

**FAUNISTIC RESULTS FROM THE 5<sup>TH</sup> BALKAN ODONATOLOGICAL MEETING – BOOM 2015, REPUBLIC OF MACEDONIA**

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**Abstract** – Dragonfly research in the West Balkans experienced significant boost in recent years, also due to the establishment of the Balkan Odonatological Meetings (BOOM) in 2011. The main goal of BOOM is to contribute to research and protection of dragonflies of the Balkan Peninsula. This paper presents the faunistic results of the 5<sup>th</sup> BOOM, held in Republic of Macedonia. Between 7 and 15 August 2015, 46 sites were surveyed and 41 dragonfly species found. This represents more than half of the hitherto recorded dragonfly species for the country. This paper includes data for localities and habitats from central and southern part of R. Macedonia, which was less investigated in the past. Significant results include the first documented report of *Selysiotthemis nigra* for the country. New data on several species with a comparably low number of previously published records for R. Macedonia, i.e. *Chalcolestes parvidens*, *Caliaeschna microstigma*, *Lindenia tetraphylla*, *Cordulegaster heros*, *C. bidentata*, *C. insignis*, *Somatochlora meridionalis*, *S. flavomaculata*, *Sympetrum vulgatum* and *S. flaveolum*, are also presented and brief discussion is provided.

KEY WORDS: dragonflies, Odonata, distribution, R. Macedonia, Balkan, BOOM, *Selysiothemis nigra*, first records

### **Izvešček – FAVNISTIČNI REZULTATI 5. MEDNARODNEGA SREČANJA ODO- NATOLOGOV BALKANA – BOOM 2015, REPUBLIKA MAKEDONIJA**

Raziskovanje kačjih pastirjev je na zahodnem Balkanu v zadnjih letih doživelo velik napredek. Slednje je tudi rezultat vzpostavitve širšega balkanskega odonatološkega sodelovanja v okviru Mednarodnih srečanj odonatologov Balkana (BOOM), ki potekajo od leta 2011 dalje. Glavni cilj srečanj je prispevati k raziskavam in varstvu kačjih pastirjev balkanskega polotoka. Ta prispevek predstavlja favnistične rezultate 5. BOOM, ki je potekal v Republiki Makedoniji. Na 46 pregledanih lokalitetah smo med 7. in 15. avgustom 2015 popisali 41 vrst kačjih pastirjev, kar je več kot polovica vseh znanih vrst kačjih pastirjev Republike Makedonije. Članek vključuje podatke za lokalitete in habitate osrednjega in južnega dela države, ki je bil v preteklosti slabo raziskan. Pomembnejši rezultati vključujejo prvo dokumentirano poročanje o pojavljanju temnega slaniščarja (*Selysiothemis nigra*) za državo. Zabeležena so tudi nova nahajališča v R. Makedoniji redkih vrst kačjih pastirjev. Ti so: presenetljiva pazverca (*Chalcolestes parvidens*), blede vetrnjak (*Caliaeschna microstigma*), velika peščenka (*Lindenia tetraphylla*), veliki, povirni in modrooki studenčar (*Cordulegaster heros*, *C. bidentata*, *C. insignis*), sredozemski in pegasti lesketnik (*Somatochlora meridionalis*, *S. flavomaculata*) ter navadni in rumeni kamenjak (*Sympetrum vulgatum*, *S. flaveolum*).

KLJUČNE BESEDE: kačji pastirji, Odonata, razširjenost, Republika Makedonija, Balkan, BOOM, *Selysiothemis nigra*, prvi podatki

### **Introduction**

Interest in dragonflies (Insecta: Odonata) is increasing in all countries of the West Balkan Peninsula in recent years. The result is the establishment of the Balkan Odonatological Meeting, or BOOM in 2011 (Jović 2011) with the main goal of further development of odonatology in the Balkans. The main concept of BOOM is to yearly gather odonatologists in a different Balkan country. With focus on fieldwork, BOOM gives the opportunity of gaining experience in dragonfly identification and to gather new data on dragonfly distribution in selected areas (Vinko 2011a). Annual BOOM Meeting quickly became a recognized event, where dragonfly enthusiasts – professional and amateur – can meet, exchange their ideas, present their research and work together in investigating dragonflies in one of the least known regions of Europe (Vinko et al. 2012). New regional cooperation and joint research resulted in several papers on dragonfly fauna of the region (Šácha & Bedjanič 2011, Vinko 2011b, Vinko & Vilenica 2013, Rajkov et al. 2015, Kulijer et al. 2016, Vinko et al. 2016).

The 5<sup>th</sup> Balkan Odonatological Meeting (BOOM 2015 – R. Macedonia) was organized by the Biology Students' Research Association Skopje (Skopje, R. Macedonia), Macedonian Ecological Society (Skopje, R. Macedonia) and the Slovene Dragonfly

Society (Ljubljana, Slovenia) in the beginning of August 2015 in R. Macedonia. A total of 16 participants from Slovenia, Serbia, Bosnia and Herzegovina, R. Macedonia, and from Germany and the Netherlands took part in this Meeting. Local media also covered the Meeting (Darudova 2015a, 2015b).

