

STATE OF RESEARCH INTO THE DRAGONFLIES (ODONATA) OF KARLOVAC COUNTY, CROATIA, WITH SPECIAL REFERENCE TO NATURA 2000 SPECIES

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Accepted: December 19th 2011

Forty two dragonfly species were previously reported for Karlovac County. Historical as well as recently collected but unpublished records add seven more species to records for the analysed territory, raising the number of dragonfly species to 49. Analysis revealed uneven temporal and spatial distribution of records, showing that the SE part of the county (Kordun subregion) is the most underexplored. Although most of the published and unpublished data were collected during the last 25 years it is obvious that odonatological inventory was not conducted systematically but rather accidentally. Furthermore, only three NATURA 2000 species (*Cordulegaster heros* Theischinger, 1979, *Leucorrhinia pectoralis* (Charpentier, 1825) and *Qphiogomphus cecilia* (Fourcroy, 1785)) with very low number of records have been reported for Karlovac County. However, the presented synthesis provides a valuable contribution to the knowledge on the Croatian dragonfly fauna.

Dragonflies, Karlovac County, checklist, distribution, NATURA 2000 species

R. ŠPANIĆ, A. CIPČIĆ, T. BOGDANOVIĆ i M. FRANKOVIĆ: Stanje istraženosti vretenaca (Odonata) Karlovačke županije s posebnim osvrtom na NATURA 2000 vrste. Entomol. Croat. 2012. Vol. 15. Num. 1-4: 209-221.

Za područje Karlovačke županije do sada su zabilježene 42 vrste vretenaca. Neobjavljeni podatci tome broju pridodaju sedam novih vrsta pa fauna vretenaca Županije sada broji 49 vrsta. Analiza objavljenih i neobjavljenih nalaza pokazala je njihovu nejednoliku vremensku i prostornu raspodjelu, a područje Korduna je najneistraženije. Premda je većina objavljenih i neobjavljenih podataka prikupljena tijekom posljednjih 25 godina, iz raščlambe podataka

je razvidno da dosadašnja inventarizacija vretenaca Karlovačke županije nije provedena sistematično već slučajnim odabirom lokacija istraživanja. To je posebice vidljivo kroz raščlambu prisutnosti NATURA 2000 vrsta na istraživanom području gdje su do sada zabilježene tek tri vrste s vrlo malim brojem njihovih nalaza.

Vretenca, Karlovačka županija, popis vrsta, rasprostranjenje, Natura 2000 vrste

Introduction

Karlovac County is situated in the central part of Croatia (Figure 1). It occupies an area of approximately 3,622 km² and it spreads over a part of the wetland of the Pannonian plain, four major river basins (Kupa, Dobra, Korana and Mrežnica), the heavily forested mountain ranges of Velika Kapela and Mala Kapela, as well as the Žumberak and Kordun karst regions.

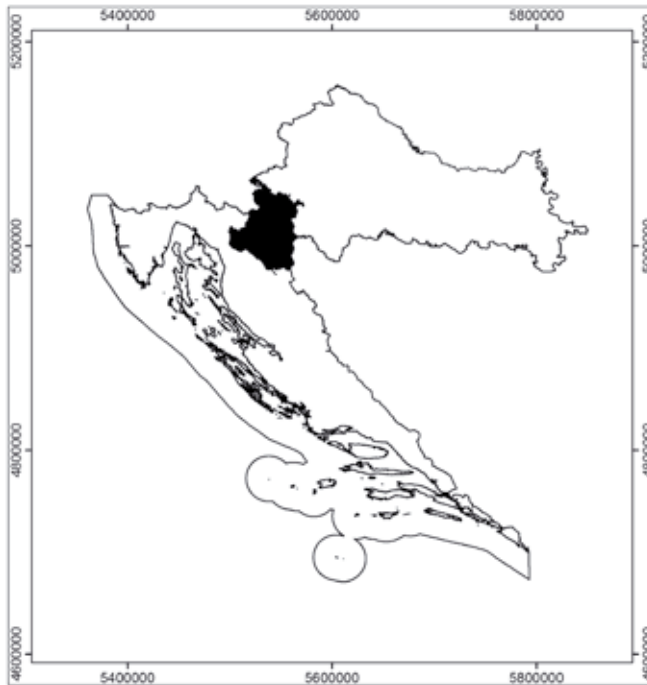


Figure 1. Study area (Karlovac County) on the map of Croatia.

