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# Odonata fauna of karst streams and rivers of South Herzegovina (Bosnia and Herzegovina, West Balkan)

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## Abstract

Results of the odonatological survey in the Neretva River Basin in South Herzegovina karst region of Bosnia and Herzegovina conducted from April to August 2013 are presented. The area had been pre-assessed as insufficiently known in term of its Odonata fauna, but believed to be important habitat for several species of conservation concern, particularly *Coenagrion ornatum*, *Ceriagrion tenellum*, *Caliaeschna microstigma*, *Lindenia tetraphylla* and *Cordulegaster heros*. Moreover, freshwater habitats of the region are increasingly threatened due to climate change and the habitat destruction due to infrastructure and hydroenergy production projects.

The focus of the study was set on the streams and rivers in Neretva, Trebižat, Trebišnjica and Bregava river valleys, Hutovo blato wetland, Mostarsko blato, Dabarsko and Fatničko polje. The survey resulted in 482 Odonata records of 49 species from 52 surveyed localities. Notable results include new distribution data on species of conservation concern, particularly six new localities of *C. ornatum*, nine of *C. microstigma* and five of *C. heros*. Comments on species of conservation concern and brief description of habitats at all surveyed localities are provided. New data on species of conservation concern are important for better conservation planning of dragonfly species and habitats in Bosnia and Herzegovina.

## Key words

Neretva River Basin; karst region; Bosnia and Herzegovina; *Coenagrion ornatum*; *Ceriagrion tenellum*; *Caliaeschna microstigma*; *Lindenia tetraphylla*; *Cordulegaster heros*

## Introduction

The Dinaric karst represents the largest continuous karst area in Europe. It extends from the Alps in Slovenia, covering large part of Croatia, Bosnia and Herzegovina and



Montenegro and ending in North Albania. The central part belongs to Herzegovina, the region characterised with high diversity of geomorphological, hydrogeological, hydrological and ecological karst phenomena (Mihevc & Prelovšek 2010, Redžić et al. 2008, 2011).

The karst topography with its diversity of freshwater habitats influenced by warm Mediterranean climate and the proximity of mountain region resulted in significant dragonfly diversity of the area. First odonatological records from the Neretva basin in Bosnia and Herzegovina were published at the end of 19<sup>th</sup> and the beginning of 20<sup>th</sup> century by Klapálek (1898), McLahland (1898) and Morton (1908). In later years several additional papers (e.g. Adamović 1948, Georgijević 1976, Dumont 1977) also reported species from this region, however, they all give only fragmentary or anecdotal information on regional dragonfly fauna. In recent years, as a result of more intensive research work in the country, significant new data were collected (e.g. Jović et al. 2010, Bedjanič 2011, Kulijer 2012, Kulijer & Topić 2013, Kulijer et al. 2012, 2013), but the dragonfly fauna of the country still remained understudied (Jović et al. 2010, Bedjanič 2011, Kulijer et al. 2013). The investigations conducted at some poljes and river valleys in the Neretva basin showed that these habitats have high importance for Odonata (Kulijer et al. 2012, 2013). Several species of conservation concern were found in the area, including *Coenagrion ornatum*, *Ceriagrion tenellum*, *Caliaeschna microstigma*, *Lindenia tetraphylla* and *Cordulegaster heros* (Kulijer et al. 2012, 2013).

This report presents results of the dragonfly survey of the streams and rivers in the southern part of the Neretva River basin that belongs to the Herzegovina karst region.

### **General characteristics of the study area**

The complex hydrological system is one of the specificities of the Dinaric karst and Herzegovina area. Under the influence of water carbonate bedrock erodes forming complex surface and underground karst features, having strong influence on the hydrological regime of the area. In karst regions, many rivers and streams sink and reappear several times. Some of them are only temporary and dry out in summer (Prelovšek 2010, Bonacci et al. 2013).

The karst areas are known as dry and only have very limited open waters. In several karst poljes (karst fields) in the region, numerous springs, permanent or temporary streams and rivers appear. Many of the streams and rivers meander through the poljes before going underground. Due to the rich water sources the poljes are important wetland areas of the Mediterranean region of Herzegovina.

Karst poljes are the most characteristic hydro-geomorphic phenomena of the Dinaric karst (Gams 1978, Prohić et al. 1998, Prelovšek 2010). Some of the largest and the most significant karst poljes are located in Bosnia and Herzegovina (Schneider-Jacoby et al. 2006), many of them in the southern, Herzegovina region.



The odontaological study was conducted in the lower part of the Neretva River basin (Fig. 1.) in the south part of Bosnia and Herzegovina. With a length of approximately 220 km (of which the final 20 km are in Croatia) it is the largest and water richest river in the region. The Neretva River rises underneath the high mountain peaks of eastern Herzegovina and in the upper part flows through the mountain region. In its lower part, from Mostar to the river mouth in Croatia, the valley of the Neretva River encompasses some of the largest and most valuable remnants of the natural Mediterranean wetlands in the Adriatic. With its tributaries, it forms the unique ecological system in this part of Mediterranean (Redžić et al. 2008).



**Figure 1. Neretva River valley and the Svitava water reservoir in Hutovo blato Nature Park**

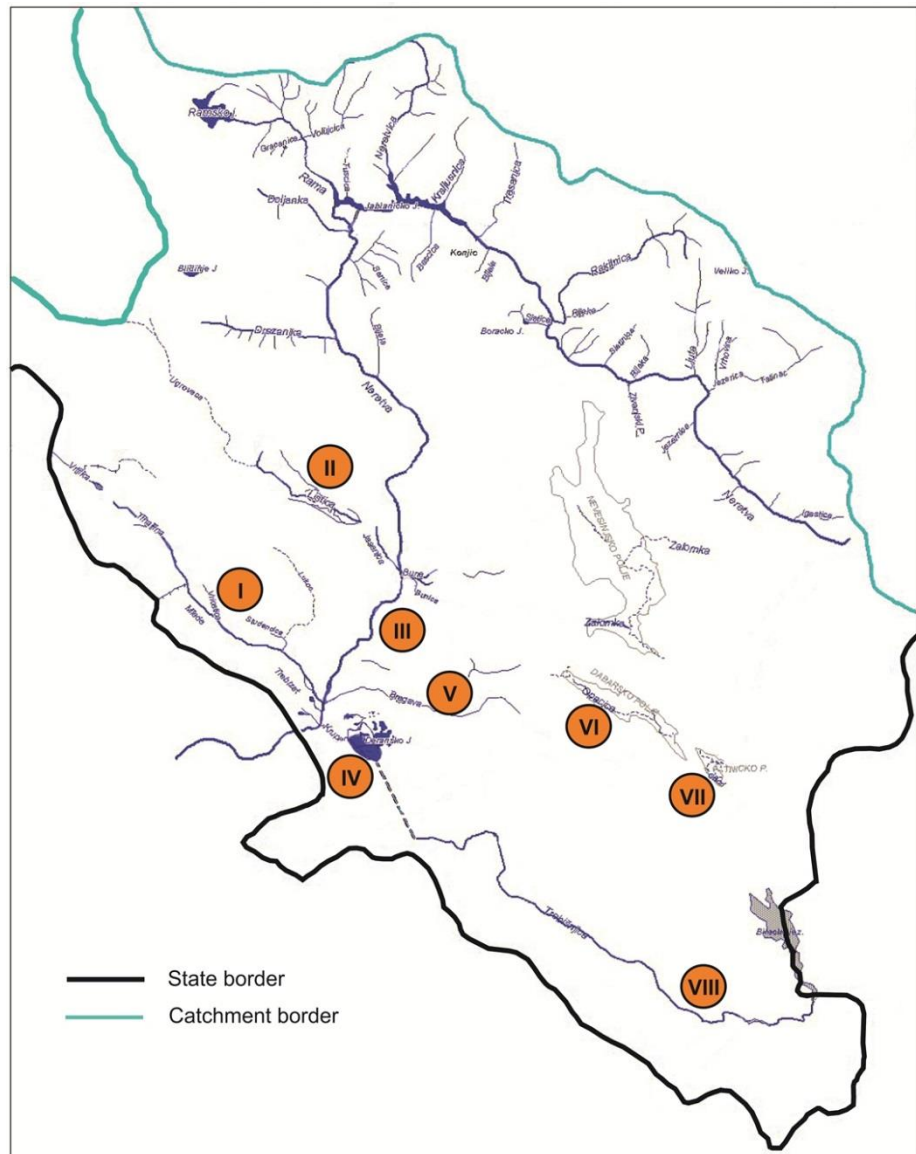
The Neretva River basin is shared between Bosnia and Herzegovina and Croatia as well as with Montenegro through Trebišnjica River subbasin. Together with its tributaries, Neretva River comprises most of the Adriatic watershed of Bosnia and Herzegovina. Major tributaries of the lower section of Neretva River are: Trebižat (right tributary), Buna, Bregava, and Krupa (left tributaries) (Fig. 2). One part of water from the Trebišnjica's subbasin drains directly to the Adriatic Sea, while other part goes also to Neretva. The Trebišnjica and the Trebižat rivers are characteristic examples of "sinking" rivers that drain into the underground system and reappear.

The Trebižat River flows into the Neretva from its right side, sinking and reappearing several times. From its spring(s) to the mouth in the Neretva River, it undergoes eight name changes. After it goes underground as Vrljika River in Croatia it reappears at Peč Mlini in Bosnia and Herzegovina as Tihaljina River. Through Herzegovina it flows as



the Tihaljina-Mlade-Trebižat river system with losing, sinking and underground stream sections. At Trebižat River several waterfalls are formed on tufa barriers. The most impressive one is 25 m high Kravice waterfall (Fig. 3) (Galić et al. 2008, Bonacci et al. 2013).

**Figure 2. The Neretva River catchment with surveyed areas: I. Trebižat River catchment, II. Lištica River catchment (Mostarsko blato), III. Neretva River, IV. Krupa River catchment (Hutovo blato wetland), V. Bregava River catchment, VI. Dabarsko polje, VII. Fatničko polje, VIII. Trebišnjica River catchment (Popovo polje)**



The lower part of the Neretva river basin is under variable influence of the Mediterranean. The area is located at the border of the Mediterranean and the continental climate belt. It is characterised by mild, rainy winters and hot, dry summers. The flooding regularly occurs during wet season, especially in the poljes, when capacity of ponors is not sufficient to drain all the water. Temporary lakes often cover large parts of the poljes for months (Fig. 4). The duration of flooding depends on the rainfall, in natural conditions lasts from 3 to 7 months on average (Bonacci et al. 2013). The water level of Neretva River fluctuates significantly over a year. It reaches spring maximum at the beginning of May, and second maximum in the middle of November. The lowest values are reached in August and September (Lepirica 2007). The study area belongs to the submediterranean deciduous vegetation zone.





**Figure 3. Kravice waterfall on Trebižat River**



**Figure 4. Dabarsko karst polje in early summer (a) and winter when transformed into lake (b)**

As a consequence of hydropower projects rivers of the Balkan region are becoming significantly modified and degraded (Fig. 5). Karst ecosystems, particularly karst watercourses, are very sensitive to anthropogenic influences. Temperature and rainfall changes has significant impact on these habitats. River runoff in many areas has already declined due to overexploitation and in combination with climate change (Skoulikidis 2009, Bonacci et al. 2012).





**Figure 5. Trebišnjica River transformed into canal in Popovo karst polje**

Threats to freshwater ecosystems are significant in the Neretva River catchment, especially as a consequence of conversion of freshwater habitats to agricultural land; changes of the hydrological regime and water flow regulations; construction in sensitive areas; unsustainable land use and the lack of public awareness. In the last 50 years many large infrastructure projects were initiated or implemented in karst region of Bosnia and Herzegovina (Prelovšek 2010).