Dragonflies of the Republic of Macedonia are still insufficiently studied, although good progress has been made in recent years. In R. Macedonia, only the dragonfly fauna of lakes Dojran, Prespa and Ohrid with their surroundings is better known and reported. The most comprehensive older works include Filevska (1954), Buchholz (1963), Karaman (1969, 1972, 1979, 1981, 1984–85), Peters & Hackethal (1986) and Adamović (1990). Though numerous papers with dragonfly records from the country have been published over the past decade, most of them include small number of records or cover only a small portion of the country (Boshamer et al. 2006, Kitanova et al. 2008, 2013, Micevski et al. 2008, Bedjanič et al. 2008, Melovski et al. 2008, Smiljkov et al. 2008, Jović 2009, Jović & Mihajlova 2009, Zawal et al. 2010, Bedjanič & Vinko 2012, Holuša & Holušova 2012, Holuša & Krivan 2012, Vinko 2012, Krpač et al. 2013, Kovacs & Muranyi 2013). The knowledge on individual species distribution has numerous gaps and is still far from being sufficient, not to mention the lack in the knowledge of group's biology, ecology or nature conservation aspects.

For R. Macedonia, Hristovski et al. (2015) gives a checklist of 64 dragonfly species, where also unpublished records for *Selysiothemis nigra* (Vander Linden 1825) are included (Dinova pers. comm.). Critical review of National list of dragonfly species is in preparation (Dinova & Jović pers. comm.). Protection of the Odonata fauna in R. Macedonia has received little attention and no national Red list exist (Kitanova 2015). In Macedonian language, odonates are called *Vilinski Konjčinja*.

## Materials and methods

Odonates were surveyed between 7 and 15 August 2015. The weather during the study was sunny, mostly with high temperatures up to 40°C and without wind. In general, the weather was very favourable for dragonflies.

Data were collected mainly in the central and southern part of R. Macedonia. The selection of localities was based on the possibility to find the most interesting species, and to present the diversity of species and habitats of the West Balkans and – with it – R. Macedonia. Within R. Macedonia the aim was to cover the least investigated central part of the country. In total, 46 localities were visited (Fig. 1). Both lotic and lentic waters were investigated, as rivers, lakes and their confluences, as well as artificial habitats: fishponds, gravel pits, dams etc. Dragonfly fauna of some sites was investigated for the first time. We used standard odonatological field work methods, including visual observation and determination, catching specimens with a net, photographing etc. We searched for imagines (adults) as well as exuviae at all sites. Imagines were identified on site, without collecting voucher samples. Identification of exuviae was mostly done by the co-authors O. Brauner and M. Olias. Sampling for larvae was done mostly on rivers and streams and only occasionally on lentic waters.



**Fig. 1:** Geographical position of investigated localities during the fifth Balkan Odonatological Meeting (BOOM 2015) in the Republic of Macedonia. The numbers correspond to the list of localities in the Materials and methods section.

During the survey, a special effort was given to confirm the presence of few enigmatic stream-dwelling species for which recent records are lacking and are most probably under-recorded: *Epallage fatime* (Charpentier 1840), *Caliaeschna microstigma* (Schneider 1845), *Cordulegaster heros* Theischinger 1979, *Cordulegaster bidentata* Sélys 1843, *Cordulegaster insignis* Schneider 1845 and *Somatochlora meridionalis* Nielsen 1935.

Abbreviation used: L – site (locality).

#### List of the localities investigated during the 5<sup>th</sup> Balkan Odonatological Meeting (BOOM 2015):

For each locality, geographical coordinates, altitudes and survey dates are given. For localities 28 and 30, only approximate coordinates are given. The localities are arranged in chronological order.