The first data published on dragonflies of Karlovac County can be found in general insect overview of “Umgebung von Karlstadt” (Sapetza, 1876) where *Calopteryx virgo* (Linnaeus, 1758) was reported. Additional data can be found in various types of publications ranging from student reports and diploma works to scientific papers and monographs. In his fine dragonfly monograph Rössler (1900) added *Platycnemis pennipes* (Pallas, 1771) to the Karlovac County regional fauna. Geelen & Oomen (1965) recorded six species, three of which were new to the region - *Coenagrion puella* (Linnaeus, 1758), *Ischnura elegans* (Vander Linden, 1820) and *Libellula depressa* Linnaeus, 1758, whilst the record of *Coenagrion armatum* (Charpentier, 1840) is considered doubtful (Belančić et al., 2008). Seidenbusch (1994) added *Calopteryx splendens* (Harris, 1782) to the list, and Bedjanić (1995) reported a record of the nationally critically endangered *Lestes macrostigma* (Schneider, 1845). Although the first distribution maps on dragonflies of Croatia were published almost twenty years ago (Franković, 1995), as 50 km x 50 km UTM grids were used it is not possible to match records presented on these maps with Karlovac County territory. During a student research camp, a group of authors (Bedjanić et al., 1997) reported 29 species - *Lestes barbarous* (Fabricius, 1798), *L. dryas* Kirby, 1890, *L. sponsa* (Hansemann, 1823), *L. viridis/parvidens* group, *Pyrrhosoma nymphula* (Sulzer, 1776), *Erythromma lindenii* (Selys, 1840), *E. viridulum* (Charpentier, 1840), *Ischnura pumilio* (Charpentier, 1825), *Aeshna affinis* Vander Linden, 1823, *A. cyanea* (Müller, 1764), *A. mixta* Latreille, 1805, *Anax imperator* Leach, 1815, *Onychogomphus forcipatus* (Linnaeus, 1758), *Cordulia aenea* (Linnaeus, 1758), *Somatochlora flavomaculata* (Vander Linden, 1825), *S. meridionalis* Nielsen, 1935, *Libellula quadrimaculata* Linnaeus, 1758, *Orthetrum albistylum* (Selys, 1848), *O. cancellatum* (Linnaeus, 1758), *Sympetrum sanguineum* (Müller, 1764), *S. striolatum* (Charpentier, 1840) and *Crocothemis erythraea* (Brulle, 1832), new to the NE part of the region. While analysing the *Calopteryx splendens* complex throughout Croatia Pongrac (2000) reported records from Karlovac County. In her diploma work on dragonflies of the Ogulin subregion Stipetić (2002) recorded 21 species, of which *Sympecma fusca* (Vander Linden, 1820), *Enallagma cyathigerum* (Charpentier, 1840), *Brachytron pratense* (Müller, 1764) and *Sympetrum vulgatum* (Linnaeus, 1758) were new to this region, and the regional presence of *Lestes parvidens* (Artobolevski, 1929) was confirmed. Ljuština (2003) added *Coenagrion pulchellum* (Vander Linden, 1825) and *Orthetrum brunneum* (Fonscolombe, 1837) out

of the 8 species recorded from the Žumberak mountain range and *Cordulegaster bidentata* Selys, 1843 and *C. heros* were two amongst the 13 species reported from the same mountain range (Vitas, 2004). Although there are no record data presented, according to the maps published in Red Data Book of Dragonflies of Croatia the number of published as well as unpublished (e.g. *Leucorrhinia pectoralis*, Mihoković pers. com.) data can be associated with the broader study area (Belančić et al., 2008). Recent analysis of NATURA 2000 dragonfly species in Croatia revealed two more localities of previously recorded *Cordulegaster heros* on the analysed territory (Franković & Bogdanović, 2009). In the section of the Kupa River forming the state border between Croatia and Slovenia Pirnat (2011) noted *Gomphus vulgatissimus* (Linnaeus, 1758) as one of the 9 dragonfly species inhabiting the river. Finally, Vinko (2011) added *Aeshna grandis* (Linnaeus, 1758), *A. isosceles* (Müller, 1767), *Libellula fulva* Müller, 1764 and *Sympetrum meridionale* (Selys, 1841) to the list of fauna of Mrežnica River, thus raising the published records of dragonfly species of Karlovac County to 42.

The main aim of this paper was to provide an insight into the published records of dragonflies of Karlovac County. Furthermore, by adding unpublished records, we opted for compiling the first checklist of dragonfly species for the region – a starting point for future research into dragonfly species of Karlovac County.

Material and Methods

A detailed overview of all published data was used to compile the dragonfly records database of Karlovac County. Private collections and the collection of the Croatian Natural History Museum were examined. The latter, along with unpublished data collected by the authors, provides a significant contribution to the spatial distribution of dragonflies. Some records in this paper, published on general distribution maps of dragonflies in the Red Data Book of Dragonflies of Croatia (Belančić et al., 2008) were treated as unpublished as they were not published as “species/locality/date” type of data.

