

Dragonfly fauna of high mountain habitats of the Dinaric Alps in Bosnia and Herzegovina (West Balkans, SE Europe) – the results of field surveys conducted in 2015 & 2016

Dejan Kulijer [dejan.kulijer@gmail.com] & Iva Miljević [ms.iva.miljevic@gmail.com]

Introduction

Here we present the results of the first phase of dragonfly research focusing on high mountain areas of the Dinaric Alps in Bosnia and Herzegovina, particularly the most significant area, Mt Zelengora. In recent years, dragonfly knowledge in Bosnia and Herzegovina has advanced notably due to increased research intensity, although several regions are still poorly investigated. One of the most interesting is certainly the mountain region that covers the largest part of the country. High mountain habitats of Bosnia and Herzegovina are often isolated and difficult to access, which is the reason why the dragonfly fauna has remained poorly known.

The goal of this research is to better understand the distribution of species, habitats and the dragonfly communities present in these relict and threatened habitats.

Study area

The Dinaric Alps are located in the western Balkans, between the Pannonian Basin and the Adriatic Sea. This mountain range spreads from Slovenia to Albania, forming the largest continuous karst landscape in Europe and encompassing some of the most significant high mountain habitats of the Balkan region. The study area is located in the central part of the Dinaric Alps, on the territory of Bosnia and Herzegovina.

The main focus of the research was Mt Zelengora, while short field trips were also conducted on Mts Treskavica, Vranica and Čvrsnica. Mt Zelengora is located in the southeast region of the country at the boundary with Montenegro. The relief of this area is complex and diverse, with high mountain peaks (including the 2,386 m high Maglić peak, the highest in BiH), nine mountain lakes and deep canyons and the gorges of the Sutjeska and Hrčavka rivers. The biological and geological diversity of this area is imposing, with numerous plant and animal species as well as geological substrates and soil types.

The survey goals were mountain lakes, ponds and peat bog fragments in the high mountain zone (between 1,400 and 2,000 m a.s.l.). These habitats are known to support populations of several species having their main European distribution in the northern and central parts and reach their southern occurrence in Europe in this



Figure 1. Geographical position of the research area and the locations of surveyed mountains.

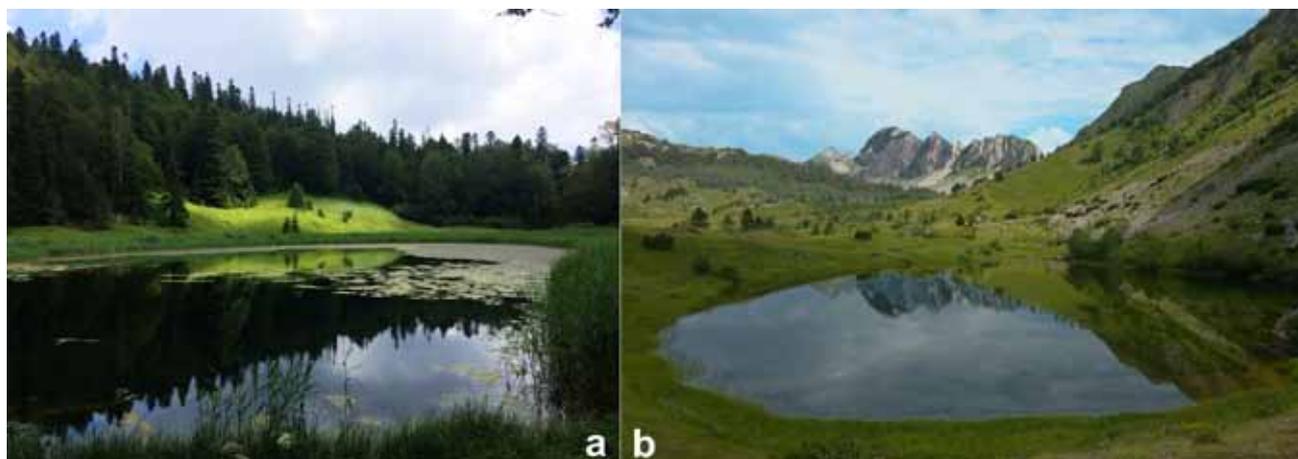


Figure 2. Crno jezero (a) and Gornje bare (b) lakes at Mt Zelengora.

area (e.g. *Coenagrion hastulatum*, *Aeshna juncea*, *Somatochlora metallica* and *Sympetrum flaveolum*).