1. Kavadarci, Kavadarci: Student dorm in Kavadarci; 41.44083, 22.02000; 255 m; 7.8.2015.

2. Kavadarci, Moklišta: Moklišta Lake (= hydroaccumulation on Luda Mara River); 41.39167, 22.03778; 290 m; 8.8.2015.
3. Kavadarci, Bojančiče: Done Popov Lake (= Vitačevo Reservoir); 41.264385, 22.055104; 920 m; 8.8.2015.
4. Demir Kapija, Demirkapiska Klisura: stream, a confluence of a stream and Vardar River in Demirkapiska Klisura Gorge; 41.405822, 22.259998; 140 m; 8.8.2015.
5. Demir Kapija, Demirkapiska Klisura: small reservoir at Demirkapiska Klisura Gorge after the tunnels; 41.405621, 22.267166; 110 m; 8.8.2015.
6. Demir Kapija, Demir Kapija: Bošava River; 41.405883, 22.242399; 115 m; 8.8.2015.
7. Demir Kapija, Demirkapiska Klisura: stream flowing into Vardar River, north from Klisura – dry at this survey; 41.402209, 22.295031; 95 m; 8.8.2015.
8. Negotino, Dubrovo: swamp between Staro Dubrovo and Bučeto south-east from Negotino; 41.475293, 22.125612; 165 m; 8.8.2015.
9. Gevgelija, Miletkovo: Petruška Reka River; 41.290452, 22.465181; 90 m; 9.8.2015.
10. Gevgelija, Negorci: Negorski Banji; 41.172987, 22.490815; 65 m; 9.8.2015.
11. Bogdanci, Bogdanci: Luda Mara River between Gorni Bolovan and Dolni Bolovan (flowing into Paljurci Lake); 41.210830, 22.630261; 145 m; 9.8.2015.
12. Dojran, Crničani: Luda Mara River with a dam; 41.236280, 22.636784; 175 m; 9.8.2015.
13. Dojran, Crničani: fishponds east from Crničani; 41.231827, 22.636307; 165 m; 9.8.2015.
14. Dojran, Nikolić: Dojran Lake before the camp; 41.236587, 22.717683; 165 m; 9.8.2015.
15. Dojran, Nov Dojran: Dojran Lake at Marshal Tito street; 41.213776, 22.709282; 155 m; 9.8.2015.
16. Dojran, Nov Dojran: Dojran Lake north from Star Dojran; 41.198551, 22.713842; 155 m; 9.8.2015.
17. Dojran, Crničani: fishpond north from Crničani; 41.242524, 22.656940; 190 m; 9.8.2015.
18. Dojran, Crničani: stream south-east from the fishpond, near Jovanov Izvor Spring; 41.240788, 22.656422; 190 m; 9.8.2015.
19. Valandovo, Valandovo: Anska Reka River at the bridge south-west from Valandovo; 41.304937, 22.541630; 80 m; 9.8.2015.
20. Kavadarci, Raec: Raec River in Drenovska Klisura Gorge; 41.437007, 21.860755; 215 m; 10.8.2015.
21. Kavadarci, Fariš: Raec River south-east from Fariš; 41.440540, 21.822173; 270 m; 10.8.2015.
22. Prilep, Prilep: Prilep Lake (= Prilepsko Ezero Reservoir); 41.389349, 21.600503; 750 m; 10.8.2015.
23. Prilep, Štavica: Bukovdelska Reka River north-east from Štavica; 41.267331, 21.577283; 905 m; 11.8.2015.

24. Prilep, Kalen: Kalenska Reka River – dry at this survey; 41.252428, 21.657105; 585 m; 11.8.2015.
25. Prilep, Manastir: Crna Reka River at Hasinbej Most Bridge; 41.195205, 21.714303; 390 m; 11.8.2015.
26. Prilep, Bešište: Satoka Reka River by the Monastery; 41.116114, 21.804475; 805 m; 11.8.2015.
27. Prilep, Vitolište: Buturica Reka River by the Manastir–Vitolište road; 41.168122, 21.783908; 705 m; 11.8.2015.
28. Rosoman, Raec: Raec River at Drenovska Klisura Gorge (L20) with a streamlet flowing into the river, by the unpaved road; 41.437227, 21.860797; 220 m; 11.8.2015.
29. Prilep, Prilep: Loc Kruša Monastery St. Gjorgji; 41.428672, 21.620085; 1.005 m; 11.8.2015.
30. Prilep, Prilep: Prasad Streamlet (= Crnička Reka River) west from Monastery St. Gjorgji; 41.428336, 21.615867; 925 m; 11.8.2015.
31. Prilep, Belo Pole: Dolneni Fishpond south from the Sarandinovo village; 41.417660, 21.410981; 610 m; 12.8.2015.
32. Prilep, Trojkrsti: Crna Reka River with a confluence of Plivska Reka River; 41.236259, 21.401862; 600 m; 12.8.2015.
33. Bitola, Ribarci: Ribarci Blato Lake (fishpond); 41.019388, 21.466716; 580 m; 12.8.2015.
34. Bitola, Gneotino: channel flowing into Crna Reka River north from Gneotino; 40.99111111, 21.4825; 580 m; 12.8.2015.
35. Bitola, Gneotino: a puddle south-east from Gneotino; 40.963611, 21.512203; 585 m; 12.8.2015.
36. Bitola, Skočivir: Crna Reka River bellow St. Archangel Mihail Church; 40.972065, 21.638586; 570 m; 12.8.2015.
37. Bitola, Skočivir: Strašnica Stream tributary of Crna Reka River north-east from St. Archangel Mihail Church; 40.973887, 21.648867; 570 m; 12.8.2015.
38. Bitola, Žabeni: meadow north from Ribnik bel kamen Fishpond (= Fishpond Žabeni); 40.965306, 21.408269; 580 m; 12.8.2015.
39. Prilep, Belovodica: Belovodičko Lake (= Belovodica Lake) and Bela Reka Stream (inflow forest stream south from the lake); 41.335733, 21.697582; 775 m; 13.8.2015.
40. Prilep, Oreovec: a fishpond with a streamlet north from Oreovec village; 41.391668, 21.634739; 850 m; 13.8.2015.
41. Prilep, Pletvar: Pletvar Lake (gravel pits); 41.372322, 21.633564; 925 m; 13.8.2015.
42. Kičevo, Novo Selo: Sateska River; 41.308266, 20.801262; 775 m; 14.8.2015.
43. Kičevo, Novo Selo: Sini Virovi Swamp (= Belčiško Blato Swamp), north-east from Belčišta; 41.317777, 20.816641; 770 m; 14.8.2015.
44. Kičevo, Novo Selo: Matica Chanel at Sini Virovi Swamp; 41.305499, 20.813822; 765 m; 14.8.2015.
45. Ohrid, Ohrid: nort-east part of Ohrid Lake near St. Erazmo Hospital; 41.135430, 20.759861; 700 m; 14.8.2015.