Identification and nomenclature of species follows Dijkstra & Lewington (2006). The conservation and protection status of species has been assigned following Red Data Book of Dragonflies of Croatia (Belančić et al., 2008), European Red List of Dragonflies (Kalkman et al., 2010), IUCN Red List of Threatened Species (IUCN, 2011), current Croatian legislation (Ordinance on the proclama-

tion of protected and strictly protected wild taxa, Official gazette 99/09) and EU Habitat Directive (92/43/EEC). GIS software ArcMap 9.3 has been used in spatial analysis of all records.

Results and Discussion

Although dragonflies are abundant in different freshwater habitat types, preliminary analysis of the growing published records of Karlovac County has shown a small number of records (“species/locality/date” type of data). Also an uneven temporal and spatial distribution of dragonfly records throughout the analyzed territory was revealed (Figure 2). Previously, 42 dragonfly species (288 records) were reported for the studied region. Compared to a total of 69 species recorded in Croatia (includes recent observation of *Pantala flavescens* (Fabricius, 1798), <http://www.libellenfunde.de/platform/lex/eurodon/forum/threadContent.do?tab=s2generalforum&thread=101121&id=141>) this number represents 61 % of the national dragonfly fauna. Although the majority of these data were collected recently, during the last two decades, published records are mainly confined to the small, NW part of Karlovac County (e.g. Geelen & Oomen, 1965; Stipetić, 2002; Ljuština, 2003; Vitas, 2004; Bedjanič et al., 1997). Out of the 54 10x10 km grid squares just 11 of them contain at least one published record of dragonfly species, showing that only around 20 % of County territory was covered by previous research activities.

Unpublished records and record sites given as “species/locality/date” type of data are listed in Tables 1 & 2. Although the list of unpublished data consisted of a smaller number of species (34) and records (139) collected from different sources (Croatian Natural History museum, Španić, R., Franković, M., Cipčić, A., Ljuština, M. and N. Mihoković, all unpublished data) it adds seven species to the County territory list, so the total of species listed was raised to 49 (Table 3). Temporal distribution of unpublished data (1902 - 2011) follows in general that of published records with the majority of data collected within the last 25 years. New data filled 19 10x10 km grid squares (35 % of analysed territory), 13 of them being newly filled squares (Figure 2) showing a notable improvement in the spatial distribution of data. Like the published, unpublished data cover mostly the northern and western parts of the County, leaving the SE Kordun subregion still odonatologically underexplored. So, to fill this gap, future research concentrated on this part of the County is essential.