### **Material & Methods**

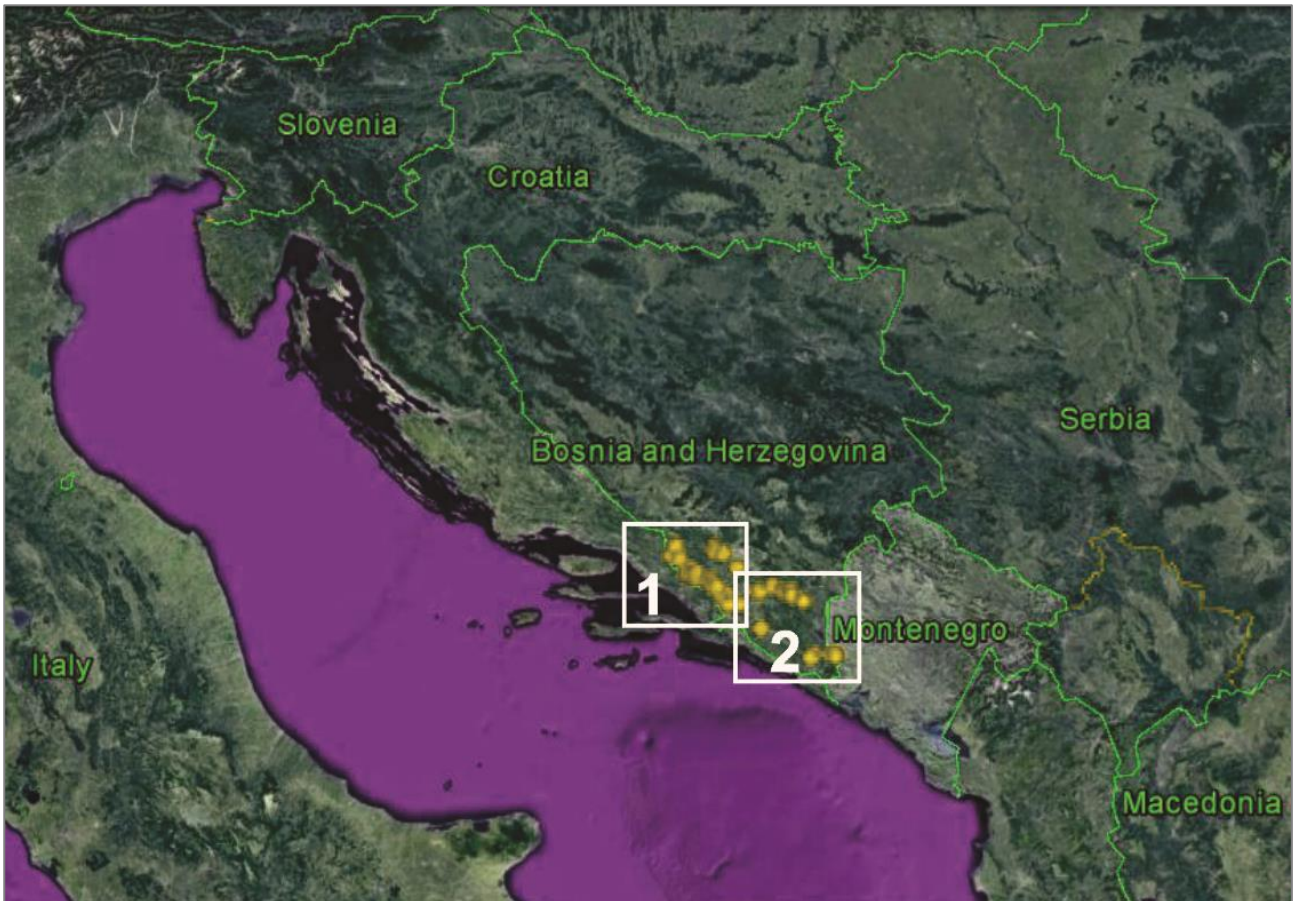
The research was done in the period between 26 April and 18 August 2013. During 17 days of field work dragonflies were observed at 52 localities. It was mainly focused on imagines, but larvae and exuviae were also collected at several localities. In total, 52 localities were visited (Fig. 6 & 7, Tab. I). Eight of these localities were surveyed twice, two three times and one was surveyed four times. Survey dates, geographical coordinates and altitudes are given in Tab. I for all the localities (see appendix I).

Focus of the survey were lotic waters, from streamlets to large rivers. Most of surveyed localities (40) belong to this category. At 11 localities both, running and stagnant water habitats were present. Only at one locality (Škrka Lake) there was no running





water present. The localities along the Neretva River and west of the river are shown in Fig. 7 (1) and the localities east of the river in Fig. 7 (2). As water level in the region is highly variable, some of these habitats considerably change throughout a year and also between the years. Some of them completely dry in summer, but during the winter they can be under several meters of water for months at the time when poljes are flooded and transformed into lakes.



**Figure 6. Geographical position of the survey area with the investigated localities in the western (1) and the eastern (2) part of the Neretva River valley**

All collected records have been entered into the national dragonfly database, and voucher specimens deposited in the collections of the National Museum of Bosnia and Herzegovina in Sarajevo.

## Results

Altogether, 482 dragonfly records of 49 species (18 Zygoptera and 31 Anisoptera) were collected from 52 different localities. For each of the investigated localities a short description is given, and a photo of the habitat is presented for several localities. The locality numbers refer to the ones given in Table I. The list of recorded dragonfly species is presented in Table II (see appendix II) with the reference numbers to specific localities. Fig. 8 presents several characteristic dragonfly species of the region.



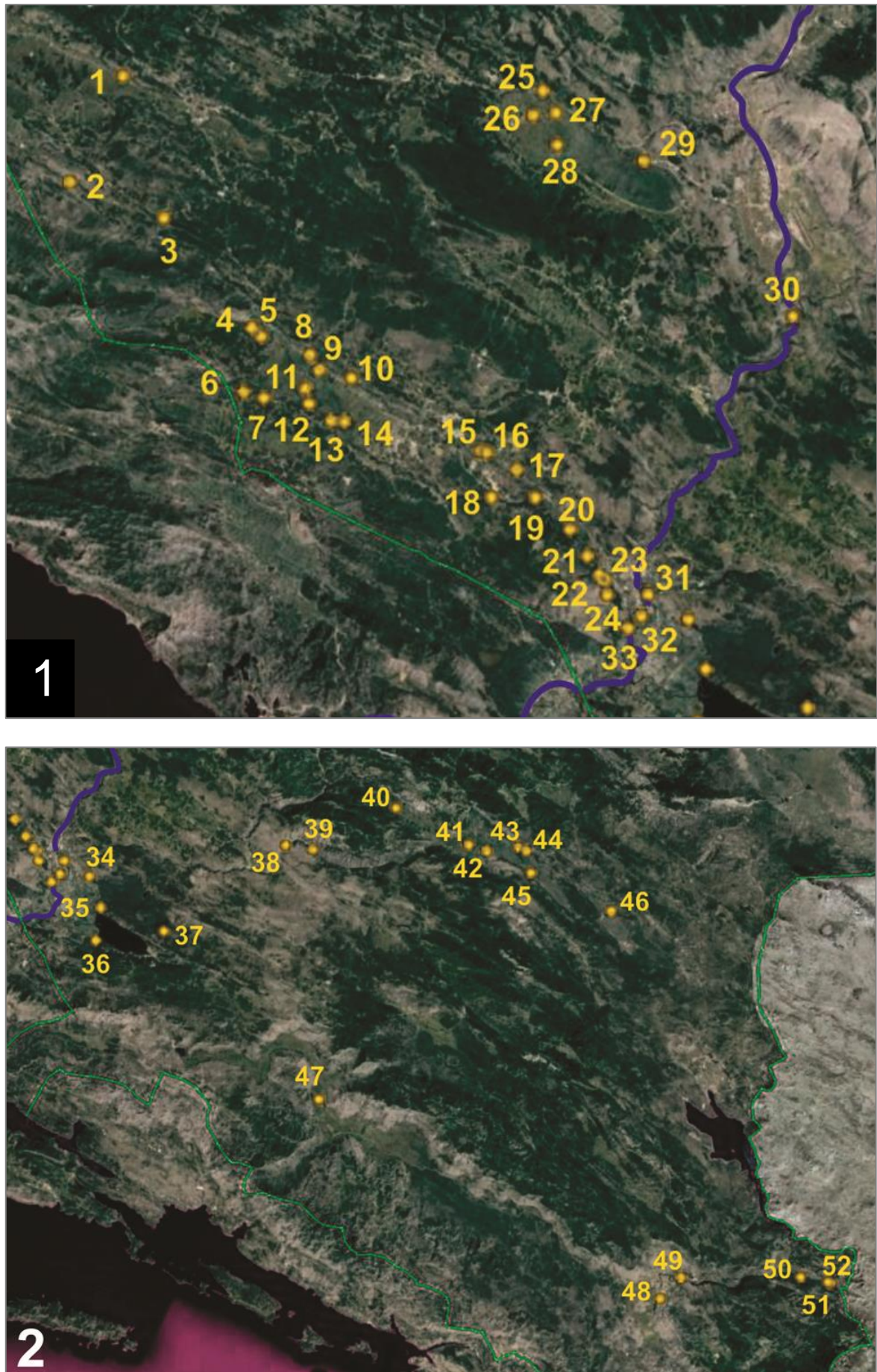


Figure 7. Surveyed localities at and west of Neretva River (1) and east of Neretva River (2)





Figure 8. Several important and interesting sp./ssp. are found in the area: *Lindenia tetraphylla* (1), *Coenagrion ornatum* (2), *Cordulegaster heros* (3), *Caliaeschna microstigma* (4&5), *Selysiothemis nigra* (6), *Calopteryx splendens balcanica* (7).



## Overview of surveyed localities and observed dragonfly species

Abbreviations used: ♂ – male(s), ♀ – female(s), MA – mature adult(s), Juv/Ten – juvenile(s)/teneral(s), Lar – larva(e), Ex – exuvium(ae), Cop – copula(e)/tandem(s), Ovip - ovipositing.

### Loc 1. Grudsko vrelo spring

Large karst spring, rich with water during wet season, but dries out in late summer. At the time of visit in early spring only one adult male of *C. virgo* was observed at the site.

**26.04.2013.**

- *Calopteryx virgo*, 1 ♂

### Loc 2. Peć Mlini

A spring of Tihaljina River. It is a large karst spring from a cave at the base of a tall cliff. Apart from the main course of the river with fast water current, several small arms (Fig. 9) with cascades and small waterfalls near the spring were inspected. The rocks on water edge and in the river bed were covered with moss and *Adiantum capillus-veneris* L., a rare and threatened fern species. Downstream from the spring river and



Figure 9. Arm of Tihaljina River at Peć Mlini (Loc. 2) where exuviae of *C. microstigma* were found.



several small stretches with rocky, gravel or sandy bottom were partly or completely overshadowed. The small streams have partly pools with muddy and organic substrate. After the construction of the hydroelectric power plant at Peć Mlini in 2004 the water level at the spring is reduced.

### 12.07.2013.

- *Calopteryx virgo*, 10's MA, 2 Ex
- *Platycnemis pennipes*, 10 MA
- *Aeshna isoceles*, 2 MA
- *Caliaeschna microstigma*, 1 ♂, 1 Ex
- *Onychogomphus forcipatus*, 3 ♂♂
- *Cordulegaster heros*, 2 ♂♂, 2 Ex
- *Cordulegaster* sp., 10 MA (specimens in flight not identified at species level *heros* or *bidentata*)
- *Orthetrum coerulescens* 1 ♀ (Most of specimens of *O. coerulescens* cf. were just observed, not captured. Based on previous studies intermediate forms of *coerulescens* and *anceps* are dominant in the study area. The majority of specimens is closer to the *anceps* phenotype.)

### Loc 3. Nezdavica stream

A small stream (Fig. 10) with its source on a gentle slope in the field used for agriculture. The stream flows through the field and a small forest patch.