46. Skopje, Skopje: The Old bazar, fountain in the pub's courtyard in the city centre; 42.000556, 21.435550; 260 m; 15.8.2015.

## Results

During this nine-day survey, the number of observed species comprised more than half of all known dragonfly species in the country. Altogether 336 records for 41 species were collected on 46 investigated sites. Larvae of seven species, exuviae of 25 and imagines of 38 species were identified. Recorded species with localities are presented in Table 1.

The noteworthy results are new records of several nationally rare species – i.e. *C. microstigma*, *Lindenia tetraphylla* (Vander Linden 1825), *C. insignis*, *Somatochlora flavomaculata* (Vander Linden 1825), *S. meridionale*, *Sympetrum vulgatum* (Linnaeus 1758), *Sympetrum flaveolum* (Linnaeus 1758), *S. nigra* – as well as new populations of *C. heros*, species from the EU Habitats Directive (Council Directive 92/43/EEC). Numerous new records of more common species were also collected. For several species with a relatively low number of previously published records for R. Macedonia, our survey adds new localities and extends their known range in the country.

**Table 1.** Checklist of dragonfly species recorded during the 5<sup>th</sup> Balkan Odonatological Meeting (BOOM 2015 – Republic of Macedonia). References for observation sites are given. The locality numbers correspond to the list of localities in the Materials and methods section. Recorded larvae, exuviae and teneral and altitude range where species were detected are also added. If not stated otherwise, data consist of imagines. Species listed in European Red list of Dragonflies (Kalkman et al. 2010) as threatened or near threatened are printed in bold, while species from Annexes of EU Habitat Directive (Council Directive 92/43/EEC) are marked with \*.

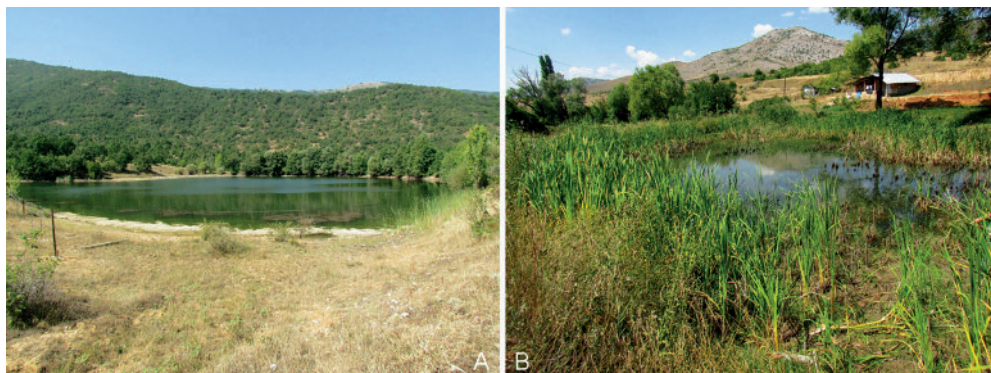
	Species	Locality numbers	Alt. (m)
	LESTIDAE		
1.	<i>Lestes barbarus</i> (Fabricius 1798)	3, 12, 17, 31, 39, 40, 41	180–925
2.	<i>Lestes virens vestalis</i> (Charpentier 1825)	31, 40	610, 860
3.	<i>Chalcolestes parvidens</i> (Artobolevskii 1929)	11, 17, 22, 24 (+ exuvia), 31, 40	145–860
4.	<i>Sympetma fusca</i> (Vander Linden 1820)	29, 33, 35, 39	580–1.005
	CALOPTERYGIDAE		
5.	<i>Calopteryx virgo</i> (Linnaeus 1758)	12, 17, 18, 20, 21, 23, 26, 27, 30, 32 (+ exuviae), 35, 36 (+ larvae), 39, 42, 43	180–930
6.	<i>Calopteryx splendens</i> (Harris 1782)	11, 12, 17, 18 (+ exuvia), 19–21, 24, 25 (+ larva, + exuviae), 27, 32 (+ exuviae), 37	80–705