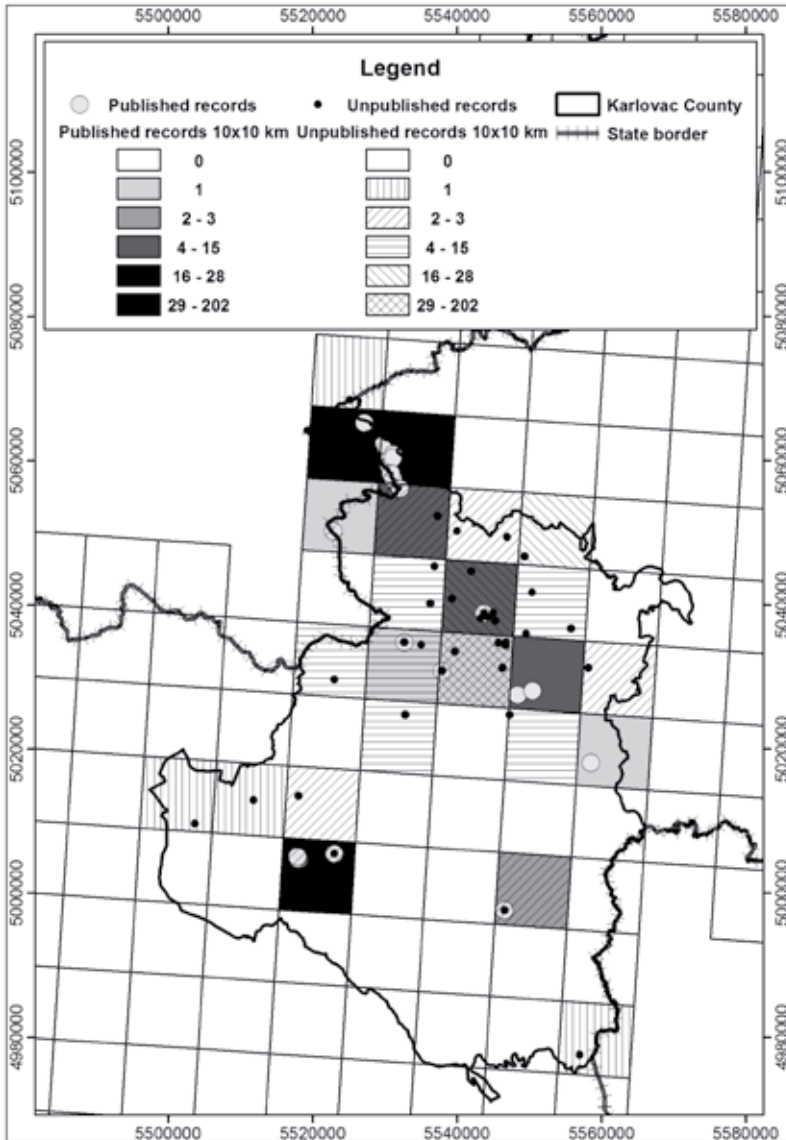


Figure 2. State of research on dragonflies of Karlovac County based on comparison of published and unpublished data.

Table 1. List of unpublished dragonfly records for Karlovac County.
List of sites is given in Table 2.

CALOPTERYGIDAE	
1	<i>Calopteryx splendens</i> (Harris, 1782): ? (S2 ¹); 13.5.1963. (S8); 13.6.1964. (S8); 15.8.1987. (S10); 4.7.1988. (S1); 19.8.1993. (S14); 29.6.1997. (S14); 14.8.1998. (S17); 1.7.2006. (S5); 30.7.2006. (S34); 9.6.2009. (S23); 25.6.2011. (S19)
2	<i>Calopteryx virgo</i> (Linnaeus, 1758): ? (S2); ? (S24); 19.6.1903. (S29); 29.6.1910. (S24); 15.8.1987. (S10); 19.7.1996. (S9); 14.8.1998. (S17); 28.7.2007. (S24); 10.6.2009. (S31); 26.7.2009. (S27); 25.4.2011. (S26); 10.5.2011. (S3); 25.5.2011. (S11); 31.5.2011. (S32); 12.6.2011. (S6); 25.6.2011. (S19)
LESTIDAE	
3	<i>Lestes barbarus</i> (Fabricius, 1798): 3.6.1964. (S8)
4	<i>Lestes virens</i> (Charpentier, 1825): 25.7.1917. (S18)
5	<i>Lestes viridis</i> (Vander Linden, 1825): 19.8.1993. (S14)
COENAGRIONIDAE	
6	<i>Coenagrion puella</i> (Linnaeus, 1758): 19.6.1913. (S29); 13.6.1964. (S8); 19.5.1973. (S8); 19.5.1975. (S8); 22.6.2006. (S21); 5.6.2009. (S23); 28.5.2011. (S20);
7	<i>Enallagma cyathigerum</i> (Charpentier, 1840): 19.6.1913. (S29); 30.7.2006. (S34)
8	<i>Erythromma lindenii</i> (Selys, 1840): 15.8.1987. (S10); 28.7.2007. (S24); 12.6.2011. (S6)
9	<i>Ischnura elegans</i> (Vander Linden, 1820): 19.5.1975. (S8); 15.8.1987. (S10); 8.5.1988. (S4, S8); 25.5.2011. (S11);
10	<i>Ischnura pumilio</i> (Charpentier, 1825): ? (S2)
11	<i>Pyrhosoma nymphula</i> (Sulzer, 1776): 27.6.1997. (S15); 22.6.2006. (S21)
PLATYCNEMIDIDAE	
12	<i>Platycnemis pennipes</i> (Pallas, 1771): 17.7.1902. (S18); 12.7.1904. (S18); 24.7.1914. (S24); 3.6.1964. (S8); 13.6.1964. (S8); 19.5.1975. (S8); 15.8.1987. (S10); 4.7.1988. (S1); 19.8.1993. (S14); 1.7.2006. (S5); 30.7.2006. (S34); 28.7.2007. (S24); 20.7.2009. (S7); 21.5.2011. (S7); 25.5.2011. (S11); 31.5.2011. (S32); 12.6.2011. (S6); 25.6.2011. (S19)
AESHNIDAE	
13	<i>Aeshna affinis</i> Vander Linden, 1823: ? (S2)
14	<i>Aeshna cyanea</i> (Müller, 1764): ? (S2); 9.10.2009. (S13)
15	<i>Aeshna mixta</i> Latreille, 1805: 19.8.1995. (S8); 8.9.1995. (S8)
16	<i>Anax imperator</i> Leach, 1815: ? (S2); 4.7.1988. (S1); 19.8.1993. (S14); 29.5.1995. (S8); 30.7.2006. (S34); ? (S28); 2.7.2009. (S12); 15.8.2010. (S23)
17	<i>Anax parthenope</i> (Selys, 1839): 29.5.1993. (S8)
GOMPHIDAE	
18	<i>Gomphus vulgatissimus</i> (Linnaeus, 1758): ? (S2); 4.7.1988. (S1); 10.5.2011. (S3); 21.5.2011. (S7); 25.5.2011. (S11)
19	<i>Onychogomphus forcipatus</i> (Linnaeus, 1758): 15.8.1987. (S10); 4.7.1988. (S1); 25.7.2005. (S31); 1.7.2006. (S5); 30.7.2006. (S34); 25.6.2011. (S19)
20	<i>Opiogomphus cecilia</i> (Fourcroy, 1785): 25.7.1914. (S22)

