Denisia	29	287-294	17.10.2010

Caddisfly (Trichoptera) fauna of the Plitvice Lakes National Park, Croatia[1]

A. PREVIŠIĆ, W. GRAF & M. KUČINIĆ

A b s t r a c t : Adult caddisflies were collected in the Plitvice Lakes NP area from 1997 to 2008 using different methods. Altogether, collections were made at 15 sampling sites and four main types of karst habitat were encompassed; springs, streams, lakes and tufa barriers. A total of 81 species belonging to 43 genera and 13 families were collected. Four species, *Crunoecia kempnyi*, *Oecetis lacustris*, *Ernodes articularis* and *Ernodes vicinus* are new to the caddisfly fauna of Croatia. The highest species richness was recorded for the tufa barrier Labudovac. Distribution of species at particular habitat types is generally in accordance with their typical distribution determined by the seasonal variability of water temperature. The multi-dimensional scaling (MDS) analysis shows grouping of sites belonging to particular habitat type, however, a clustering of geographically close sites was also observed. This study represents an important contribution to the knowledge of caddisfly fauna of Croatia and of various karstic habitats in general.

K e y w o r d s : Trichoptera, fauna, diversity, karst habitats, Croatia.

Introduction

The Plitvice Lakes National Park is located in the mountainous region of Croatia, in the Lika region. The barrage system of the Plitvice Lakes is a highly specific biodynamic ecosystem formed by sixteen lakes divided by numerous travertine barriers. The area of the National Park harbours high diversity of different habitat types typical of the karst systems, such as springs, streams, lakes and tufa barriers (STILINOVIĆ & BOŽIČEVIĆ 1998). Considering the high diversity of freshwater habitats, high diversity of aquatic insects is also expected (e.g. WIBERG-LARSEN et al. 2000). Therefore, various aspects of faunistics, ecology and distribution of caddisflies within the Plitvice Lakes NP have been studied (e.g., MARINKOVIĆ-GOSPODNETIĆ 1971, 1979), however, intensive systematic research started in the 1990's through collaboration of M. Kučinić and H. Malicky (KUČINIĆ 2002, MALICKY & KUČINIĆ 2002). So far, two new taxa were described from this area; *Drusus croaticus* MARINKOVIĆ-GOSPODNETIĆ, 1971 and *Rhyacophila dorsalis plitvicensis* MALICKY & KUČINIĆ, 2002. A comprehensive study using emergence traps has been carried out since 2000 and first results revealing emergence patterns, composition and diversity of caddisflies in this karstic region were published (PREVIŠIĆ et al. 2007). However, an overall list of caddisfly species inhabiting the Plitvice Lakes NP area has not been published so far. Therefore, the main objective of this paper is to document the species richness of caddisflies of this region by presenting the complete list of species collected using various methods.

[1] This paper is dedicated to Prof. Dr. Hans Malicky on the occasion of his 75th birthday.

Material and methods

Here we present data on faunistics of caddisflies collected in the Plitvice Lakes NP area during various studies carried out from 1997 to 2008 using different methods; light traps, emergence traps, window traps and entomological nets. Specimens collected in 1997 and 1998 are deposited in the Croatian Natural History Museum (Zagreb) and the remaining material is deposited at Faculty of Science, University of Zagreb (Croatia), and in the collections of Prof. H. Malicky and Wolfram Graf.