	PLATYCNEMIDIDAE		
7.	<i>Platycnemis pennipes</i> (Pallas 1771)	2–5, 11–13, 17–21, 23, 24, 25 (+ exuviae), 26–28, 31, 32 (+ exuviae), 33, 36–39, 41	80–925
	COENAGRIONIDAE		
8.	<i>Ischnura elegans</i> (Vander Linden 1820)	2, 3 (+ exuviae), 6, 11–13, 14 (+ tenerals), 15–18, 22, 24, 25 (+ exuviae), 28, 31, 32 (+ exuviae), 33, 34, 37, 39–41, 45	115–925
9.	<i>Ischnura pumilio</i> (Charpentier 1825)	3, 8, 17, 22, 34, 37, 40, 41, 43	165–925
10.	<i>Enallagma cyathigerum</i> (Charpentier 1840)	3 (+ exuvia), 14, 15, 22, 39	155–920
11.	<i>Coenagrion puella</i> (Linnaeus 1758)	43	750
12.	<i>Erythromma lindenii</i> (Sélys 1840)	3, 14, 17, 32 (+ exuvia), 33, 39 (+ exuvia)	165–920
13.	<i>Erythromma viridulum</i> (Charpentier 1840)	3, 14–17, 31, 33, 39, 41	155–925
	AESHNIDAE		
14.	<i>Aeshna affinis</i> Vander Linden 1820	24, 39, 40	590–860
15.	<i>Aeshna mixta</i> Latreille 1805	19 (exuvia), 34 (exuviae), 37 (exuviae), 40 (exuviae)	80–860
16.	<i>Aeshna cyanea</i> (Müller 1764)	26, 30 (exuvia), 39, 40, 43 (+ exuviae)	750–930
17.	<i>Anax imperator</i> Leach 1815	3 (+ exuviae), 13, 15 (exuvia), 31–33, 37, 39, 40 (+ exuviae), 41 (+ exuvia), 44	150–930
18.	<i>Anax parthenope</i> (Sélys 1839)	3 (+ exuvia), 15, 16, 31–33, 39	150–920
19.	<b><i>Caliaeschna microstigma</i> (Schneider 1845)</b>	4, 20 (exuvia), 21 (exuviae), 22 (exuvia), 25 (exuvia), 27 (exuviae), 29, 30 (+ exuviae)	140–1.005
	GOMPHIDAE		
20.	<i>Gomphus vulgatissimus</i> Linnaeus 1758	25 (+ larva, + exuviae), 32 (exuvia), 41 (larvae)	390–925
21.	<i>Onychogomphus forcipatus</i> (Linnaeus 1758)	5–9, 11 (exuvia), 12 (+ exuvia), 20 (+ exuvia), 21 (+ exuvia), 23, 24, 25 (+ larva, exuviae), 27 (+ exuviae), 32 (exuvia), 34, 36, 37, 45 (+ exuvia)	90–905
22.	<b><i>Lindenia tetraphylla</i> (Vander Linden 1825) *</b>	14 (exuviae)	165
	CORDULEGASTRIDAE		