Figure 10. Nezdavica stream (Loc. 3)



**26.04.2013.**

- *Calopteryx virgo*, 2 Juv/TenM, 2 Juv/TenF, 3 Lar

**12.07.2013.**

- *Calopteryx virgo*, 10's MA
- *Ischnura elegans*, 5 MA
- *Platycnemis pennipes*, 10's MA
- *Caliaeschna microstigma*, 1 ♀
- *Cordulegaster heros*, 1 ♂
- *Cordulegaster* sp., 3 MA
- *Orthetrum coerulescens*, 30 MA
- *Orthetrum brunneum*, 10 ♂♂, 2 ♀♀

**Loc 4. Sedra stream**

A streamlet with its spring in the meadow in Ljubuško polje. It flows through the field and between vineyards, partly along the road. At the cascades on a small slope numerous exuviae of *C. microstigma* and *C. bidentata* were found. This stream flows into the Mlade River close to the Koćuša waterfall.

**05.05.2013.**

- *Calopteryx splendens*, 10's MA
- *Calopteryx virgo*, 10's MA
- *Coenagrion ornatum*, 10 ♂♂, 2 ♀♀, 3 Cop, 5 Juv/Ten, 2 Ex
- *Platycnemis pennipes*, 1 Juv/Ten
- *Caliaeschna microstigma*, <10 Ex
- *Cordulegaster bidentata*, 10's Ex
- *Somatochlora meridionalis*, 1 MA

**Loc 5. Koćuša waterfall**

One of the largest tufa waterfalls on Trebižat River (Fig. 11). It is the main course of the Trebižat River with deep water and strong water current. The river banks are overgrown with dense trees and bushes.

**05.05.2013.**

- *Calopteryx splendens*, 10's MA, 10's Juv/Ten
- *Calopteryx virgo*, 10's MA, 10's Juv/Ten
- *Somatochlora meridionalis*, 1 MA





**Figure 11. Kočuša waterfall (Loc. 5)**

### **Loc 6. Muratovac stream/canal**

One of many small canals that belongs to the network built for irrigation of Ljubuško polje. The whole network is connected with the Trebižat River. At this site the canal is app. 2 m wide, partly or completely shaded, with clear water current (Fig. 12). Several small armlets with small tufa cascades and pools flow through forest patches.



**Figure 12. Muratovac canal (Loc. 6)**



**26.04.2013.**

- *Calopteryx splendens*, 15 ♂♂, 10 ♀♀, 1 Ex
- *Gomphus vulgatissimus*, 3 Ex
- *Caliaeschna microstigma*, 1 MA, 1 ♀, 3 Lar, 2 Ex
- *Cordulegaster heros*, 2 Ex
- *Cordulegaster bidentata*, 3 Ex

**Loc 7. Stream/canal at Grab**

As the former locality, it is part of the same irrigation system of Ljubuško polje. A small natural looking stream at the site is flowing along the field and dirty road, and later through a small forest patch. The margins are mostly overgrown with dense thicket.

**11.05.2013.**

- *Calopteryx splendens*, 10's MA
- *Calopteryx virgo*, 10's MA
- *Coenagrion ornatum*, 2 ♂♂, 1 ♀
- *Platycnemis pennipes*, 10's Juv/Ten♀
- *Aeshna isoceles*, 1 MA
- *Gomphus vulgatissimus*, 1 ♂, 1 ♀
- *Libellula fulva*, 10 MA, 1 Cop

**Loc 8. Vitina, Vrioštica spring**

Large karst spring under a cliff with the small waterfall at the spring. The dragonflies were observed along the first 50 m stretch with rocky bottom, rich underwater vegetation and fast water current.

**12.07.2013.**

- *Calopteryx virgo*, 2 ♂♂
- *Ischnura elegans*, 2 MA
- *Platycnemis pennipes*, 1 ♂, 1 ♀
- *Anax imperator*, 2 ♂♂, 1 ♀
- *Cordulegaster* sp., 3 MA
- *Libellula depressa*, 1 ♂
- *Orthetrum cancellatum*, 1 ♂
- *Orthetrum coerulescens*, 5 ♂♂
- *Orthetrum brunneum*, 1 ♂, 1 ♀

**Loc 9. Vrioštica River**

Shaded stretch of Vrioštica River in the polje with slow flowing water, deep water and abundant water vegetation. The river is bordered by small farms and its margins are mostly shaded by tall trees.





**11.05.2013.**

- *Calopteryx splendens*, 10's MA
- *Calopteryx virgo*, <10 MA, 2 Juv/TenF, 1 Ex
- *Libellula fulva*, 1 ♂

**Loc 10. Proboj spring**

Several small springs forming a creek at Proboj, near the main road and close to several houses. The water from springs is used for households. Area around the springs is mostly covered with concrete. The springs are shaded by trees and tall bushes. At least a couple of the springs dry out in summer. Most of the creek in its lower part is overgrown and hardly accessible. Upstream from the springs is dry river bed that is probably active only during wet season.

**12.07.2013.**

- *Calopteryx virgo*, 10 MA
- *Aeshna isoceles*, 1 MA
- *Caliaeschna microstigma*, 2 ♂♂
- *Onychogomphus forcipatus*, 3 ♂♂
- *Cordulegaster heros*, 1 ♀
- *Orthetrum coerulescens*, 2 ♂♂
- *Orthetrum brunneum*, 2 ♂♂, 1 ♀

**Loc 11. Voša canal**

A narrow canal flowing between the road and the field. Mostly overgrown by dense and tall reed and some *Salix* sp. bushes, with only small open stretch (Fig. 13) on a gentle slope where several *C. microstigma* larvae were found.

**11.05.2013.**

- *Calopteryx splendens*, 10's MA, 10's Juv/Ten, <10 Ex
- *Calopteryx virgo*, 10's MA, <10 Juv/Ten, < 10 Ex
- *Caliaeschna microstigma*, 5 Ex



**Figure 13. Voša canal (Loc. 11)**



### Loc 12. Mlade River at Otunj

Flooded field (Fig. 14) between the dike that is constructed along the Mlade River. It is connected with the river by small water-gate and concrete canal. Several hundred m<sup>2</sup> of field covered with shallow water and mostly field vegetation, and some *Typha* sp. and *Alisma plantago-aquatica* L. plants near the canal.



Figure 14. Flooded field at Otunj (Loc. 12)

#### 11.05.2013.

- *Calopteryx splendens*, 10's MA, <10 Juv/Ten
- *Calopteryx virgo*, 10's MA, <10 Juv/Ten
- *Coenagrion puella*, 10's MA, 10's Juv/Ten
- *Coenagrion ornatum*, 1 ♂, 2 ♀♀
- *Ceriagrion tenellum*, 10's MA
- *Platycnemis pennipes*, 5 Juv/Ten
- *Aeshna isoceles*, 1 ♂
- *Libellula fulva*, 10's MA, <10 Cop
- *Orthetrum coerulescens*, 3 Ten
- *Orthetrum brunneum*, 1 ♂, 1 Juv/Ten
- *Crocothemis erythraea*, 1 Juv/Ten



**Loc 13. Vrioštica River near Humac**

The dikes are constructed along the river on both sides with no trees and grass vegetation that is regularly mowed. The river has a strong current, with small cascade at the site. At the river margins some patches of marsh vegetation dominated with *Iris pseudacorus* L. and *Typha* sp. are present. The right river bank in the upper part is overgrown with dense bushes, where most of the dragonflies were found. *C. ornatum* was found at small concrete canal near the river with some vegetation present in the canal.

**11.05.2013.**

- *Calopteryx splendens*, 10's MA, 10's Juv/Ten
- *Calopteryx virgo*, 1 ♀
- *Ischnura elegans*, 3 MA, 1 OvipF, 1 Juv/Ten
- *Coenagrion puella*, 3 ♂♂
- *Coenagrion ornatum*, 2 ♂♂, 1 ♀
- *Platycnemis pennipes*, 2 ♂♂, 5 Juv/Ten, 1 Cop

**Loc 14. Mlade River near Humac**

Mlade River with dikes built along both sides. The habitat is similar as at the previous locality.

**11.05.2013.**

- *Calopteryx splendens*, 100's MA, 10's Juv/Ten, 1 Cop
- *Calopteryx virgo*, 20 MA
- *Coenagrion puella*, 1 ♂
- *Platycnemis pennipes*, 10 MA
- *Anax imperator*, 1 ♂
- *Libellula fulva*, 3 ♂♂, 2 Cop

**Loc 15. Gornji Studenci**

A spring and stream at Gornji Studenci with fast flowing shallow water and steep margins, overgrown with dense shrubs and *Rubus* sp. Stream flows through farmland with several very small armlets with water-gates for irrigation that are mostly overgrown by tall grass and herbaceous meadow vegetation. *C. microstigma* males patrolled fast flowing, partly shaded spring area of the stream with rocks covered with moss. *C. heros* is mostly found along the road and patrolling smaller armlets and the stream at lower part.

**12.07.2013.**

- *Calopteryx splendens*, 4 ♂♂
- *Platycnemis pennipes*, 2 ♂♂



- *Aeshna affinis*, 1 ♂
- *Aeshna isoceles*, 1 MA
- *Anax imperator*, 1 ♂
- *Caliaeschna microstigma*, 10 ♂♂
- *Onychogomphus forcipatus*, 3 ♂♂
- *Cordulegaster heros*, 6 ♂♂, 1 ♀
- *Libellula depressa*, 1 ♂
- *Orthetrum brunneum*, 2 ♂♂
- *Crocothemis erythraea*, 2 MA
- *Selysiotthemis nigra*, 1 ♂

#### 14.05.2013.

- *Calopteryx splendens*, 1 ♂
- *Caliaeschna microstigma*, 4 ♂♂
- *Gomphus vulgatissimus*, 1 MA
- *Cordulegaster heros*, 2 ♂♂, 1 Ex

#### 28.06.2013.

- *Calopteryx virgo*, 1 ♀
- *Aeshna isoceles*, 1 MA
- *Caliaeschna microstigma*, 1 ♂
- *Cordulegaster* sp., 1 ♂A

### Loc 16. Vakuf spring

Another karst spring in Studenačko polje. Water from the spring is used for households and is directly taken from the source. Water margins are densely and fully overgrown with thick bushes and *Rubus* sp. and inaccessible. Near the road one small patch was investigated with fast flowing water and dense aquatic vegetation between rocks covered with moss. Along app. 10 m of the stream *C. microstigma* males were found patrolling low over the water surface along the edges and close to the rocks.

#### 14.05.2013.

- *Aeshna isoceles*, 5 MA
- *Caliaeschna microstigma*, 10 ♂♂
- *Cordulegaster* sp., 2 MA
- *Libellula fulva*, 1 MA
- *Libellula depressa*, 1 ♀

#### 28.06.2013.

- *Calopteryx virgo*, 2 ♂♂
- *Aeshna isoceles*, 1 MA
- *Caliaeschna microstigma*, 2 ♀♀



- *Cordulegaster heros*, 1 ♂, 1 Ex
- *Libellula fulva*, 1 MA

### Loc 17. Spring near Donji Studenci

Karst spring at the base of a tall cliff at the field margin. A huge flow of water is coming out of this karst spring and flows over large rocks forming several cascades and waterfalls (Fig. 15). After 30-40 m it becomes a shallow fast river with gravel / rocky bottom and 4-5 m in diameter. In the lower part, it flows through flat fields. *Alnus glutinosa* (L.) Gaertn. Trees are growing along the river margins.