Table 1. - continued

CORDULIIDAE	
21	<i>Cordulia aenea</i> (Linnaeus, 1758): 8.5.1988. (S4, S8); 29.5.1993. (S8); 18.6.2009. (S31)
22	<i>Somatochlora flavomaculata</i> (Vander Linden, 1825): 4.7.1988. (S1)
23	<i>Somatochlora meridionalis</i> Nielsen, 1935: 4.7.1988. (S1); 1.7.2006. (S5); 30.7.2006. (S34); 21.7.2009. (S23)
LIBELLULIDAE	
24	<i>Crocothemis erythraea</i> (Brulle, 1832): 19.8.1993. (S14); 1.8.2006. (S21); 25.7.2009. (S12)
25	<i>Leucorrhinia pectoralis</i> (Charpentier, 1825): 25.5.2002. (S8)
26	<i>Libellula depressa</i> Linnaeus, 1758: ? (S2); 20.6.1917. (S30); 3.6.1964. (S8); 13.6.1964. (S8); 1.7.2006. (S5); 6.7.2006. (S21); 1.8.2006. (S21); 8.6.2009. (S23); 2.7.2009. (S31); 25.5.2011. (S11)
27	<i>Libellula fulva</i> Müller, 1764: 4.7.1988. (S1); 1.7.2006. (S5)
28	<i>Orthetrum albistylum</i> (Selys, 1848): 13.5.1963. (S8); 3.6.1964. (S8); 13.6.1964. (S8); 5.6.1989. (S8); 25.7.2010. (S33)
29	<i>Orthetrum brunneum</i> (Fonscolombe, 1837): ? (S2); 22.6.2006. (S21); 20.7.2009. (S7)
30	<i>Orthetrum cancellatum</i> (Linnaeus, 1758): 25.7.2009. (S12); 12.6.2011. (S6)
31	<i>Orthetrum coerulescens</i> (Fabricius, 1798): 4.7.1988. (S1); 27.7.2006. (S21); 21.5.2011. (S7)
32	<i>Sympetrum fonscolombii</i> (Selys, 1840): 13.6.1964. (S8)
33	<i>Sympetrum meridionale</i> (Selys, 1841): 19.8.1993. (S14)
34	<i>Sympetrum sanguineum</i> (Müller, 1764): 3.6.1964. (S8); 15.7.2006. (S16); 30.7.2006. (S34)

Table 2. List of sites of unpublished dragonfly records of Karlovac County

S#	Site	X	Y	S#	Site	X	Y
1	Belavići	5537948	5030860	18	Karlovac	5543764	5038860
2	Bosiljevo	5522966	5029616	19	Karlovac	5544223	5038354
3	Brnjenica	5558225	5031262	20	Karlovac	5543285	5038162
4	Budrovci	5546916	5049366	21	Karmanica	5546736	5034390
5	Bukovica	5546289	5031278	22	Klek	5511790	5012896
6	Donje Pokupje	5541985	5044618	23	Lipje	5555819	5036718
7	Donji Budački	5547268	5024734	24	Ogulin	5518046	5013520
8	Draganići	5549366	5046676	25	Ozalj	5537291	5052309
9	Dubravci	5535044	5034440	26	Polaki	5536861	5045377
10	Duga Resa	5539696	5033520	27	Popović Brdo	5549569	5035980
11	Gradašić Selo	5536311	5040212	28	Sadilovac	5556980	4977578
12	Gornje Mekušje	5545284	5037795	29	Slunj	5546608	4997612
13	Gornje Stative	5539282	5040793	30	Sv. Gera	5525118	5068436
14	Jarče Polje	5532728	5034796	31	Štrekovac	5546722	5034711
15	Jasenak	5503670	5009650	32	Šumbar	5550405	5041719
16	Jelaši	5545725	5034733	33	Zorkovac na Kupi	5545025	5038878
17	Josipdol	5522968	5005478	34	Zvečaj	5532832	5024733