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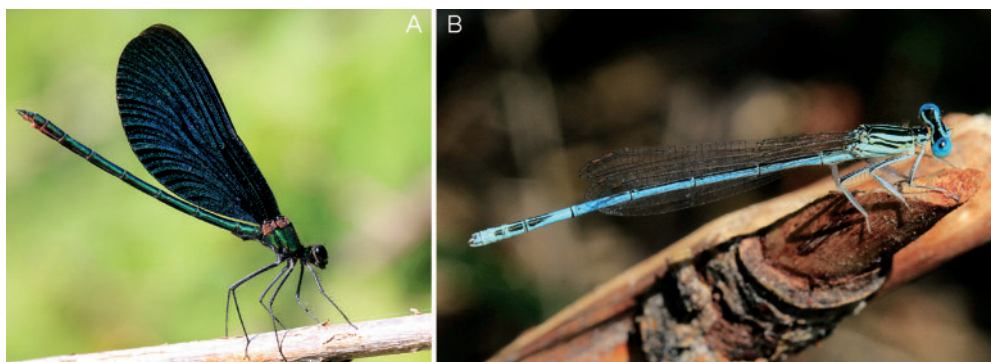
23.	<i>Cordulegaster bidentata</i> Sélys 1843	28, 43	220, 750
24.	<i>Cordulegaster heros</i> Theischinger 1979 *	11, 20, 26 (+ larvae), 36 (larvae), 39 (+ larva)	145–805
25.	<i>Cordulegaster insignis</i> Schneider 1845	28	220
	<i>Cordulegaster</i> sp.	21 (wing)	
	CORDULIIDAE		
26.	<i>Somatochlora flavomaculata</i> (Vander Linden 1825)	43, 44	765, 770
27.	<i>Somatochlora meridionalis</i> Nielsen 1935	22, 39	750, 775
	LIBELLULIDAE		
28.	<i>Libellula depressa</i> Linnaeus 1758	3 (+ exuvia), 5, 24, 37, 43	110–920
29.	<i>Libellula fulva</i> (Müller 1764)	32 (exuvia)	600
30.	<i>Orthetrum albistylum</i> (Sélys 1848)	2, 3, 6, 8, 12–17, 25 (+ larva), 31, 32 (+ exuviae), 33, 34 (exuvia), 37, 39, 41	115–925
31.	<i>Orthetrum brunneum</i> (Fonscolombe 1837)	2, 9, 12, 14, 17, 20, 22–25, 31, 34, 37, 40	90–905
32.	<i>Orthetrum cancellatum</i> (Linnaeus 1758)	3 (+ exuvia), 12–14, 15 (exuviae), 17, 22, 25, 28, 32, 39, 41, 43, 45	155–925
33.	<i>Orthetrum coerulescens</i> (Fabricius 1798)	2, 4, 6, 8–12, 17, 18, 22–24, 28, 31–33, 36, 37	65–905
34.	<i>Sympetrum flaveolum</i> (Linnaeus 1758)	43	750
35.	<i>Sympetrum fonscolombii</i> (Sélys 1840)	1, 2, 3 (+ exuviae), 7–9, 12–14, 15 (exuvia), 17, 21 (+ teneral), 22–24, 28, 31–33, 37, 39–41, 43, 45, 46	90–925
36.	<i>Sympetrum meridionale</i> (Sélys 1841)	2, 16, 31, 40 (+ exuviae)	155–860
37.	<i>Sympetrum sanguineum</i> (Müller 1764)	2, 3, 22, 24, 25, 31, 33, 39–41, 43	290–925
38.	<i>Sympetrum striolatum</i> (Charpentier 1840)	17, 23, 39 (+ teneral), 40 (+ exuviae, + tenerals)	190–905
39.	<i>Sympetrum vulgatum</i> (Linnaeus 1758)	40 (+ exuviae, + teneral)	860
40.	<i>Crocothemis erythraea</i> (Brullé 1832)	3 (+ exuvia), 9, 12–14, 15 (+ exuviae), 16, 17, 22, 25, 31, 33, 39, 41	90–925
41.	<i>Selysiothemis nigra</i> (Vander Linden 1825)	3 (exuvia), 14, 15 (+ exuviae), 16	150–920



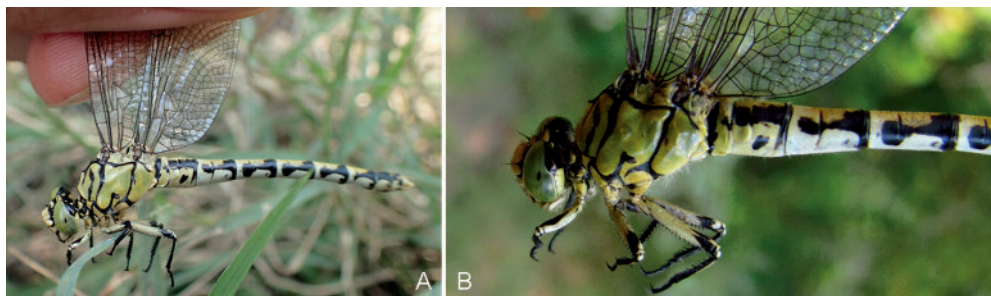
**Fig. 2:** Belovodičko Lake (L39, A) where we observed the most dragonfly species per site (20) and a fishpond north from Oreovec village (L40, B), 13.8.2015 (photo D. Kulijer).

In terms of number of dragonfly species per site, few showed high biodiversity: Belovodičko Lake (L39: 20 spp., Fig. 2A), Done Popov Lake (L3: 16 spp., Fig. 10A), fishponds near Crničani (L17: 16 spp.), Sarandinovo (L31: 15 spp.) and Oreovec (L40: 15 spp., Fig. 2B), confluence of rivers at Trojkrsti (L32: 14 spp.), Dojran Lake (L14–L16: 14 spp., Fig. 5). 12 species were recorded on six sites (L12, L22, L33, L37, L41, L43).