Figure 15. Spring near Donji Studenci (Loc. 17)

**05.05.2013.**

- *Calopteryx splendens*, 5 MA
- *Calopteryx virgo*, 2 MA
- *Caliaeschna microstigma*, 1 ♂, 1 F, 1 Juv/TenM
- *Gomphus vulgatissimus*, 1 MA
- *Libellula fulva*, 1 MA



**14.05.2013.**

- *Calopteryx splendens*, 1 ♂
- *Calopteryx virgo*, 10's MA
- *Aeshna isoceles*, 5 MA
- *Caliaeschna microstigma*, 1 ♂
- *Somatochlora meridionalis*, 1 MA
- *Libellula fulva*, 3 MA
- *Orthetrum brunneum*, 1 ♀

**28.06.2013.**

- *Calopteryx virgo*, 2 ♂♂, 2 ♀♀
- *Aeshna isoceles*, 2 F, <10 ♂♂A
- *Caliaeschna microstigma*, 3 ♂♂
- *Somatochlora meridionalis*, 2 ♂♂, <10 MA
- *Cordulegaster heros*, 1 ♂
- *Cordulegaster* sp., <10 MA

**Loc 18. Kravice waterfall**

A 25 m high Kravice waterfall on Trebižat River (Fig. 3) formed on tufa barrier is the largest waterfall in the area and one of the most impressive ones in the country. Sides are mostly shaded, and several small armlets are flowing along both sides of the waterfall. This is the place where most of *Cordulegaster* sp. were observed patrolling.

**12.07.2013.**

- *Calopteryx splendens*, 10 ♂♂
- *Ischnura elegans*, 2 MA
- *Platycnemis pennipes*, 10's MA
- *Aeshna isoceles*, 1 MA
- *Aeshna cyanea*, 1 ♂
- *Anax imperator*, 10 ♂♂
- *Anax parthenope*, 1 ♂
- *Onychogomphus forcipatus*, 2 ♂♂
- *Cordulegaster heros*, 1 ♀
- *Cordulegaster* sp., 10 MA
- *Libellula fulva*, 2 M, 1 ♀
- *Orthetrum coerulescens*, 10 MA
- *Sympetrum sanguineum*, 2 ♂♂
- *Crocothemis erythraea*, <10 MA
- *Selysiothemis nigra*, 1 ♂



**Loc 19. Studenčica River mouth**

Studenčica River collects water from the springs in Studenačko polje. It is one of the main left tributaries of Trebižata River. At the mouth to Trebižat River Studenčica is partly shaded with steep, muddy and sandy banks. The surveyed locality is app. 3 km downstream of Kravice waterfall.

**05.05.2013.**

- *Calopteryx splendens*, 100's MA, 10's Juv/Ten
- *Calopteryx virgo*, 10's MA, 10's Juv/Ten, 2 Cop
- *Platycnemis pennipes*, 5 Juv/Ten
- *Aeshna isoceles*, 1
- *Gomphus vulgatissimus*, 10 MA, 20 Juv/Ten, 100's Ex
- *Libellula depressa*, 1 ♂
- *Libellula fulva*, 10 MA, 30 Juv/Ten

**Loc 20. Trebižat River at Krča**

The left bank of the Trebižat River bordering with meadows and agricultural land. Main course of the river with *A. glutinosa* and *Salix* sp. trees on the margins. Numerous exuviae of *G. vulgatissimus* were found at tree trunks and muddy shores of Trebižat River. At a small canal parallel with the river numerous exuviae and several juveniles of *C. ornatum* were observed. The shallow canal is completely overgrown with young *Berula erecta* (Huds.) Coville and through partly opened water-gate connected with the river. Many juveniles and young adults of *C. ornatum* and *G. vulgatissimus* were found among tall grass along the river and the canal.

**12.05.2013.**

- *Calopteryx splendens*, 100's MA, 10's Juv/Ten
- *Calopteryx virgo*, 10's MA, <10 Juv/Ten
- *Ischnura elegans*, 1 MA
- *Coenagrion ornatum*, 5 ♂♂, 10 MA, 15 Juv/Ten, 1 Cop, 10's Ex
- *Platycnemis pennipes*, 2 ♂♂, 5 MA, 2 Juv/Ten
- *Brachytron pratense*, 1 ♂
- *Gomphus vulgatissimus*, 10's MA, 10's Juv/Ten, 10's Ex
- *Libellula fulva*, 3 ♂♂
- *Sympetrum meridionale*, 1 Juv/TenM

**Loc 21. Trebižat River at Lopata**

Two armlets of the Trebižat River and a small shallow open pool remained after the spring flood. The river margins is overgrown with *A. glutinosa* and *Salix* sp. trees.



**12.05.2013.**

- *Calopteryx splendens*, 100's MA, <10 Juv/Ten
- *Calopteryx virgo*, 10's MA
- *Ischnura elegans*, 1 MA
- *Coenagrion puella*, 3 ♂♂
- *Platycnemis pennipes*, 2 MA
- *Aeshna isoceles*, 10 MA
- *Anax parthenope*, 1 ♂
- *Brachytron pratense*, 1 ♂
- *Gomphus vulgatissimus*, 10's MA, <10 Juv/Ten, 10's Ex
- *Libellula fulva*, 30 MA, 5 Cop
- *Sympetrum sanguineum*, 2 Juv, 10 Juv/Ten

**Loc 22. Trebižat River near Grabovine**

Left arm of the Trebižat River was surveyed at the locality where the river bank is overgrown with tall *Salix* sp. and *Populus alba* L. trees.

**14.05.2013.**

- *Calopteryx splendens*, 100's MA, 10's Ex
- *Calopteryx virgo*, <10 MA
- *Ischnura elegans*, 1 MA
- *Coenagrion puella*, 1 ♂
- *Platycnemis pennipes*, 70 MA
- *Aeshna isoceles*, 1 MA
- *Gomphus vulgatissimus*, 15 MA, 10's Ex
- *Libellula fulva*, 10 MA, 1 Cop

**Loc 23. Stream at Grabovine**

A small armlet of the Trebižat River with water flow controlled by water-gate. At the survey site after flowing through thick bushes and trees, water flows down the small cascade and forms a small shallow pool before going into the dense forest patch. Most of the dragonflies were observed at the pool or patrolling along the shaded road.

**14.05.2013.**

- *Calopteryx splendens*, 100's MA, <10 Cop, <10 Juv/Ten, <10 Ovip
- *Ischnura elegans*, 2 MA
- *Coenagrion pulchellum*, 1 ♀
- *Coenagrion puella*, 2 ♂♂
- *Platycnemis pennipes*, 30 MA
- *Aeshna affinis*, 1 F, 2 MA





- *Caliaeschna microstigma*, 1 ♂
- *Gomphus vulgatissimus*, 10 MA
- *Libellula fulva*, 3 ♂♂, 3 ♀♀, 1 Cop
- *Orthetrum cancellatum*, 1 ♀

#### Loc 24. Trebižat River at Gorica

The lowest part of the Trebižat River valley where the river meanders and splits into several larger and smaller armlets. Abundant marshland vegetation is developed in between, and along these armlets. Fragments of flooded forest are present along the water courses. The survey included several armlets on the right side of the river upstream from the Gorica village. At the time of visit the water level was high and the surrounding field was partly flooded.

##### 14.05.2013.

- *Calopteryx splendens*, 100's MA, 10's Juv/Ten, 10's Ex
- *Calopteryx virgo*, 1 ♀, <10 MA
- *Ischnura elegans*, 3 MA, 10 Juv/Ten
- *Coenagrion pulchellum*, 1 ♂, 2 ♀♀
- *Coenagrion puella*, 5 ♂♂, 5 MA, 5 Cop, <10 Juv/Ten
- *Platycnemis pennipes*, 10's MA, 10's Juv/Ten
- *Aeshna isoceles*, 20 MA, 1 Cop
- *Brachytron pratense*, 2 MA
- *Gomphus vulgatissimus*, 100's MA
- *Libellula fulva*, 10's MA, <10 Cop, <10 Juv/Ten

#### Loc 25. Žvatić stream in Mostarsko blato

Several springs and the upper part of the stream in the north part of Mostarsko blato karst polje were investigated. The stream is mostly shaded with thick bushes and trees on the margins and several small sunlit stretches. The water current is strong, and the river bed is covered with gravel and sand.

##### 26. 04. 2013.

- *Libellula fulva*, 1 MA

##### 10. 06. 2013.

- *Calopteryx virgo*, 20 MA
- *Ischnura elegans*, 5 MA
- *Coenagrion puella*, 1 ♂
- *Caliaeschna microstigma*, 3 ♂♂
- *Cordulegaster heros*, 2 ♂♂
- *Orthetrum coerulescens*, 10 MA



**Loc 26. Lištica River and pond near football camp**

Lištica River is the main watercourse in Mostarsko blato karst polje. At the site it is a fast flowing deep river with sandy and rocky bottom. Near the river, several ponds formed in old gravel pits were also investigated.

**10. 06. 2013.**

- *Ischnura elegans*, 10 MA
- *Coenagrion puella*, 2 ♂♂
- *Erythromma lindenii*, 10 ♂♂
- *Anax imperator* 5 ♂♂
- *Anax parthenope*, 1 ♂
- *Libellula fulva*, 10 MA
- *Orthetrum coerulescens*, 2 ♂♂
- *Sympetrum meridionale*, 1 ♀
- *Crocothemis erythraea*, 2 ♂♂

**17. 08. 2013.**

- *Erythromma viridulum*, 10 ♂♂
- *Erythromma lindenii*, 5 MA
- *Platycnemis pennipes*, 2 ♂♂
- *Aeshna mixta*, 10 MA
- *Anax parthenope*, 1 ♂
- *Libellula depressa*, 1 ♀
- *Orthetrum cancellatum*, 2 ♂♂
- *Sympetrum sanguineum*, 20 MA
- *Crocothemis erythraea*, 10's MA

**Loc 27. Lištica River near Dobrić**

At the site, Lištica River meanders slowly across the flat terrain of the lower part of the polje. The margins are densely overgrown with *Salix* sp. (Fig. 16). Numerous *C. puella* tandems were observed ovipositing on submerged grassy vegetation in the shade along the river bank at the parts with more stagnant water. River bed is mostly rocky at parts with faster and more shallow water, and sandy or gravel at deeper and calmer pools in the stream bed.

**10. 06. 2013.**

- *Calopteryx virgo*, 10's MA
- *Ischnura elegans*, 2 ♀♀
- *Coenagrion puella*, 10's MA, 10's Cop
- *Anax imperator*, 1 ♀
- *Onychogomphus forcipatus*, 10 ♂♂





Figure 16. Lištica River near Dobrić (Loc. 27)

### 17. 08. 2013.

- *Calopteryx splendens*, 10's MA
- *Ischnura elegans*, 10's MA
- *Enallagma cyathigerum*, 10 ♂♂, 2 Cop
- *Coenagrion puella*, 10's ♂♂A, 10's Cop
- *Erythromma lindenii*, 10 ♂♂
- *Platycnemis pennipes*, 10's MA
- *Aeshna mixta*, 10's MA
- *Aeshna cyanea*, 1 ♀
- *Anax imperator*, 1 ♂
- *Anax parthenope*, 1 ♂
- *Onychogomphus forcipatus*, 10 ♂♂
- *Orthetrum brunneum*, 1 ♂
- *Sympetrum sanguineum*, 10's MA
- *Sympetrum meridionale*, 10's MA
- *Crocothemis erythraea*, 2 ♂♂



**Loc 28. Govnuša stream**

Govnuša stream is the remnant of the old river course before the water regulation network in the polje was developed. It meanders through flat meadow terrain of the central upper part of the polje. It is richly vegetated with *Salix* sp. bushes, *Iris pseud-acorus* and other water plants and swamp vegetation.