The current study has revealed an extremely low number of records of three NATURA 2000 species: *Ophiogomphus cecilia* (1 unpublished record from the collection of the Croatian Natural History Museum, 1914), *Cordulegaster heros* (6 published records on four localities; Vitas, 2004; Franković & Bogdanović, 2009) and one unpublished record of *Leucorrhinia pectoralis* (Mihoković, pers. com, map published in Belančić et al., 2008). Regarding this, further records of these species at additional localities are expected in the future. For instance, *C. heros* was recently also recorded in nearby Slovenia (Kotarac, et al., 2003; Šalamun et al., 2010). Additional records and/or confirmation of the record of *Leucorrhinia pectoralis* (reported by N. Mihoković, pers. com.), as well as of further NATURA 2000 species are expected. In particular, *Coenagrion ornatum* (Selys, 1850) and *Gomphus flavipes* (Charpentier, 1825) are likely to occur in this area, due to the presence of suitable river habitats and recent records in adjacent counties in Croatia and Slovenia (Kotarac et al., 2003; Franković & Bogdanović, 2009; Franković & Vilenica, 2009; Šalamun et al., 2010) and in the nearby Turopolje region (Vilenica et al., 2011), respectively.

Table 3. The checklist of dragonfly species of Karlovac County with different conservation status.

¹ Dalmatian part of metapopulations;

² According to Kalkman, et al., 2010; IUCN, 2011;

³ P - Protected species, SP - Strictly protected species;

⁴ Annex II and/or IV of EU Habitat Directive, NATURA 2000 species.

No.	Taxon	Published before	New data	Red list Croatia	IUCN Europe ²	Protection in Croatia ³	HD Annex ⁴
1	<i>Calopteryx splendens</i>	YES	YES	DD ¹	LC	SP ¹	-
2	<i>Calopteryx virgo</i>	YES	YES	LC	LC	-	-
3	<i>Lestes barbarus</i>	YES	YES	NT	LC	P	-
4	<i>Lestes dryas</i>	YES	-	NT	LC	P	-
5	<i>Lestes macrostigma</i>	YES	-	CR	VU	SP	-
6	<i>Lestes parvidens</i>	YES	-	DD	LC	P	-
7	<i>Lestes sponsa</i>	YES	-	NT		P	-
8	<i>Lestes virens</i>	-	YES	VU	LC	SP	-
9	<i>Lestes viridis</i>	-	YES	LC	LC	-	-
10	<i>Sympecma fusca</i>	YES	-	LC	LC	-	-
11	<i>Coenagrion puella</i>	YES	YES	LC	LC	-	-

Table 3. - continued

12	<i>Coenagrion pulchellum</i>	YES	-	NT	LC	P	-
13	<i>Enallagma cyathigerum</i>	YES	YES	LC	LC	-	-
14	<i>Erythromma lindenii</i>	YES	YES	LC	LC	-	-
15	<i>Erythromma viridulum</i>	YES		LC	LC	-	-
16	<i>Ischnura elegans</i>	YES	YES	LC	LC		-
17	<i>Ischnura pumilio</i>	YES	YES	LC	LC	-	-
18	<i>Pyrrhosoma nymphula</i>	YES	YES	LC	LC	-	-
19	<i>Platycnemis pennipes</i>	YES	YES	LC	LC	-	-
20	<i>Aeshna affinis</i>	YES	YES	LC	LC	-	-
21	<i>Aeshna cyanea</i>	YES	YES	LC	LC	-	-
22	<i>Aeshna grandis</i>	YES	-	EN	LC	-	-
23	<i>Aeshna isosceles</i>	YES	-	NT	LC	P	-
24	<i>Aeshna mixta</i>	YES	YES	LC	LC	-	-
25	<i>Anax imperator</i>	YES	YES	LC	LC	-	-
26	<i>Anax parthenope</i>	-	YES	NT	LC	P	-
27	<i>Brachytron pratense</i>	YES	-	LC	LC	-	-
28	<i>Gomphus vulgatissimus</i>	YES	YES	LC	LC	-	-
29	<i>Onychogomphus forcipatus</i>	YES	YES	LC	LC	-	-
30	<i>Ophiogomphus cecilia</i>	-	YES	VU	LC	SP	II, IV
31	<i>Cordulegaster bidentata</i>	YES	-	LC	NT	-	-
32	<i>Cordulegaster heros</i>	YES	-	LC	NT	SP	II, IV
33	<i>Cordulia aenea</i>	YES	YES	LC	LC	-	-
34	<i>Somatochlora flavomaculata</i>	YES	YES	NT	LC	P	-
35	<i>Somatochlora meridionalis</i>	YES	YES	LC	LC	-	-
36	<i>Crocothemis erythraea</i>	YES	YES	LC	LC	-	-
37	<i>Leucorrhinia pectoralis</i>	-	YES	EN	LC	SP	II, IV
38	<i>Libellula depressa</i>	YES	YES	LC	LC	-	-
39	<i>Libellula fulva</i>	YES	YES	LC	LC	-	-
40	<i>Libellula quadrimaculata</i>	YES	-	LC	LC	-	-