The most frequent species were *Platycnemis pennipes* (Pallas 1771) and *Sympetrum fonscolombii* (Sélys 1840), both found at 26 localities (57 % of all investigated sites) (Tab. 1). On more than a third of all the investigated sites *Ischnura elegans* (Vander Linden 1820), *Orthetrum coerulescens* (Fabricius 1798), *Orthetrum albistylum* (Sélys 1848), *Onychogomphus forcipatus* (Linnaeus 1758), *Calopteryx virgo* (Linnaeus 1758), *Crocothemis erythraea* (Brullé 1832), *Orthetrum brunneum* (Fonscolombe 1837) and *Orthetrum cancellatum* (Linnaeus 1758) were recorded. Six species, i.e. *Coenagrion puella* (Linnaeus 1758), *L. tetraphylla*, *C. insignis*, *Libellula fulva* Müller



**Fig. 3:** *Calopteryx virgo* (A) and *Platycnemis pennipes pennipes* (B) were among the most abundant dragonfly species during this study (photo O. Brauner).



**Fig. 4:** Atypically coloured females of *Onychogomphus forcipatus* at Demir Kapija (L5, A), 8.8.2015, and at Crna Reka River (L25, B), 11.8.2015 (photo D. Vinko, A and D. Kulijer, B).

1764, *S. flaveolum* and *S. vulgatum* were each observed at only one locality. Most abundant species were *Calopteryx splendens* (Harris 1782), *P. pennipes* and *I. elegans* (with more than 1.000 individuals), *O. albistylum* and *S. fonscolombii* (more than 500 individuals), and with more than 200 individuals *C. virgo* (Fig. 3A), *Ischnura pumilio* (Charpentier 1825), *Erythromma viridulum* (Charpentier 1840), *O. forcipatus*, *O. coerulescens* and *C. erythraea*.

Majority of species recorded on at least two sites (29) were discovered at various altitudes, from approximate 100 m to 950 m (Tab. 1). For other six species recorded on at least two sites altitudinal range was narrower, i.e. *Aeshna cyanea* (Müller 1764) from 750 m to 930 m, *Sympecma fusca* (Vander Linden 1820) from 580 m to 1.005 m above sea level.

All hand checked *P. pennipes* individuals belonged to subspecies *pennipes* (Fig. 3B).

On some of the 19 sites with *O. coerulescens* presence, males were checked for subspecies determination. All showed tendency towards the subspecies *anceps*. Intermediate phenotypes that are closer to the ssp. *anceps* were also encountered. Individual males and females with fully pruinose abdomen and thorax were also recorded.

Some really greenish and dark *O. forcipatus* females were observed on several sites (Fig. 4).

Next to dragonflies also some other interesting animal species were observed during the Meeting. Among them are first findings of two invasive insect species for R. Macedonia reported separately by Kulijer (2016), western conifer seed bug (*Leptoglossus occidentalis* Heidemann, 1910) and harlequin ladybird (*Harmonia axyridis* (Pallas 1773)). Three species listed on the European Habitats Directive (Council Directive 92/43/EEC) were also recorded. European pond turtle (*Emys orbicularis* (Linnaeus 1758), Ann. II, IV) adults were observed at Done Popov Lake (L3), while on the road near Bitola the Greek tortoise (*Testudo hermanni boettgeri* Bour 1987, Ann. II, IV) was seen. At Nov Dojran area (L15–L17) and at Ribarci Blato Lake (L33) the Hungarian leech (*Hirudo verbana* Carena 1820, Ann. V) was caught.

## Discussion

Considering the number of collected records (336) and the number of surveyed localities (46) we conclude the 5<sup>th</sup> BOOM was successful. Even though our results do not contribute any additional dragonfly species for the country, except for the first written documented report of *S. nigra*, these records represent a valuable contribution to the knowledge of the distribution of many species of dragonflies in the R. Macedonia.

As a consequence of short or early flight period, some of the species were either missed or under-recorded, i.e. *C. puella*, which is a widespread species in R. Macedonia (Boudot & Kalkman 2015), while during BOOM was found only at one site (Tab. 1).

Except of *E. fatime*, all enigmatic stream-dwelling species in the focus of our Meeting mentioned in Materials and methods section were detected. Lack of *E. fatime* during this survey is most probably due to incorrect selection of sampling sites with unsuitable habitats for the species, while some other sites where the species was previously confirmed (Bedjanič & Vinko 2012) were desiccated during our survey. Four reports of this species for R. Macedonia exist (Bilek 1966, Karaman 1979, 1981, Bedjanič & Vinko 2012).

### Notes on selected species

Based on published records some of the less common or rare species in R. Macedonia were selected and a brief discussion in the contexts of their regional distribution is given:

***Chalcolestes parvidens* (Artobolevskii 1929)** – We recorded the species at six sites in southern and central part of the country, at altitudes from 145 m to 805 m above sea level. At dry Lisička Reka River (L24) also exuvia was found. Except for Prilep Lake (L22) and Dolneni Fishpond (L31) only individual specimens were seen. The distribution of closely related *Chalcolestes viridis* (Vander Linden 1825) and *C. parvidens* in R. Macedonia is still insufficiently known. As the range of both species overlaps in R. Macedonia (Jović & Mihajlova 2009), it is interesting to have more precise data on the local distribution of both species. Until now *C. parvidens* was reported only from Skopje area (Jović & Mihajlova 2009). As the species is probably widespread in the country, only lack of survey is the reason for the single record. Older data from R. Macedonia consist of only *C. viridis* (Buchholz 1963, Karaman 1972, 1981), which was not detected during our survey. As we visited some known sites of *C. viridis* and found only *C. parvidens* individuals, a review of the material, if present, is needed as the presence of both species on same sites is possible.