**10. 06. 2013.**

- *Calopteryx splendens*, 2 ♂♂
- *Lestes barbarus*, 10 MA
- *Ischnura elegans*, 10's MA
- *Ischnura pumilio*, 1 ♂
- *Coenagrion puella*, 10's MA, 10's Cop
- *Erythromma viridulum*, 5 ♂♂
- *Platycnemis pennipes*, 10 MA
- *Aeshna affinis*, 4 ♂♂
- *Anax imperator*, 2 ♂♂, 1 ♀
- *Anax parthenope*, 3 ♂♂, 1 Cop
- *Libellula quadrimaculata*, 10 MA
- *Libellula depressa*, 5 MA
- *Libellula fulva*, 10's MA
- *Orthetrum coerulescens*, 2 ♂♂
- *Orthetrum* sp., 2 ♀♀
- *Sympetrum sanguineum*, 10's MA, 10's Juv/Ten
- *Crocothemis erythraea*, 15 MA

**Loc 29. Krenica in Mostarsko blato**

Large, open and sun-exposed pool and the flooded meadow that are connected with main course of the Lištica River.

**10. 06. 2013.**

- *Calopteryx splendens*, 1 ♀
- *Ischnura elegans*, 10's MA, 10's Cop
- *Enallagma cyathigerum*, <10 ♂♂
- *Coenagrion puella*, 10's MA, 10's Cop, 10's Juv/Ten
- *Erythromma lindenii*, 10's MA, 10's Cop, 10's Juv/Ten
- *Anax imperator*, 5 ♂♂
- *Anax parthenope*, 3 ♂♂
- *Aeshna isoceles*, 1 ♂
- *Orthetrum albistylum*, 1 ♀
- *Sympetrum sanguineum*, 1 Juv/Ten
- *Sympetrum fonscolombii*, 10 MA
- *Crocothemis erythraea*, 10 MA



**Loc 30. Neretva River at Buna River mouth**

The locality is situated at the Buna River mouth on the left river bank of Neretva River. Cascades at Neretva River at the mouth of river Buna were investigated. Low summer water regime of Neretva River left the large part of river bed dry. At this site, the river is fast, rocky and shallow with small *Salix* sp. Bushes growing in the river bed.

**13.07.2013.**

- *Calopteryx splendens*, 10's MA
- *Ischnura elegans*, 10 MA, 2 Cop
- *Coenagrion puella*, 1 ♀
- *Aeshna affinis*, 1 ♀
- *Gomphus vulgatissimus*, 2 MA, 1 Cop
- *Onychogomphus forcipatus*, 6 ♂♂
- *Orthetrum coerulescens*, 2 ♂♂
- *Sympetrum sanguineum*, 10's MA

**Loc 31. Neretva near Bregava River mouth**

The survey site is situated at the Bregava River mouth on the left side of one small armlet of the Neretva River, connected with the main river course. It is an armlet with slow flowing water, and has a gravel water bottom.

**16.08.2013.**

- *Calopteryx splendens*, 10 MA
- *Lestes barbarus*, 4 ♂♂
- *Ischnura elegans*, 2 ♂♂, 1 ♀
- *Platycnemis pennipes*, 2 ♂♂
- *Aeshna mixta*, 10 MA
- *Anax imperator*, 1 ♀
- *Lindenia tetraphylla*, 2 MA
- *Sympetrum meridionale*, 2 ♂♂
- *Crocothemis erythraea*, 1 ♂, 1 ♀
- *Selysiotthemis nigra*, 10 MA

**Loc 32. Neretva River near Klepci**

Ponds formed in the old armlets of Neretva River. Deep ponds with gravel bottom and steep margins overgrown with bushes and trees. Flooded during winter, most of them dries out in late summer. The dragonflies were mainly observed at the pond margins, at the left side of the river and along the fields bordering these ponds.

**29.06.2013.**

- *Calopteryx splendens*, 3 ♂♂, 2 ♀♀



- *Coenagrion puella*, 1 ♂
- *Erythromma lindenii*, 5 ♂♂, 2 ♀♀
- *Platycnemis pennipes*, 2 ♂♂, 1 ♀, 1 Juv/Ten
- *Onychogomphus forcipatus*, 2 Ex
- *Orthetrum albistylum*, 2 F
- *Sympetrum striolatum*, 1 Juv/Ten ♀
- *Crocothemis erythraea*, 3 ♂♂, 1 ♀
- *Selysiotthemis nigra*, 2 ♂♂, 3 ♀♀

### Loc 33. Neretva River at Struge

The lower part of Neretva River app. 7 km before the river crosses the border with Croatia. In this area the river slows down in velocity looking more as lowland river, with gravel islands and sandy banks with some tall trees and reed beds (Fig. 17). The study site is on the right side of Neretva River at an old gravel extraction site, today mainly used as a waste disposal area. Several small ponds are formed in these gravel extractions. One of these ponds has shallow water and has a rich vegetation dominated by *A. plantago-aquatica* and *Typha* sp.



Figure 17. Neretva River at Struge (Loc. 33)



**14.05.2013.**

- *Calopteryx splendens*, 10's MA, <10 Juv/Ten
- *Sympecma fusca*, 1 MA
- *Ischnura elegans*, 10 MA, 2 Cop
- *Coenagrion puella*, 1 ♀
- *Aeshna affinis*, 1 Juv/TenF
- *Anax parthenope*, 1 ♂
- *Gomphus vulgatissimus*, 2 MA, 1 Cop

**Loc 34. Škrka Lake**

Hutovo blato is one of the largest and most important wetlands in Bosnia and Herzegovina. Škrka Lake is a richly vegetated lake at the N-W side of the Hutovo blato Nature Park. The wide belt of sedges, reeds and rushes is developed around the lake, especially along its northern side (Fig. 18).



Figure 18. Marshland vegetation on the west edge of Škrka Lake (Loc. 34)

**15.05.2013.**

- *Ischnura elegans*, 100's MA, 10's Cop, <10 Juv/Ten
- *Coenagrion pulchellum*, 20 MA
- *Ceriagrion tenellum*, 1 ♂



- *Aeshna isoceles*, 15 MA
- *Anax imperator*, 2 MA
- *Anax parthenope*, 15 MA, 1 Juv/Ten
- *Brachytron pratense*, 5 MA
- *Libellula quadrimaculata*, 2 MA
- *Libellula fulva*, 10 MA
- *Sympetrum striolatum*, 2 Juv/Ten
- *Crocothemis erythraea*, 10 MA, 3 Juv/Ten, 2 Cop, 1 OvipF

### Loc 35. Krupa River at Karaotok

The Krupa River is the main waterway in Hutovo blato wetland. The river collects water from several lakes and directs it towards the Neretva River. At the survey site it has deep, slow flowing river with abundant water vegetation and bank tree vegetation dominated by *Salix alba* L., *Salix purpurea* L. and *Fraxinus angustifolia* Vahl. (Fig. 19). Dragonflies were observed along the 500 m stretch of the river and along one of the side canals.



Figure 19. Krupa River near Karaotok (Loc. 35)

**15.05.2013.**

- *Calopteryx splendens*, 20 MA
- *Ischnura elegans*, 100 MA, 10 Cop, <10 OvipCop





- *Coenagrion pulchellum*, 100 MA, 20 Cop, <10 OvipCop
- *Aeshna isoceles*, 5 MA, 2 Cop
- *Anax imperator*, 2 ♂♂, 1 OvipF
- *Gomphus vulgatissimus*, 1 MA
- *Libellula fulva*, 30 MA, 10 Cop
- *Sympetrum striolatum*, 3 Juv/TenM
- *Crocothemis erythraea*, 2 ♂♂

### 27.06.2013.

- *Ischnura elegans*, 10's MA
- *Erythromma viridulum*, 5 ♂♂
- *Platycnemis pennipes*, <10 MA
- *Aeshna affinis*, 3 ♂♂
- *Aeshna isoceles*, 2 MA
- *Lindenia tetraphylla*, 5 ♂♂, 1 F, 5 MA
- *Libellula fulva*, 10's MA, 1 Cop
- *Orthetrum cancellatum*, 20 MA
- *Orthetrum albistylum*, 1 ♀
- *Orthetrum coerulescens*, 10's MA
- *Sympetrum sanguineum*, 1 ♂, 5 Juv/Ten
- *Sympetrum striolatum*, 2 Juv/Ten
- *Crocothemis erythraea*, 10's MA
- *Selysiothemis nigra*, 30 MA

### 13.07.2013.

- *Sympecma fusca*, 1 ♂
- *Ischnura elegans*, 10's MA
- *Erythromma viridulum*, 1 ♂
- *Erythromma lindenii*, 3 MA
- *Ceriagrion tenellum*, 1 ♂
- *Platycnemis pennipes*, 100's MA, 10's Cop
- *Aeshna isoceles*, 1 ♀
- *Anax imperator*, 2 ♂♂
- *Anax parthenope*, 1 ♂
- *Lindenia tetraphylla*, 15 MA
- *Orthetrum cancellatum*, 1 ♂
- *Orthetrum albistylum*, 1 ♂
- *Orthetrum coerulescens*, 2 ♂♂
- *Libellula quadrimaculata*, 1 ♂
- *Libellula fulva*, 20 MA
- *Sympetrum sanguineum*, 5 ♂♂



- *Crocothemis erythraea*, 10's MA
- *Selysiothemis nigra*, 10's MA

**16.08.2013.**

- *Lestes barbarus*, 1 ♀
- *Chalcolestes parvidens*, 2 ♀♀
- *Ischnura elegans*, 20 MA
- *Platycnemis pennipes*, 50 MA
- *Aeshna mixta*, 10 ♂♂
- *Anax imperator*, 2 ♂♂
- *Lindenia tetraphylla*, 5 MA
- *Orthetrum cancellatum*, 2 MA
- *Orthetrum albostillum*, 1 ♂
- *Orthetrum coerulescens* 5 ♂♂
- *Sympetrum sanguineum* 10's MA, 10's Cop
- *Sympetrum meridionale*, 10 MA
- *Crocothemis erythraea* 10's MA
- *Selysiothemis nigra* 10's MA

**Loc 36. Svitava canal near Sjekose**

A natural looking canal along the dike of the Svitava water reservoir. Dragonflies were investigated along a 100 m sunny stretch of the canal and in the nearby meadows.

**13.07.2013.**

- *Calopteryx splendens*, 10 MA
- *Ischnura elegans*, 1 ♀
- *Coenagrion pulchellum*, 1 ♂
- *Platycnemis pennipes*, 5 MA
- *Anax imperator*, 2 ♂♂
- *Anax parthenope*, 1 ♂
- *Libellula fulva*, 1 ♂
- *Orthetrum cancellatum*, 1 ♂
- *Orthetrum coerulescens*, 2 ♂♂
- *Orthetrum brunneum*, 1 ♂
- *Sympetrum sanguineum*, 3 ♂♂
- *Crocothemis erythraea*, 10's MA
- *Selysiothemis nigra*, 10's MA

**16.08.2013.**

- *Lestes barbarus*, 1 ♀
- *Lestes virens*, 2 ♂♂



- *Ischnura elegans*, 2 ♂♂
- *Platycnemis pennipes*, 1 ♂
- *Aeshna mixta*, 10 ♂♂
- *Anax imperator*, 1 ♂
- *Lindenia tetraphylla*, 2 ♂♂
- *Sympetrum sanguineum*, 100 MA
- *Sympetrum striolatum*, 10 MA
- *Crocothemis erythraea*, 15 MA
- *Selysiothemis nigra*, 10 MA

### Loc 37. Londža spring

Large karst spring in the NE part of the Nature Park Hutovo blato. A 2 m wide stream directs the water from the spring towards Deransko Lake. At the spring and the stream abundant water and marshland vegetation is developed.