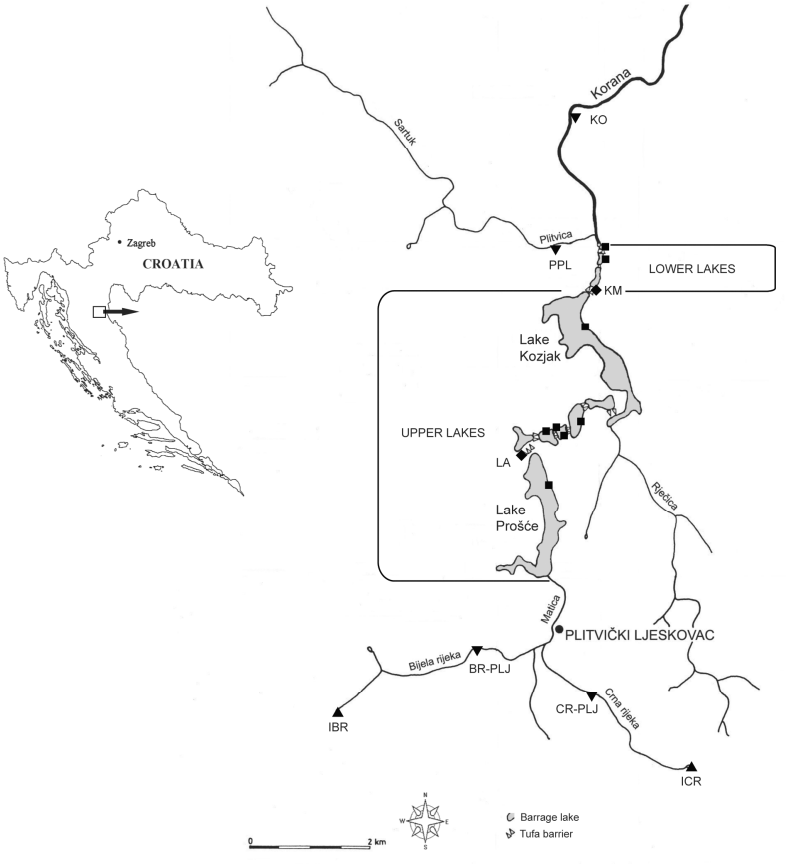

Fig. 1: Map of the study area showing the location of sampling sites in the Plitvice Lakes National Park, Croatia (modified from PREVIŠIĆ et al. 2007). Abbreviations of the sampling sites: IBR – spring of the Bijela rijeka, ICR – spring of the Crna rijeka, BR-PLJ – stream Bijela rijeka, CR-PLJ – stream Crna rijeka, PPL – Stream Plitvica, KO – stream Korana, LA – barrier Labudovac, KM – barrier Kozjak/Milanovac. Symbols indicate location of sampling sites at springs ▲, streams ▼, tufa barriers ◆ and lakes ■.

The list of species presented here is based only on data of adult caddisflies. Altogether, collections were made at 15 sampling sites, but with different effort and methods, therefore data were pooled to show distribution of species at particular habitat types. Four main habitat types were encompassed; springs (springs of the rivers Bijela Rijeka [IBR] and Crna Rijeka [ICR]), streams (Bijela Rijeka [PL-BR], Crna Rijeka [PL-CR], Plitvica stream [PLL], Korana [KO]), lakes (six upper lakes [UPPER LAKES]; Prošće, Galovac, Okrugljak, Veliko jezero,

Malo jezero, Kozjak and two lower lakes [LOWER LAKES]; Novakovića brod, Kaluđerovac) and tufa barriers (Labudovac [LA] and Kozjak/Milanovac [KM], Fig. 1). Identification of the collected material was based on MALICKY (1983, 2004) and systematic review on BOTOSANEANU and MALICKY (1978) and MALICKY (2004). In order to find out more about the similarity of caddisfly fauna of particular habitat types a multi-dimensional scaling (MDS) analysis based on presence/absence data was conducted using Primer v5 software (CLARKE & GORLEY 2001).

Results and discussion

A total of 81 species belonging to 43 genera and 13 families were collected in the Plitvice Lakes NP area from 1997 to 2008 using different methods. The complete list of species is presented in Tab. 1 showing also habitat types where species were collected. Limnephilidae was the most diverse family with 28 species collected belonging to 12 genera, followed by Leptoceridae with 10 species collected belonging to 5 genera.

The following four species *Crunoecia kempnyi* MORTON, 1901, *Oecetis lacustris* (PICTET, 1834), *Ernodes articularis* (PICTET, 1834) and *Ernodes vicinus* (MCLACHLAN, 1879) are the first records not only for the caddisfly fauna of the Plitvice Lakes area, but also of Croatia (KUČINIĆ 2002, MARINKOVIĆ-GOSPODNETIĆ 1979, PREVIŠIĆ et al. 2007a, 2007b, RADOVANOVIĆ 1935).

