♀, leg. B. Horvat; Red bridge, 22.06.2005, 4 ♂, 8 ♀, leg. I. Sivec & B. Horvat; Obrovac Sinjski, 20.07.2005, 1 ♂, leg. M. Kučinić; Čikotina lada, 06.06.2007, 1 ♀, leg. W. Graf; Preočani spring, 07.06.2007, 3 ♂, 12 ♀, leg. A. Popijač, A. Previšić & M. Ivković. - COMMENTS. Data Deficient (DD) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Protected species in Croatia (Narodne novine, No. 99/2009).

Subfamily **PERLODINAE** Klapálek, 1909

Tribe **PERLODINI** Klapálek, 1909

Genus *Besdolus* Ricker, 1952

14. *Besdolus imhoffi* (Pictet, 1841) (Figure 4-6)

MATERIAL COLLECTED. Čikotina lađa, 17.04.2005, 1 big larva, leg. A. Popijač; Radmanove mlinice, 17.04.2005, 1 big larva, leg. A. Popijač; Čikotina lađa, 08.05.2005, 1 ♀, leg. M. Kučinić; Čikotina lađa, 01.06.2005, 29 ♂, 42 ♀, 11 exuviae, leg. I. Sivec, B. Horvat & M. Kučinić; Čikotina lađa, 21.06.2005, 3 ♂, 4 ♀, leg. B. Horvat; Radmanove mlinice, 27.04.2006, 26 larvae, leg. A. Popijač; Čikotina lađa, 06.06.2007, 7 ♂, 23 ♀, leg. W. Graf, I. Sivec, A. Popijač, A. Previšić & M. Ivković; Radmanove mlinice, 06.06.2007, 1 ♂, 2 ♀, leg. A. Popijač; Radmanove mlinice, 08.05.2009, 1 ♂, leg. A. Previšić. First records for Croatia (Popijač & Sivec, 2009b). - COMMENTS. Vulnerable (VU) on the Red list of stoneflies (Plecoptera) of Croatia (Popijač, 2008). Strictly protected species in Croatia (Narodne novine, No. 99/2009).



Figure 4. *Besdolus imhoffi* (Pictet, 1841) - Radmanove mlinice, 27.4.2006, larva (Photo: I. Sivec). Vulnerable (VU) and strictly protected species in Croatia (Popijač, 2008; Narodne novine, No. 99/2009).

Slika 4. *Besdolus imhoffi* (Pictet, 1841) - Radmanove mlinice, 27.4.2006, ličinka (foto: I. Sivec). Ugrožena i strogo zaštićena vrsta u Hrvatskoj (Popijač, 2008; Narodne novine, No. 99/2009).



Figure 5. *Besdolus imhoffi* (Pictet, 1841) - Čikotina lađa, 06.06.2007, exuvia (Photo: I. Sivec). Vulnerable (VU) and strictly protected species in Croatia (Popijač, 2008; Narodne novine, No. 99/2009).

Slika 5. *Besdolus imhoffi* (Pictet, 1841) - Čikotina lađa, 06.06.2007, ostaci egzoskeleta (foto: I. Sivec). Ugrožena i strogo zaštićena vrsta u Hrvatskoj (Popijač, 2008; Narodne novine, No. 99/2009).



Figure 6. *Besdolus imhoffi* (Pictet, 1841) - Čikotina lađa, 06.06.2007, 1 ♀ (Photo: I. Sivec). Vulnerable (VU) and strictly protected species in Croatia (Popijač, 2008; Narodne novine, No. 99/2009).

Slika 6. *Besdolus imhoffi* (Pictet, 1841) - Čikotina lađa, 06.06.2007, 1 ♀ (foto: I. Sivec). Ugrožena i strogo zaštićena vrsta u Hrvatskoj (Popijač, 2008; Narodne novine, No. 99/2009).

Conclusions

Fourteen stonefly species were documented within the Cetina River system. Five species were recorded for the first time in Croatia (Popijač & Sivec, 2009b): *Protonemura autumnalis*, *Protonemura hrabei*, *Besdolus imhoffi*, *Leuctra fusca*, and *Leuctra mortoni*. These findings, together with 14 new species recently recorded from the Plitvice Lakes National Park (Popijač & Sivec, 2009b), one new species from the Gorski kotar region (Popijač & Sivec, 2009a), and two new species from the Entomological Department of the Varaždin Municipal Museum (Popijač & Sivec, 2008, 2009c) brings the number of stonefly species for Croatia to 50, up from 28, and represent important new findings for the Croatian part of the Western Dinaric region.

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