Table 3. - continued

41	<i>Orthetrum albistylum</i>	YES	YES	LC	LC	-	-
42	<i>Orthetrum brunneum</i>	YES	YES	LC	LC	-	-
43	<i>Orthetrum cancellatum</i>	YES	YES	LC	LC	-	-
44	<i>Orthetrum coerulescens</i>	-	YES	DD	LC	P	-
45	<i>Sympetrum fonscolombii</i>	-	YES	NT	LC	P	-
46	<i>Sympetrum meridionale</i>	YES	YES	NT	LC	P	-
47	<i>Sympetrum sanguineum</i>	YES	YES	LC	LC	-	-
48	<i>Sympetrum striolatum</i>	YES	-	LC	LC	-	-
49	<i>Sympetrum vulgatum</i>	YES	-	NT	LC	P	-

The conservation status of the species were evaluated on a national (Belančić et al., 2008) as well as a European level (Kalkman et al., 2010; IUCN, 2011; Habitat Directive 92/43/EEC) (Table 3) revealing one nationally critically endangered species (*Lestes macrostigma*), two nationally endangered species (*Aeshna grandis*, *Leucorrhinia pectoralis*), two nationally vulnerable species (*Lestes virens* (Charpentier, 1825), *Ophiogomphus cecilia*), 10 nationally near threatened species (*Lestes barbarus*, *L. dryas*, *L. sponsa*, *Coenagrion pulchellum*, *Aeshna isosceles*, *Anax parthenope* (Selys, 1839), *Somatochlora flavomaculata*, *Sympetrum fonscolombii* (Selys, 1840), *S. meridionale*, *S. vulgatum*) and three nationally data deficient species (*Calopteryx splendens* - Dalmatian metapopulations, *Lestes parvidens*, *Orthetrum coerulescens* (Fabricius, 1798)). All of the mentioned species, as well as species listed on Anexes II and/or IV of EU Habitat directive were given strictly protected or protected status in the Republic of Croatia (Ordinance on the proclamation of protected and strictly protected wild taxa, Official gazette 99/09).

Acknowledgements

The authors are grateful to Ms Maša Ljuština, and Mr Nino Mihoković for sharing their unpublished records of dragonflies of the region.