Species richness is not presented according to the four main habitat types since number of sites belonging to particular habitat type and sampling effort between some of them varied. Regarding particular sampling sites, the highest species richness was recorded for the tufa barrier Labudovac (LA; 35 species), possibly due to the variety of microhabitats present at the barrier and the availability of various food resources (HABDIJA et al. 2004, MILIŠA et al. 2006).

Distribution of species at particular habitat types is generally in accordance with their typical distribution (GRAF et al. 2002) determined by the difference in seasonal variability of water temperature. Water temperature shows the classical pattern, with springs having almost constant temperature throughout the year, whereas the downstream sites exhibit high seasonal variability (e.g. PREVIŠIĆ et al. 2007). Some of the species typical of crenal sections (GRAF et al. 2002) were recorded solely at the springs (e.g. *Crunoecia*, *Ernodes*, *Plectrocnemia brevis*; Tab. 1), whereas some typical of crenal/rhithral where recorded at the springs and sites in the streams (e.g. *Drusus croaticus*, *Potamophylax nigricornis*, *Rhyacophila fasciata*, *Synagapetus krawanyi*; Tab. 1). Furthermore, species typical for stagnant waterbodies (GRAF et al. 2002) were collected at lakes and travertine barriers (e.g. *Neureclipsis bimaculata*, *Oecetis lacustris*, *Mystacides nigra*; Tab. 1). None of the species was recorded at all sampling sites although some occurred at all habitat types (e.g. *Rhyacophila tristis*, *Wormaldia subnigra*, *Tinodes dives*, Tab. 1). Typical distribution of some of these species encompasses variety of habitats along the watercourse (e.g. *Plectrocnemia conspersa*, *R. tristis*, *Stenophylax permistus* (GRAF et al. 2002)), however, such findings can largely depend on the use of attractant traps (MALICKY 1987, for further discussion see below). Additionally, some of the species recorded at the springs (e.g. *Tinodes waeneri*, *Athripsodes aterrimus*, *A. cinereus*, *Limnephilus* sp.) are typical for stagnant waterbodies and their distribution is not only determined by the water temperature, but also by other specific habitat conditions such as slow flowing water, fine sediments, presence of macrophytes etc. However, the majority of specimens belonging to these taxa were collected at the springs with light traps.

In the multi-dimensional scaling (MDS) analysis, grouping of sites belonging to particular habitat types were observed in some cases, e.g. grouping of sites at streams Bijela rijeka and Crna rijeka (BR-PLJ and CR-PLJ, respectively; Fig. 2). However, a clustering of sites that are geographically close was also evident, for instance in the case of upper lakes and tufa barrier Labudovac (UP-LAKES and LA, respectively; Fig. 2) and lower lakes and tufa barrier Kozjak/Milanovac (LOW-LAKES and KM, respectively; Fig. 2). Even though a variety of methods was used and thus a fairly good insight into community composition of particular habitats provided, the majority of data are obtained by the light trapping. Attractant traps such as light traps usually attract insects even from larger distances, and since here different habitats are found in a short distance this has probably influenced the results (e.g. MALICKY 1987). However, the current study represents an important contribution to the knowledge of caddisfly fauna of Croatia and of various karstic habitats in general.

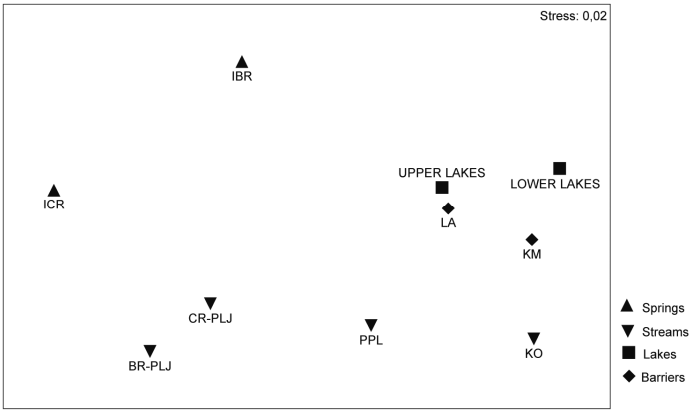

Fig. 2: Multi-dimensional scaling (MDS) analysis based on the presence/absence data showing similarity of caddisfly fauna between different sites. Abbreviations and symbols for sampling localities correspond to labels in Fig. 1.