#### 13.07.2013.

- *Chalcolestes parvidens*, 5 MA
- *Ischnura elegans*, 10 MA
- *Coenagrion pulchellum*, 5 MA
- *Erythromma lindenii*, 3 ♂♂
- *Aeshna affinis*, 1 ♀
- *Aeshna isoceles*, 1 ♂
- *Anax parthenope*, 2 ♂♂
- *Brachytron pratense*, 1 ♂
- *Lindenia tetraphylla*, 1 MA
- *Somatochlora flavomaculata*, 10 MA
- *Libellula fulva*, 1 ♂
- *Orthetrum coerulescens*, 10 ♂♂, 1 ♀
- *Orthetrum brunneum*, 1 ♂
- *Sympetrum striolatum*, 2 ♂♂, 1 ♀
- *Crocothemis erythraea*, 20 MA
- *Selysiothemis nigra*, 20 ♂♂

### Loc 38. Bregava River in Stolac

A stretch of Bregava River was surveyed at the north margin and upstream from the town of Stolac. Bregava River is a typical karst river with clear cold water, several cascades and small waterfalls. The river bed is mostly covered with rocks, gravel and sand, and scarce *Salix* sp. trees grow along the margins.

#### 13. 05. 2013.

- *Calopteryx splendens*, 10 MA
- *Calopteryx virgo*, 30 MA



**11. 06. 2013.**

- *Calopteryx splendens*, 100's MA
- *Calopteryx virgo*, 10's MA
- *Platycnemis pennipes*, 1 MA
- *Anax imperator*, 1 ♂
- *Anax parthenope*, 1 ♂
- *Libellula depressa*, 1 ♂
- *Orthetrum coerulescens*, 1 ♂, 2 ♀♀
- *Sympetrum sanguineum*, 1 ♂
- *Sympetrum striolatum*, 2 ♀♀

**Loc 39. Bregava river at small dam**

Broadening of the Bregava River located app. 3 km upstream from Stolac, formed by an artificial barrier built on the river (Fig. 20). At the widest part of the river, at its right bank the vegetation was mostly represented with flooded meadow vegetation and scarce *A. plantago-aquatica* plants. In the upstream part several large trees created shade along the bank.



Figure 20. Small dam at Bregava River (Loc. 39)

**11. 06. 2013.**

- *Calopteryx splendens*, 10's MA
- *Calopteryx virgo*, 100's MA



- *Pyrrhosoma nymphula*, 1 ♂
- *Aeshna isoceles*, 2 MA
- *Anax imperator*, 3 ♂♂, 1 ♀
- *Onychogomphus forcipatus*, 1 ♂
- *Somatochlora flavomaculata*, 5 MA
- *Sympetrum sanguineum*, 1 ♂

#### Loc 40. Opaćica stream at Potkom

A small, fast flowing river with gravel beds, eroded walls and sandy substrate and small muddy pools with deeper water (Fig. 21) in the NW part of Dabarsko polje.



Figure 21. Opaćica stream at Potkom (Loc. 40)

#### 11. 06. 2013.

- *Aeshna affinis*, 1 ♀
- *Onychogomphus forcipatus*, 5 ♂♂
- *Libellula fulva*, 1 ♂
- *Orthetrum coerulescens*, 1 ♂



**Loc 41. Stream south of Berkovići**

A small stream in the lower, flat part of the polje. The stream is meandering through the meadows with scarce *Salix* sp. trees and bushes along the margins. Rich vegetation mostly overgrown the stream (Fig. 22). Dragonflies were also observed along several small canals in the vicinity.



Figure 22. Habitat of *C. ornatum* at Dabarsko polje (Loc. 41)

**11. 06. 2013.**

- *Calopteryx splendens*, 2 ♂♂
- *Calopteryx virgo*, 1 ♂
- *Coenagrion puella*, 10's MA, <10 Juv/Ten
- *Coenagrion ornatum*, 10's MA, 10 Cop
- *Pyrrhosoma nymphula*, 10 MA
- *Aeshna affinis*, 1 ♂
- *Libellula quadrimaculata*, 5 MA
- *Libellula depressa*, 1 ♂
- *Orthetrum coerulescens*, 10's MA
- *Orthetrum brunneum*, 10's MA
- *Sympetrum sanguineum*, 10 MA, 10 Juv/Ten



- *Sympetrum flaveolum*, 1 Juv/Ten
- *Sympetrum striolatum*, 10 Juv/Ten

#### Loc 42. Opaćica stream at Kljenci

Lower part of the Opaćica River in the central part of the polje. Near the investigated segment of the river a canal with dense reed and stagnant water was also inspected for dragonflies.

##### 11. 06. 2013.

- *Ischnura elegans*, 10's MA, 10's Cop
- *Coenagrion puella*, 10's MA, 10's Cop
- *Platycnemis pennipes*, 10's MA, <10 Cop
- *Aeshna isoceles*, 1 ♂
- *Anax imperator*, 10 MA
- *Somatochlora meridionalis*, 2 MA
- *Libellula quadrimaculata*, 5 ♂♂
- *Libellula depressa*, 10's MA
- *Orthetrum brunneum*, 10 ♂♂
- *Sympetrum flaveolum*, 1 ♂, 1 ♀
- *Sympetrum fonscolombii*, 1 ♂
- *Sympetrum striolatum*, 10 ♂♂
- *Sympetrum meridionale*, 10 MA
- *Crocothemis erythraea*, 1 ♂

#### Loc 43. Pribitu spring

A spring and stream found under the slopes of hills bordering the polje from the north side. The stream was investigated from its spring to the lower part where it is transformed into a canal with almost stagnant water, and overgrown with sedges.

##### 11. 06. 2013.

- *Calopteryx virgo*, 2 ♂♂
- *Ischnura elegans*, 10's MA, 10's Juv/Ten, 10's Cop
- *Coenagrion puella*, 2 ♂♂
- *Aeshna isoceles*, 1 Cop
- *Anax imperator*, 2 ♂♂
- *Somatochlora meridionalis*, 1 ♂
- *Libellula quadrimaculata*, 10's MA, 10's Cop
- *Libellula depressa*, 10 MA
- *Orthetrum coerulescens*, 20 MA
- *Sympetrum sanguineum*, 10's MA, 10's Juv/Ten
- *Sympetrum flaveolum*, 10's MA, 10's Juv/Ten
- *Crocothemis erythraea*, 1 ♂, 1 ♀



**Loc 44. Spring of Vrijeka River**

At the base of a steep slope on the north edge of the polje several springs merge and form Vrijeka River, the main water course of Dabarsko polje. Dragonflies were investigated along the first 50 m of the river. In its lower part the river flows through dense bushes to the lower parts of the polje.

**11. 06. 2013.**

- *Calopteryx virgo*, 20 MA
- *Pyrrhosoma nymphula*, 1 ♂
- *Brachytron pratense*, 1 ♂
- *Somatochlora flavomaculata*, 10 MA
- *Libellula quadrimaculata*, 2 ♂♂
- *Libellula fulva*, 2 ♂♂
- *Orthetrum coerulescens*, 1 ♂
- *Orthetrum brunneum*, 2 ♀♀
- *Sympetrum sanguineum*, 10 MA
- *Sympetrum flaveolum*, 10 MA, 10 Juv/Ten

**Loc 45. Vrijeka River near Ponor**

The final stretch of Vrijeka River before it goes underground at the southern margin of the polje (Fig. 23). River bed with eroded margins is one to two meters buried into



Figure 23. Vrijeka River before sinking underground at the south-east border of Dabarsko polje (Loc. 45)





the flat surface of the polje. It is a wider part of the river where bottom is covered with sand or organic substrate and vegetation at one side of the river.

**11. 06. 2013.**

- *Calopteryx splendens*, 10 MA
- *Calopteryx virgo*, 20 MA
- *Aeshna isoceles*, 2 MA
- *Anax imperator*, 1 ♂
- *Anax parthenope*, 1 ♂
- *Somatochlora flavomaculata*, 10's MA
- *Libellula quadrimaculata*, 5 ♂♂
- *Sympetrum sanguineum*, 2 ♀♀
- *Sympetrum flaveolum*, 10 Juv/Ten

**Loc 46. Spring and small stream in Fatničko polje**

A small spring and nearby stream in a meadow on the margins of small hill in the upper part of Fatničko polje. Many *C. ornatum* were found along the stream with stretches of dense water vegetation. In the nearby river bed several shallow ponds were investigated, while the whole upper part of the river bed was completely dry.

**11. 06. 2013.**

- *Ischnura elegans*, 10's MA, 10's Juv/Ten, 10's Cop
- *Ischnura pumilio*, 10's MA
- *Enallagma cyathigerum*, 20 MA
- *Coenagrion puella*, 10 MA
- *Coenagrion ornatum*, 10's MA
- *Coenagrion scitulum*, 3 ♂♂
- *Erythromma lindenii*, 10 MA
- *Platycnemis pennipes*, 10's MA
- *Anax imperator*, 5 ♂♂, 1 Ex
- *Anax parthenope*, 2 ♂♂
- *Libellula quadrimaculata*, 1 ♀
- *Orthetrum coerulescens*, 1 ♀
- *Orthetrum brunneum*, 20 MA, 10 Ex
- *Sympetrum flaveolum*, 10 Juv
- *Sympetrum striolatum*, 2 ♂♂
- *Sympetrum meridionale*, 1 ♂

**Loc 47. Trebišnjica River near Ravno**

The lower part of Trebišnjica River in the West part of Popovo polje. As a result of water regulation projects in the 70's, the river in the polje is completely canalised and



the river bed is turned into a concrete canal (Fig. 5). At the site near Ravno village, at the water surface mixed with algae numerous small larval skins of *O. forcipatus* were found floating. Several dam lakes are built in the upper section of the river, upstream of Trebinje town. The larvae were probably washed downstream as a consequence of water release from one of these lakes.

**13. 05. 2013.**

- *Onychogomphus forcipatus*, 100's Lar

**Loc 48. Canal/stream S of Trebinje**

Water canal at the south margin of Trebinje city. It is connected with Trebišnjica River and flows through fields and the city suburb settlement. At the study site the canal goes along the road, it is significantly polluted and largely inaccessible for closer inspection.

**12. 06. 2013.**

- *Calopteryx virgo*, 10's MA
- *Ischnura elegans*, 10's MA, 10's Cop
- *Coenagrion puella*, 10's MA, <10 Cop
- *Platycnemis pennipes*, 10's MA, <10 Cop
- *Aeshna isoceles*, 1 MA
- *Anax imperator*, 1 ♂
- *Cordulia aenea*, 1 ♂
- *Libellula fulva*, 1 ♂
- *Orthetrum brunneum*, 1 ♂

**Loc 49. Trebišnjica River E of Trebinje**

The dragonflies were mainly observed among the herbaceous vegetation at or around several pools formed in the holes originating from gravel extraction along the left side of Trebišnjica River.

**12. 06. 2013.**

- *Lestes virens*, 3 ♂♂
- *Ischnura elegans*, 10's MA, <10 Cop
- *Enallagma cyathigerum*, 1 ♂
- *Coenagrion puella*, 20 MA
- *Erythromma viridulum*, 10 MA
- *Anax imperator*, 1 ♂
- *Anax ephippiger*, 1 Cop
- *Libellula depressa*, 1 ♂
- *Orthetrum cancellatum*, 1 ♂
- *Orthetrum coerulescens*, 2 ♂♂



- *Orthetrum brunneum*, 1 ♂
- *Sympetrum fonscolombii*, 1 ♂
- *Crocothemis erythraea*, 4 ♂♂

### Loc 50. Jazina stream

Jazina stream or small river, was investigated app. 100 m before the mouth to Sušica River. Fast stream with rocky and sandy river bed (Fig. 24). Larvae that were collected during the spring visit were found under larger stones and between roots of small trees growing on the river margins.



Figure 24. Jazina River (Loc. 50)

#### 13. 05. 2013.

- *Calopteryx virgo*, 4 Ex
- *Caliaeschna microstigma*, 1 Juv/TenF, 2 Lar, 2 Ex
- *Cordulegaster heros*, 2 Lar
- *Cordulegaster* sp., 2 Lar
- *Onychogomphus forcipatus*, 10 Lar

#### 12. 06. 2013.

- *Calopteryx virgo*, 10's MA
- *Platycnemis pennipes*, 10's MA, <10 Cop



- *Caliaeschna microstigma*, 1 ♂
- *Onychogomphus forcipatus*, 5 ♂♂, 3 Ex, 1 Lar
- *Orthetrum brunneum*, 1 ♂

### Loc 51. Sušica River

Sušica River (Fig. 25), left tributary of Trebišnjica, at the study site near Arandželovo village is a fast flowing river with rocky and sandy bottom and shores partly overgrown by *Salix* sp. bushes.