References

- BEDJANIĆ, M., 1996. *Lestes macrostigma* (Eversmann, 1836) a new species in the dragonfly fauna of Slovenia and rediscovered in Croatia (Zygoptera: Lestidae). *Exuviae* 2/1:10-12.
- BEDJANIĆ, M., BOŽIČ, L., FERK, A. & PIRNAT, A., 1997. Prispevek k poznavanju favne kačjih pastirjev (Odonata) na območju med rekama Dobro in Kolpo (S Hrvaška). V: Kotarac, M. (ured.), Mladinska biološka raziskovalna tabora Podzemelj '95 in Duplje '96, ZOTKS - Gibanje znanost mladini Ljubljana, 43-49 pp.
- BELANČIĆ, A., BOGDANOVIĆ, T., FRANKOVIĆ, M., LJUŠTINA, M., MIHOKOVIĆ, N. & VITAS, B., 2008. Crvena knjiga vretenaca Hrvatske. Državni zavod za zaštitu prirode, Republika Hrvatska, 132 pp.
- DIJKSTRA, K.-D. B. & LEWINGTON, R., 2006. Field guide to the Dragonflies of Britain and Europe. British Wildlife Publishing Milton on Stour, 320 pp.
- FRANKOVIĆ, M. 1995. Popis vretenaca Hrvatske s nalazištima, UTM mreža. <http://www.botanic.hr/cisb/doc/fauna/odonata/odopornovi.htm>, Access 19. 5. 2011.
- FRANKOVIĆ, M. & BOGDANOVIĆ, T. 2009. Znanstvena analiza vrsta vretenaca (Odonata) s Dodatka. II. Direktive o zaštiti divlje flore i faune, DZZP Zagreb, 108 pp.
- FRANKOVIĆ, M. & VILENICA, M. 2009. Inventory of Dragonflies (Odonata) of the lower part of the Una river and its coastal zone. State Institute for Nature Protection Zagreb Croatia, 14 pp.
- GEELEN, J. F. M. & OOMEN, H. C. J., 1965. Verslag van de excursie naar N. W. Joegoslavië. 12 juni t/m 1 juli 1965, Zool. Lab., Kathol. Univ. Nijmegen, 9-13 pp.
- IUCN, 2011. IUCN Red List of Threatened Species. Version 2011.1. <http://www.iucnredlist.org>
- KALKMAN, V.J., BOUDOT, J.-P., BERNARD, R., CONZE, K.-J., DE KNIJF, G., DYATLOVA, E., FERREIRA, S., JOVIĆ, M., OTT, J., RISERVATO, E. & SAHLÉN, G., 2010. European Red List of Dragonflies. Luxembourg. Publications Office of the European Union, 29 pp.
- KOTARAC, M., ŠALAMUN, A. & WELDT, S., 2003. Strokovna izhodišča za vzpostavlanje omrežja Natura 2000, kačji pastirji (Odonata) (končno poročilo). Naročnik: MOPE, ARSO, Ljubljana. Center za kartografijo favne in flore, Miklavž na Dravskem polju, 104 pp + CD z digitalnimi prilogami.
- LJUŠTINA, M., 2003. Fauna vretenaca (Odonata) u različitim tipovima lokvi u Parku prirode »Žumberak - Samoborsko gorje«. Diplomski rad, Prirodoslovno-matematički fakultet Zagreb, 60 pp.
- PIRNAT, A., 2011. O favni kačjih pastirjev reke Kolpe. *Erjavec* 26: 21-26.
- PONGRAC, Z., 2000. Morfometrijske značajke različitih populacija vrste *Calopteryx splendens* (Harris, 1782) (Insecta: Odonata) u Hrvatskoj. Magistarski rad, Prirodoslovno-matematički fakultet, Zagreb, 115 pp.

- RÖSSLER, E., 1900. Odonata Fabr. s osobitim obzirom na Hrvatsku, Slavoniju i Dalmaciju. Glasnik Hrvatskoga Naravoslovnoga Društva 12: 1-97.
- SAPETZA, J., 1867. Verzeichniss einiger in der Umgebung von Karlstadt gesammelten Insekten. Jahrbuch K. K. Ober-Realschule Karlovac 4: 20-26.
- SEIDENBUSCH, R., 1994. Anmerkungen zur Variabilität des dunklen Flügelfleckes bei *Calopteryx splendens splendens* Harris. Acta Albertina Ratisbonensia 49: 209-212.
- STIPETIĆ, A., 2002. Vretenca (Odonata) izvorišnog dijela zagorske Mrežnice kod Ogulina. Diplomski rad, Prirodoslovno-matematički fakultet Zagreb.
- ŠALAMUN, A., GOVEDIĆ, M., PODGORELEC M. & KOTARAC, M., 2010. Dopolnitev predloga območij za vključitev v omrežje Natura 2000 – kačji pastirji (Odonata): veliki studenčar (*Cordulegaster heros*) - končno poročilo. Naročnik: Ministrstvo za okolje in prostor RS. Center za kartografijo favne in flore, Miklavž na Dravskem polju, 64 pp. + priloga 1 & 2 + podatkovna zbirka.
- ŠALAMUN, A., PODGORELEC, M. & KOTARAC, M., 2010. Dopolnitev predloga območij za vključitev v omrežje Natura 2000 – kačji pastirji (Odonata): košični škratec (*Coenagrion ornatum*) - končno poročilo. Naročnik: Ministrstvo za okolje in prostor RS. Center za kartografijo favne in flore, Miklavž na Dravskem polju, 34 pp. + podatkovna zbirka.
- VILENICA, M., MIČETIĆ STANKOVIĆ, V. & FRANKOVIĆ, M., 2011. Dragonfly fauna (Insecta, Odonata) in the Turopolje region (Croatia). Nat. Croat. 20(1): 141-158.
- VINKO, D., 2011. Drobtinice in ocvirki: Veslanje po reki Mrežnici na Hrvaškem. Erjavecia 26: 56-58.
- VITAS, B., 2004. Fauna vretenaca (Odonata) Parka prirode "Žumberak - Samoborsko gorje". Diplomski rad, Prirodoslovno-matematički fakultet Zagreb, 79 pp.