Acknowledgements

The authors would like to thank the many colleges from Department of Zoology, University of Zagreb and Croatian Natural History Museum who helped with collecting of caddisflies in the Plitvice Lakes NP. We are grateful to the Plitvice Lakes National Park authorities, for their support and permission in field sampling. We are very grateful to Hans Malicky for his support and help with identification of caddisflies, especially at the beginning of our study at the Plitvice Lakes NP. Also, we thank him for providing us his data from the Plitvice Lakes and permission to use them in this paper. This research was supported by Croatian Ministry of Science, Education and Sports as a part of the Projects nos. 119-1193080-1206 and 119-1193080-3076.

Zusammenfassung

Im Nationalpark Plitvicer Seen wurden von 1997 bis 2008 81 Köcherfliegenarten nachgewiesen. Davon sind vier Arten (*Crunoecia kempnyi*, *Oecetis lacustris*, *Ernodes articularis* und *E. vicinus*) neu für Kroatien. Die Untersuchungen wurden an 15 Stellen durchgeführt und schlossen Quellen, Bäche, Seen und Sinterbarrieren ein. Die höchste Artenvielfalt wurde an der Sinterstelle Labudovac dokumentiert. Die Artenzusammensetzung wird hauptsächlich von der Wassertemperatur gesteuert, daneben ist der Habitattyp und die räumliche Nähe der Stellen wesentlich.

References

BOTOSANEANU L. & H. MALICKY (1978): Trichoptera. — In: ILLIES J. (ed.), Limnofauna Europaea. Gustav Fischer Verlag, Stuttgart, 333-359.

CLARKE K.R. & R.N. GORLEY (2001): Primer v5: user manual/tutorial. — PRIMER-E, Plymouth.

GRAF W., GRASSER U. & J. WARINGER (2002): Trichoptera. Part III, 41 pp. — In: MOOG O. (ed.), Fauna Aquatica Austriaca. Version 2002, Wasserwirtschaftskataster, Bundesministerium für Land- und Forstwirtschaft, Wien.

HABDIJA I., PRIMC HABDIJA B., MATONIČKIN R., KUČINIĆ M., RADANOVIĆ I., MILIŠA M. & Z. MIHALJEVIĆ (2004): Current velocity and food supply as factors affecting the composition of macroinvertebrates in bryophyte habitats in karst running water. — Biol. Brat. **59**: 577-593.

KUČINIĆ M. (2002) Diversity and distribution of caddisflies (Trichoptera, Insecta) of Plitvice Lakes. PhD. — Thesis (in Croatian), University of Zagreb, 1-139.

MALICKY H. (1983) Atlas of European Trichoptera. — Dr. W. Junk Publishers, The Hague. 1-298 pp.

MALICKY H. (1987): Anflugdistanz und Fallenfangbarkeit von Köcherfliegen (Trichoptera) bei Lichtfallen. — Jber. Biol. Stn. Lunz **10**: 140-157.

MALICKY H. (2004) Atlas of European Trichoptera. — Springer, Dordrecht. 359 pp.

KUČINIĆ M. & H. MALICKY (2002): *Rhyacophila dorsalis plitvicensis* new subspecies from Croatia. — In: MEY W. (ed.), Proceedings of the 10th International Symposium on Trichoptera. Nova Suppl. Entomol. **15**: 145-147.

MARINKOVIĆ-GOSPODNETIĆ M. (1971): The species of the genus *Drusus* in Yugoslavia. — Godišnjak Biološkog Instituta Univerziteta Sarajevo (Annual of the Institute of Biology-University of of Sarajevo). **24**: 105-109.

MARINKOVIĆ-GOSPODNETIĆ M. (1979) Trichoptera (Insecta) velikih karstnih izvora u Dinaridima. — In: RAUŠ Đ. (ed.), Drugi kongres Ekologa Jugoslavije (Second Congress of Ecologists of Yugoslavia), Savez društava ekologa Jugoslavije. Zagreb. 1837-1849.