Figure 25. Sušica River near Arandželovo (Loc. 51)

### 12. 06. 2013.

- *Calopteryx virgo*, 30 MA
- *Anax imperator*, 1 ♂
- *Gomphus vulgatissimus*, 1 ♂
- *Onychogomphus forcipatus*, 2 ♂♂, 1 Lar
- *Cordulegaster bidentata*, 1 ♂
- *Libellula depressa*, 2 ♂♂
- *Orthetrum coerulescens*, 1 ♂
- *Orthetrum brunneum*, 2 ♂♂



## Loc 52. Small stream near Arandelovo

A streamlet flowing down the steep slope and under the road to the Sušica river. Completely shaded by bushes and tall herbaceous vegetation. Many exuviae of *C. bidentata* were found near the road among the vegetation (mostly tall grass and *Urtica* sp. stems).

**13. 05. 2013.**

- *Cordulegaster bidentata*, 1 Juv/TenF, 10's Ex

## Discussion

Although karst habitats in Bosnia and Herzegovina are still relatively well preserved, they are increasingly threatened by water extraction and unsustainable use of natural resources. The streams and rivers of the Neretva River basin are important habitats of *Coenagrion ornatum*, *Caliaeschna microstigma* and *Cordulegaster heros* and many other threatened freshwater species, but still not protected. Within the study region only Hutovo blato wetland is legally protected.

Several species found during the survey are of special conservation concern, *Lindenia tetraphylla* is listed as Vulnerable in the European Red List and *C. heros* is classified as Near Threatened in Europe and Vulnerable in Mediterranean region. *C. ornatum*, *L. tetraphylla* and *C. heros* are also listed in the Annexes of the Habitats Directive (Riservato et al. 2009, Kalkman et al. 2010). In addition to the species of European conservation concern, based on current knowledge on the dragonfly fauna of the country, additional three species recorded during this study are regarded as rare or potentially threatened in Bosnia and Herzegovina: *Ceriagrion tenellum*, *Caliaeschna microstigma* and *Selysiothemis nigra* (Kulijer et al. 2013).

Noteworthy results of the study include six new localities of *C. ornatum*, nine of *C. microstigma* and five of *C. heros*. For *Chalcolestes parvidens*, *Ceriagrion tenellum*, *L. tetraphylla*, *Cordulegaster bidentata* and *Selysiothemis nigra*, new localities contribute to a better understanding of their distribution and result in an extension of their range in the country. Data on distribution and habitats of species are important in order to enable protection of key habitats of threatened species, especially at the time of establishment of the NATURA 2000 Network in the country. Results of this research contribute to a better conservation planning and protection of these species and their habitats.

The population of *L. tetraphylla* in the Neretva River delta is one of the most significant in the north-east Adriatic and probably the only one in Bosnia and Herzegovina (Belančić et al. 2008, Boudot et al. 2009, Kulijer et al. 2013). This study confirms the presence of a population in Hutovo blato wetland with several additional localities in the same area.



The distribution of *C. microstigma* in Europe is restricted to the Balkans. Populations in the southern part of Bosnia and Herzegovina and along the Dalmatian coast (Croatia) represent the western edge of the species range (Belančić et al. 2008, Boudot et al. 2009, Kulijer et al. 2013). New observations considerably increase the number of known localities in Herzegovina karst region and provide a prospect of locating new sites to the north.

High numbers of *C. ornatum* were observed at Krča locality in Trebižat River valley (Loc. 20), Dabarsko polje (Loc. 41) and Fatničko polje (Loc. 46). Habitats include natural streams and artificial canals, both characterized by slow flowing water and a rich water vegetation. Most localities where the species was observed are small, shallow, richly vegetated running waters, usually with a diameter less than 0.5 m.

The large number of Odonata species found during the survey is a result of the high diversity of water bodies that are often situated in close proximity at the investigated localities. The data collected during the study represent a valuable contribution to the knowledge of dragonfly species and habitats of the region, primarily lotic waters. As many habitats in the region are still not surveyed or surveys included single visit and one seasonal aspects the knowledge of dragonfly fauna remains fragmentary. In addition to further faunistic research, in the future it is important to establish a monitoring program for threatened species and habitats, in order to determine population status, trends and threats to their habitats, and to work on their protection.

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## References

- Adamović, Ž.R. 1948. List of dragonflies (Odonata Fabr.) in the Biological Institute in Sarajevo. *Godišnjak Biološkog Instituta u Sarajevu* 1: 79-84.
- Bedjanič, M. 2011. *Coenagrion hastulatum* (Charpentier, 1825), new for the dragonfly fauna of Bosnia and Herzegovina (Odonata: Coenagrionidae). *Natura Sloveniae* 1(2): 31-36.
- Belančić, A., Bogdanović, T., Franković, M., Ljuština, M., Mihoković, N. & B. Vitas 2008. Red data book of dragonflies of Croatia . Ministry of Culture, State Institute for Nature Protection, Croatia.



- Bonacci, O., Ljubenkov, I. & S. Knezić 2012. The water on a small karst island: the island of Korčula (Croatia) as an example. *Environmental Earth Sciences* 66(5): 1345–1357.
- Bonacci, O., Željковиć, I. & I. Galić 2013 Karst rivers' particularity: an example from Dinaric karst (Croatia/Bosnia and Herzegovina). *Environmental Earth Sciences* 70: 963–974.
- Boudot, J.-P., Kalkman, V.J., Azpilicueta Amorín, M., Bogdanović, T., Cordero Rivera, A., Degabriele, G., Dommanget, J.-L., Ferreira, S., Garrigós, B., Jović, M., Kotarac, M., Lopau, W., Marinov, M., Mihoković, N., Riservato, E., Samraoui, B. & W. Schneider 2009. Atlas of the Odonata of the Mediterranean and North Africa. *Libellula Supplement* 9: 1-256.
- Dumont, H.J. 1977. Sur une collection d'odonates de Yougoslavie, avec notes sur la faune des territoires adjacents de Roumanie et de Bulgarie. *Bulletin et Annales de la Societe Royale Belge d'Entomologie* 113: 187-209.
- Galić, A., Prskalo, M., Glamuzina, G. & J. Marinčić 2008. Complex analyzes of regional characteristics of the waterfall Kravice on the Trebižat River. *Rudarsko Geološki Glasnik* 12: 89–108.
- Gams, J. 1978. The polje: the problem of definition. *Zeitschrift für Geomorphologie* 55: 170–181.
- Georgijević, E. (ed.) 1976. Contribution to the knowledge of entomofauna of forests in Bosnia and Herzegovina. Šumarski fakultet i Institut za sumarstvo u Sarajevu, posebno izdanje br. 10: 51-53.
- Jović, M., Gligorović, B. & M. Stanković 2010. Review of faunistical data on Odonata in Bosnia and Herzegovina. *Acta entomologica serbica*. 15(1): 7-27.
- Kalkman, V.J., Boudot, J.-P., Bernard, R., Conze, K.-J., De Knijf, G., Dyatlova, E., Ferreira, S., Jović, M., Ott, J. Riservato, E. & G. Sahlen 2010. European Red List of dragonflies. Publications Office of the European Union. Luxembourg.
- Klapalek, F. 1898. Notes on Neuroptera and Pseudoneuroptera collected in Bosnia and Herzegovina. *Vestnik České Akademie cisare Fantiška Josefa pro vedy, slovesnost a umeni*. 7(2): 126-134.
- Kulijer, D. 2012. Odonata species and habitats at Livanjsko polje karst wetland area. *IDF-Report* 48: 1-38.
- Kulijer, D., Vinko, D., Billqvist, M. & J.J. Mekkes 2012. Contribution to the knowledge of the Odonata fauna of Bosnia and Herzegovina – Results of the ECOO 2012. *Natura Sloveniae* 14(2): 23-38.
- Kulijer, D. & G. Topić 2013. First record of a Balkan population of *Ceriagrion tenellum* outside the influence of the Mediterranean climate (Odonata: Coenagrionidae). *Libellula* 32(3/4): 193-204.



- Kulijer, D., De Knijf, G. & M. Franković 2013. Review of the Odonata of Bosnia and Herzegovina. *Odonatologica* 42: 109- 123.
- Lepirica, A. 2007. The physio-geographic features of endemic development center Prenj, Čvrsnica and Čabulja. In: Redžić, S. (ed.) Biodiversity of endemic development centers in Herzegovina as contribution to Targets 2010. Monografija EKO BiH, p. 34–66, Sarajevo, Bosnia and Herzegovina.
- McLachlan, R. 1898. On Neuroptera collected by Mr. Malcolm Burr in Wallachia, Bosnia, Herzegovina, & c., in July and August, 1898. *Entomologist's monthly magazine* (II) 34: 248-249.
- Mihevc, A. & M. Prelovšek 2010. Geographical Position and General Overview.- In: Andrej Mihevc, Mitja Prelovšek, Nadja Zupan Hajna (ed.) Introduction to the Dinaric karst. Karst Research Institute at ZRC SAZU, p. 6–8, Postojna, Slovenia.
- Morton, K. 1908. Odonata collected by Miss Fountaine in Bosnia and Hercegovina. *Entomologist's monthly magazine* (II) 44: 37.
- Prelovšek, M. 2010. Hydrology. In: Andrej Mihevc, Mitja Prelovšek, Nadja Zupan Hajna (ed.) Introduction to the Dinaric karst. Karst Research Institute at ZRC SAZU, p. 25–29, Postojna, Slovenia.
- Prohić, E., Peh, Z. & S. Miko 1998. Geochemical characterization of a karst polje. An example from Sinjsko Polje, Croatia. *Environmental Geology* 33(4): 263– 273.
- Redžić, S., Barudanović, S. & M. Radević 2008. Bosnia and Herzegovina – Land of Diversity, First national Report of Bosnia and Herzegovina for the Convention on Biodiversity, Sarajevo. 164 pp.
- Redžić, S., Barudanović, S., Trakić, S. & D. Kulijer 2011. Vascular plant biodiversity richness and endemo relictness of the karst mountains Prenj–Čvrsnica–Čabulja in Bosnia and Herzegovina (W. Balkan). *Acta Carsologica* 40(3): 527-555.
- Riservato, E., Boudot, J.-P., Ferreira, S., Jović, M., Kalkman, V.J., Schneider, W., Samraoui, B. & A. Cuttelod 2009. The Status and Distribution of Dragonflies of the Mediterranean Basin. Gland, Switzerland and Malaga, Spain: IUCN. vii + 33 pp.
- Schneider-Jacoby, M., Rubinić, B., Sackl, P. & B. Štumberger 2006. A preliminary assessment of the ornithological importance of Livanjsko Polje (Cetina River Basin, Bosnia and Herzegovina). *Acrocephalus* 27(128-129): 45-47.
- Skoulikidis, N.T. 2009. The environmental state of rivers in the Balkans—A review within the DPSIR framework. *Science of the Total Environment* 407: 2501–2516.