Several field trips were conducted between the end of June 2015 and the end of July 2016. The survey in the Sutjeska National Park was implemented in collaboration with the Center for Environment that is working on the research and the protection of the freshwater habitats in the Park.

Results and Discussion

At Mt Zelengora and NP Sutjeska we recorded a total of 35 species, representing 55% of the dragonfly fauna of BiH. The highest number of species was recorded at the lakes of Orlovačko jezero (22 species), of Gornje Bare (20 spp.) and of Donje Bare (19 spp.). The dragonfly diversity at the investigated mountain lakes was positively correlated with the diversity of the vegetation and the water depth. The most numerous species at the lakes and ponds were *Cordulia aenea*, *Aeshna grandis*, *Enallagma cyathigerum* and *Libellula quadrimaculata*. Lakes at Mt Zelengora were also the habitats with the highest number of threatened and regionally endangered species. The most important species here were: *Coenagrion hastulatum*, *A. grandis*, *Aeshna juncea*, *Somatochlora metallica* and *Sympetrum flaveolum*. The mountain lakes of Mt Zelengora contain the only known populations of *C. hastulatum* and *S. metallica* in Bosnia and Herzegovina that are among only a few known in the west Balkan region, while for *A. grandis* and *A. juncea* these lakes are the most important localities within the country. During this research at Mt Zelengora several new populations of these species were found. New populations of *A. juncea* and *S. flaveolum* were discovered at several locations on Mts Čvrstica, Treskavica and Vranica and *A. grandis* at Mt Treskavica. The high mountain area of this part of the Dinaric Alps probably hosts the largest populations of these species in the west Balkans.

Among 14 species found in the Sutjeska and Hrčavka River canyons, *Cordulegaster bidentata* was the most numerous. Adults were seen flying along streams and rivers, and above roads and forest paths, while larvae were present in many small streams in the area. The highest locality where we found *C. bidentata* was at 1,460 m a.s.l. In Sutjeska River canyon a single male of *Cordulegaster heros* was also found, more precisely it was caught in an ornithological net stretched above the Sutjeska River. It is the only record of the species for the area. Several species, such as *E. cyathigerum*, *A. grandis* and particularly *C. aenea*, that are dominant at mountain lakes were also found to be abundant in the canyons.

From a biogeographical point of view, the Dinaric Alps are one of the most important refugia in southeastern Europe that harbour disjunct relict populations of several central and northern dragonfly species. The range of these species in the Balkans is very small and fragmented. Their habitats are increasingly threatened due to climate warming and human activity, which can lead to local extinction of these species.

Although it is expected that these habitats could host populations of *Leucorrhinia dubia* or even *Somatochlora arctica*, both species were hitherto never found.

The results of this study are important for the threat status assessment of the species of high mountain habitats in BiH and the region and the work on the Red List of dragonflies of the country, which still does not exist. The collected data are also a valuable contribution to the Atlas of Dragonflies of Bosnia and Herzegovina that is in progress.

Further research is necessary and will be continued, including other mountain areas. One of the future goals would be a monitoring of several mountain lakes at Mt Zelengora in order to track the climate parameters, their change and influence on dragonfly populations.

Acknowledgements

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Figure 3. *Coenagrion hastulatum* at Donje Bare Lake (a) and *Somatochlora metallica* at Gornje Bare Lake (b).