MILIŠA M., HABDIJA I., PRIMC-HABDIJA B., RADANOVIĆ I. & R. MATONIČKIN KEPČIJA (2006): The role of flow velocity in the vertical distribution of particulate organic matter on moss-covered travertine barriers of the Plitvice Lakes (Croatia). — Hydrobiologia **553**: 231-243.

PREVIŠIĆ A., KEROVEC M. & M. KUČINIĆ (2007a): Emergence and composition of Trichoptera from karst habitats, Plitvice Lakes region, Croatia. — Internat. Rev. Hydrobio. **92** (1): 61-83.

PREVIŠIĆ A., MIHALJEVIĆ Z. & M. KEROVEC (2007b): Caddisfly (Insecta: Trichoptera) fauna of altered and man-made habitats in the Drava River, NW Croatia. — Natura Croatica **16** (3): 181-189.

RADOVANOVIĆ M. (1935) Trihoptere Jugoslavije. — Glasnik Zem. Muz. Bosn. Herceg. **47**: 73-84.

STILINOVIĆ B. & S. BOŽIČEVIĆ (1998): The Plitvice Lakes – a natural phenomenon in the middle of the Dinaric karst in Croatia. — European Water Manage. (1461-6971) **1** (5): 15-24.

WIBERG-LARSEN P., BRODERSEN K.P., BIRKHOLM S., GRØN P.N. & J. SKRIVER (2000): Species richness and assemblage structure of Trichoptera in Danish streams. — Freshwater Biol. **43**: 633-647.

Authors' addresses: Ana PREVIŠIĆ
Mladen KUČINIĆ
Department of Zoology, Division of Biology, Faculty of Science
University of Zagreb, Rooseveltov trg 6
HR-10000 Zagreb, Croatia
E-mail: aprevis@zg.biol.pmf.hr
kucinic@zg.biol.pmf.hr

Wolfram GRAF
Institute of Hydrobiology and Aquatic Ecosystem Management
University of Natural Resources and Applied Life Sciences
Max Emanuel Straße 17
A-1180 Vienna, Austria
E-mail: wolfram.graf@boku.ac.at

Tab. 1: List of caddisfly species collected at different habitat types in the Plitvice Lakes National Park area between 1997 and 2008.

Species	Springs	Streams	Lakes	Tufa barriers
Rhyacophilidae				
Rhyacophila aurata BRAUER, 1857		●	●	●
R. dorsalis plitvicensis MALICKY & KUČINIĆ, 2002		●	●	●
Rhyacophila fasciata HAGEN, 1859	●	●		●
R. schmidinarica URBANIČ, KRUŠNIK & MALICKY, 2000	●	●	●	
Rhyacophila tristis PICTET, 1834	●	●	●	●
Glossosomatidae				
Glossosoma bifidum MCLACHLAN, 1879	●			
Glossosoma discophorum KLAPALEK, 1902	●	●		
Synagapetus krawanyi ULMER, 1938	●	●		
Philopotamidae				
Philopotamus montanus (DONOVAN, 1813)	●	●	●	
Philopotamus variegatus (SCOPOLI, 1763)			●	
Wormaldia occipitalis (PICTET, 1834)		●	●	●
Wormaldia subnigra MCLACHLAN, 1865	●	●	●	●
Hydropsychidae				
Hydropsyche incognita PITSCH, 1993		●		●
Hydropsyche instabilis (CURTIS, 1834)		●	●	●
Hydropsyche saxonica MCLACHLAN, 1884		●	●	●
Polycentropodidae				
Cyrnus trimaculatus (CURTIS, 1834)	●	●	●	
Neureclipsis bimaculata (LINNAEUS, 1758)				●
Plectrocnemia brevis MCLACHLAN, 1871	●		●	
Plectrocnemia conspersa (CURTIS, 1834)	●	●	●	●
Polycentropus excisus KLAPALEK, 1894			●	
Polycentropus flavomaculalus (PICTET, 1834)	●	●	●	●
Polycentropus schmidi NOVAK & BOTOSANEANU, 1965		●	●	●
Psychomyiidae				
Lype phaeopa (STEPHENS, 1836)			●	
Lype reducta (HAGEN, 1868)			●	●
Psychomyia klapaleki MALICKY, 1995		●		
Tinodes dives (PICTET, 1834)	●	●	●	●
Tinodes unicolor (PICTET, 1834)		●		●
Tinodes waeneri (LINNAEUS, 1758)	●		●	
Phryganeidae				
Agrypnia varia (FABRICIUS, 1793)		●	●	●