## Appendices

**Table I. List of localities**

	Name of locality	Date	Coordinates		Altitude in m a.s.l.
<b>I. Trebižat River catchment</b>					
1.	Grudsko vrelo spring	26.04.2013.	43°23'20"	17°22'07"	258
2.	Peć Mlini	12.07.2013.	43°20'11"	17°19'30"	220
3.	Nezdravica stream	26.04.2013. 12.07.2013.	43°18'50"	17°23'19"	160
4.	Sedra stream	05.05.2013.	43°15'17"	17°26'44"	93
5.	Kočuš waterfall	05.05.2013.	43°14'58"	17°27'08"	95
6.	Muratovac stream/canal	26.04.2013.	43°13'15"	17°26'13"	79
7.	Stream/canal at Grab	11.05.2013.	43°13'01"	17°27'04"	75
8.	Vitina, Vrioštica spring	12.07.2013.	43°14'15"	17°29'10"	94
9.	Vrioštica River	11.05.2013.	43°13'46"	17°29'32"	78
10.	Proboj spring	12.07.2013.	43°13'26"	17°30'53"	99
11.	Voša canal	11.05.2013.	43°13'13"	17°28'50"	76
12.	Mlade River at Otunj	11.05.2013.	43°12'44"	17°28'59"	60
13.	Vrioštica River near Humac	11.05.2013.	43°12'06"	17°30'26"	72
14.	Mlade River near Humac	11.05.2013.	43°12'09"	17°29'53"	73
15.	Gornji Studenci	14.05.2013. 28.06.2013. 12.07.2013.	43°10'51"	17°36'10"	55
16.	Vakuf spring	14.05.2013. 28.06.2013.	43°10'47"	17°36'27"	42
17.	Spring near Donji Studenci	05.05.2013. 14.05.2013. 28.06.2013.	43°10'10"	17°37'42"	44
18.	Kravice waterfall	12.07.2013.	43°09'23"	17°36'29"	50
19.	Studenci River mouth	05.05.2013.	43°09'16"	17°38'22"	25
20.	Trebižat River at Krča	12.05.2013.	43°08'09"	17°39'49"	21
21.	Trebižat River at Lopata	12.05.2013.	43°07'22"	17°40'26"	19
22.	Trebižat River near Grabovine	14.05.2013.	43°06'36"	17°40'50"	16
23.	Stream at Grabovine	14.05.2013.	43°06'31"	17°41'04"	22
24.	Trebižat River at Gorica	14.05.2013.	43°06'02"	17°41'09"	15
<b>II. Lištica River catchment (Mostarsko blato)</b>					
25.	Žvatić stream in Mostarsko blato	26.04.2013. 10.06.2013.	43°21'58"	17°40'02"	252
26.	Lištica River and pond near football camp	10.06.2013. 17.08.2013.	43°21'12"	17°39'35"	234



27.	Lištica River near Dobrić	10.06.2013. 17.08.2013.	43°21'12"	17°40'33"	228
28.	Govnuša stream	10.06.2013.	43°20'12"	17°40'30"	226
29.	Krenica in Mostarsko blato	10.06.2013.	43°19'31"	17°44'11"	224
<b>III. Neretva River</b>					
30.	Neretva River at Buna river mouth	13.07.2013.	43°14'16"	17°50'02"	29
31.	Neretva River near Bregava river mouth	16.08.2013.	43°05'57"	17°42'52"	5
32.	Neretva River near Klepci	29.06.2013.	43°05'41"	17°42'52"	5
33.	Neretva River at Struge	14.05.2013.	43°05'03"	17°41'54"	2
<b>IV. Krupa River catchment (Hutovo blato wetland)</b>					
34.	Škrka lake	15.05.2013.	43°05'03"	17°44'30"	4
35.	Krupa River at Karaotok	15.05.2013. 27.06.2013. 13.07.2013. 16.08.2013.	43°03'29"	17°45'04"	1
36.	Svitava canal near Sjekose	13.07.2013. 16.08.2013.	43°01'48"	17°44'40"	2
37.	Londža spring	13.07.2013.	43°02'02"	17°49'15"	3
<b>V. Bregava River catchment</b>					
38.	Bregava River in Stolac	13.05.2013. 11.06.2013.	43°05'44"	17°58'04"	79
39.	Bregava River at small dam	11.06.2013.	43°05'56"	17°59'23"	100
<b>VI. Dabarsko polje</b>					
40.	Opaćica stream at Potkom	11.06.2013.	43°07'05"	18°05'47"	549
41.	Stream south of Berkovići	11.06.2013.	43°04'58"	18°10'28"	489
42.	Opaćica stream at Kljenci	11.06.2013.	43°04'36"	18°11'41"	485
43.	Pribitu spring	11.06.2013.	43°04'38"	18°13'49"	482
44.	Spring of Vrijeka River	11.06.2013.	43°04'27"	18°14'20"	492
45.	Vrijeka River near ponor	11.06.2013.	43°03'18"	18°14'29"	475
<b>VII. Fatničko polje</b>					
46.	Spring of small stream in Fatničko polje	11.06.2013.	43°01'04"	18°19'41"	470
<b>VIII. Trebišnjica River catchment (Popovo polje)</b>					
47.	Trebišnjica River near Ravno	13.05.2013.	42°53'02"	17°58'57"	238
48.	Canal S of Trebinje	12.06.2013.	42°41'45"	18°20'46"	280
49.	Trebišnjica River E of Trebinje	12.06.2013.	42°42'43"	18°22'17"	277
50.	Jazina River	13.05.2013. 12.06.2013.	42°42'10"	18°30'20"	320
51.	Sušica River	12.06.2013.	42°41'50"	18°32'10"	333
52.	Small stream near Arandželovo	13.05.2013.	42°41'47"	18°32'22"	338



**Table II. Checklist of the recorded species with localities where they were observed**

	Species	Localities
	CALOPTERYGIDAE	
1	<i>Calopteryx splendens</i> (Harris, 1782)	4, 5, 6, 7, 9, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 27, 28, 29, 30, 31, 32, 33, 35, 36, 38, 39, 41, 45
2	<i>Calopteryx virgo</i> (Linnaeus, 1758)	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 24, 25, 27, 38, 39, 41, 43, 44, 45, 48, 50, 51
	LESTIDAE	
3	<i>Lestes barbarus</i> (Fabricius, 1798)	28, 31, 35, 36
4	<i>Lestes virens</i> (Charpentier, 1825)	36, 49
5	<i>Chalcolestes parvidens</i> (Artobolevskii, 1929)	35, 3
6	<i>Sympecma fusca</i> (Vander Linden, 1820)	33, 35
	COENAGRIONIDAE	
7	<i>Ischnura elegans</i> (Vander Linden, 1820)	3, 8, 13, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, 35, 36, 37, 42, 43, 46, 48, 49
8	<i>Ischnura pumilio</i> (Charpentier, 1825)	28, 46
9	<i>Enallagma cyathigerum</i> Charpentier, 1840	27, 29, 46, 49
10	<i>Coenagrion pulchellum</i> (Vander Linden, 1825)	23, 24, 34, 35, 36, 37
11	<i>Coenagrion puella</i> (Linnaeus, 1758)	12, 13, 14, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 32, 33, 41, 42, 43, 46, 48, 49
12	<i>Coenagrion ornatum</i> (Selys, 1850)	4, 7, 12, 13, 20, 41, 46
13	<i>Coenagrion scitulum</i> (Rambur, 1842)	46
14	<i>Erythromma viridulum</i> (Charpentier, 1840)	26, 28, 35, 49
15	<i>Erythromma lindenii</i> (Selys, 1840)	26, 27, 29, 32, 35, 37, 46
16	<i>Pyrrhosoma nymphula</i> (Sulzer, 1776)	39, 41, 44
17	<i>Ceriagrion tenellum</i> (de Villers, 1789)	12, 34, 35
	PLATYCNEMIDIDAE	
18	<i>Platycnemis pennipes</i> (Pallas, 1771)	2, 3, 4, 7, 8, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 31, 32, 35, 36, 38, 42, 46, 48, 50
	AESHNIDAE	
19	<i>Aeshna mixta</i> Latreille, 1805	26, 27, 31, 35, 36
20	<i>Aeshna affinis</i> Vander Linden, 1820	15, 23, 28, 30, 33, 35, 37, 40, 41
21	<i>Aeshna isoceles</i> (Müller, 1767)	2, 7, 10, 12, 15, 16, 17, 18, 19, 21, 22, 24, 34, 35, 37, 39, 42, 43, 45, 48
22	<i>Aeshna cyanea</i> (Müller, 1764)	18, 27
23	<i>Anax imperator</i> Leach, 1815	8, 14, 15, 18, 26, 27, 28, 29, 31, 34, 35, 36, 38, 39, 42, 43, 45, 46, 48, 49, 51
24	<i>Anax parthenope</i> (Selys, 1839)	18, 21, 26, 27, 28, 29, 33, 34, 35, 36, 37, 38, 45, 46
25	<i>Anax ephippiger</i> (Burmeister, 1839)	49



	Species	Localities
26	<i>Caliaeschna microstigma</i> (Schneider, 1845)	2, 3, 4, 6, 10, 11, 15, 16, 17, 23, 25, 50
27	<i>Brachytron pratense</i> (Müller, 1764)	20, 21, 24, 34, 37, 44
	GOMPHIDAE	
28	<i>Gomphus vulgatissimus</i> (Linnaeus, 1758)	6, 7, 15, 17, 19, 20, 21, 22, 23, 24, 30, 33, 35, 51
29	<i>Onychogomphus forcipatus</i> (Linnaeus, 1758)	2, 10, 15, 18, 27, 30, 32, 39, 40, 47, 50, 51
30	<i>Lindenia tetraphylla</i> (Vander Linden, 1825)	31, 35, 36, 37,
	CORDULEGASTERIDAE	
31	<i>Cordulegaster heros</i> Theischinger, 1979	2, 3, 6, 10, 15, 16, 18, 25, 50
32	<i>Cordulegaster bidentata</i> Selys, 1843	4, 6, 51, 52
	CORDULIIDAE	
33	<i>Cordulia aenea</i> (Linnaeus, 1758)	48,
34	<i>Somatochlora meridionalis</i> Nielsen, 1935	4, 5, 17, 42, 43
35	<i>Somatochlora flavomaculata</i> (Vander Linden, 1825)	37, 39, 44, 45
	LIBELLULIDAE	
36	<i>Libellula quadrimaculata</i> Linnaeus, 1758	28, 34, 35, 41, 42, 43, 44, 45, 46
37	<i>Libellula depressa</i> Linnaeus, 1758	8, 15, 16, 19, 26, 28, 38, 41, 42, 43, 49, 51
38	<i>Libellula fulva</i> (Müller, 1764)	7, 9, 12, 14, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 34, 35, 36, 37, 40, 44, 48
39	<i>Orthetrum cancellatum</i> (Linnaeus, 1758)	8, 23, 26, 35, 36, 49
40	<i>Orthetrum albistylum</i> (Selys, 1848)	29, 32, 35
41	<i>Orthetrum coerulescens</i> (Fabricius, 1798)	2, 3, 8, 10, 12, 18, 25, 26, 28, 30, 35, 36, 37, 38, 40, 41, 43, 44, 46, 49, 51
42	<i>Orthetrum brunneum</i> (Fonscolombe, 1837)	3, 8, 10, 12, 15, 17, 27, 36, 37, 41, 42, 44, 46, 48, 49, 50, 51
43	<i>Sympetrum sanguineum</i> (Müller, 1764)	18, 21, 26, 27, 28, 29, 30, 35, 36, 38, 39, 41, 43, 44, 45,
44	<i>Sympetrum flaveolum</i> (Linnaeus, 1758)	41, 42, 43, 44, 45, 46
45	<i>Sympetrum fonscolombii</i> (Selys, 1840)	29, 42, 49
46	<i>Sympetrum striolatum</i> (Charpentier, 1840)	32, 34, 35, 36, 37, 38, 41, 42, 46
47	<i>Sympetrum meridionale</i> (Selys, 1841)	20, 26, 27, 31, 35, 42, 46,
48	<i>Crocothemis erythraea</i> (Brullé, 1832)	12, 15, 18, 26, 27, 28, 29, 31, 32, 34, 35, 36, 37, 42, 43, 49
49	<i>Selysiotthemis nigra</i> (Vander Linden, 1825)	15, 18, 31, 32, 35, 36, 37



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