Species	Springs	Streams	Lakes	Tufa barriers
Phryganea bipunctata RETZIUS, 1783			●	
Phryganea grandis LINNAEUS, 1758			●	●
L i m n e p h i l i d a e				
Allogamus uncatus (BRAUER, 1857)	●	●		
Drusus croaticus MARINKOVIĆ-GOSPODNETIĆ, 1971	●	●		
Chaetopteryx fusca BRAUER, 1857		●	●	
Chaetopteryx gonospina MARINKOVIĆ-GOSPODNETIĆ, 1966	●			
Glyphotaelius pellucidus (RETZIUS, 1783)	●	●	●	●
Grammotaulius nigropunctatus (RETZIUS, 1783)	●	●		
Halesus digitatus (SCHRANK, 1781)		●	●	●
Halesus tesselatus (RAMBUR, 1842)	●		●	●
Hydatophylax infumatus (MCLACHLAN, 1865)		●		
Limnephilus affinis CURTIS, 1834	●			
Limnephilus auricula CURTIS, 1834	●	●		
Limnephilus extricatus MCLACHLAN, 1865		●	●	
Limnephilus flavicornis (FABRICIUS, 1787)	●			●
Limnephilus hirsutus (PICTET, 1834)	●	●		
Limnephilus ignavus MCLACHLAN, 1865	●	●	●	
Limnephilus lunatus CURTIS, 1834		●	●	●
Limnephilus rhombicus (LINNAEUS, 1758)	●	●	●	●
Limnephilus sparsus CURTIS, 1834	●	●	●	●
Micropterna lateralis (STEPHENS, 1834)		●		
Micropterna nycterobia MCLACHLAN, 1875		●	●	
Micropterna sequax MCLACHLAN, 1875		●	●	●
Stenophylax permistus MCLACHLAN, 1895	●	●	●	●
Stenophylax vibex (CURTIS, 1834)	●			
Potamophylax latipennis (CURTIS, 1834)		●	●	
Potamophylax nigricornis (PICTET, 1834)	●	●		
Potamophylax pallidus (KLAPALEK, 1899)	●	●	●	●
Potamophylax rotundipennis (BRAUER, 1857)		●	●	●
Rhadicoleptus alpestris (KOLENATI, 1848)		●		
G o e r i d a e				
Goera pilosa (FABRICIUS, 1775)			●	
Litax niger (HAGEN, 1859)	●			
Silo pallipes (FABRICIUS, 1781)	●	●		
L e p i d o s t o m a t i d a e				
Crunoecia kempnyi MORTON, 1901	●			
Lepidostoma hirtum FABRICIUS, 1775)	●	●	●	●
L e p t o c e r i d a e				
Adicella filicornis (PICTET, 1834)	●	●		
Adicella syriaca ULMER, 1907		●		
Athripsodes aterrimus (STEPHENS, 1836)	●		●	●
Athripsodes bilineatus (LINNAEUS, 1758)		●	●	●
Athriposdes cinereus (CURTIS 1834)	●	●	●	●
Ceraclea dissimilis (STEPHENS, 1836)	●	●	●	●
Mystacides nigra (LINNAEUS, 1758)			●	

Species	Springs	Streams	Lakes	Tufa barriers
Mystacides azurea (LINNAEUS, 1761)		●	●	●
Oecetis lacustris (PICTET, 1834)			●	
Oecetis testacea (CURTIS, 1834)	●		●	●
S e r i c o s t o m a t i d a e				
Notidobia ciliaris (LINNAEUS, 1761)				●
Sericostoma flavicorne SCHNEIDER, 1845	●	●	●	●
B e r a e i d a e				
Beraea pullata (CURTIS, 1834)		●		
Beraeamyia schmidi BOTOSANEANU, 1960		●	●	●
Ernodes articularis (PICTET, 1834)	●			
Ernodes vicinus (MCLACHLAN, 1879)	●			
O d o n t o c e r i d a e				
Odontocerum albicorne (SCOPOLI, 1763)		●		