***Caliaeschna microstigma* (Schneider 1845)** – During our survey, streams and rivers were investigated thoroughly, also for larvae and exuviae. Therefore, presence of *C. microstigma* at eight sites is not surprising, considering known distribution of

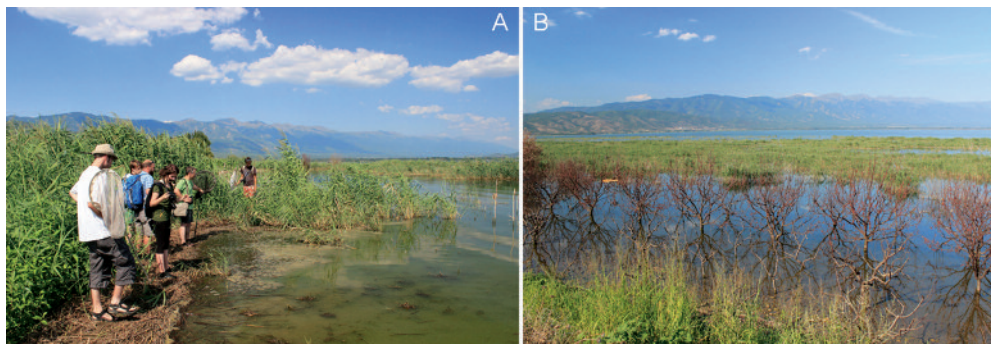


the species. The species was observed during the Meeting even away from water, a male was passing by near Monastery St. Gjorgji (L29). Most probably the specimen originated at a small stream west to south-west from Monastery (L30), where two exuviae were recorded, together with exuvia of *A. cyanea* and five *C. virgo* males. Exuviae of *C. microstigma* were also recorded at Raec River (L20: 1, L21: 2, Fig. 11), Crna Reka River (L25: 1), Buturica River (L27: 4) and Prilep Lake (L22: 1). All these sites were visited in the afternoon. Imagines were observed at a stream in Demirkapiska Klisura Gorge (L4), already a known site for the species (Vinko 2012). A permanent population probably occupies the site; therefore, we propose to conduct investigations for larvae and exuviae so the stability of the population can be confirmed. The species was at Raec River during the ECOO post congress tour in 2012 (Kitanova et al. 2013) also recorded (Dinova pers. comm.), so we presume the Raec River supports a stable population of *C. microstigma*.

The European range of *C. microstigma* is restricted to Cyprus, the Aegean Islands and the Balkan Peninsula. Its northern limit runs from north Bulgaria to south-west Croatia (Kalkman & Jović 2015). As the species is not confirmed from Serbia with voucher specimen (Jović 2013), its northern border runs through R. Macedonia (Boudot et al. 2009), where the species was confirmed at several sites (Buchholz 1963, Peters & Hackethal 1986, Adamović 1990, Bedjanič & Bogdanović 2006, Bedjanič et al. 2008, Vinko 2012, Kovacs & Muranyi 2013, Kalkman & Jović 2015). It develops in cold and swift well-oxygenated streams and small rivers with stony, pebble or gravel substrate where at least part of the water is shaded and where pools of calm water provide refuges for the larvae (Breuer & Douma-Petridou 2000, Kovacs & Muranyi 2013). Specimens (including exuviae) during the BOOM were found at a wide altitudinal range, up to approximately 1.000 m (Tab. 1), which is not the most characteristic for *C. microstigma* (Kalkman & Jović 2015). The species occurs mainly in hilly or mountainous regions but most European populations are found below 500 m (Kalkman & Jović 2015).

***Lindenia tetraphylla* (Vander Linden 1825)** – Four exuviae of this species from Annexes II and IV of the EU Habitats Directive (Council Directive 92/43/EEC) had been recorded at Dojran Lake. First published record for the species from R. Macedonia is given by Karaman (1969). Several papers confirm the lasting presence of *L. tetraphylla* at Dojran Lake (Karaman 1981, Peters & Hackethal 1986, Jović & Mihajlova 2009), where a large population is already long known (Bedjanič & Bogdanović 2006). Other known localities from R. Macedonia are from Skopje area, reservoir near Bogdanci, Mavrovo National Park and Mladost Lake near Veles (Peters & Hackethal 1986, Jović & Mihajlova 2009, Krpač et al. 2013, Kitanova et al. 2013). At BOOM, exuviae were found at not easily accessible extensive reed at north-western part of the lake (L14; Fig. 5A), but no imagines were seen. As strong permanent populations of *L. tetraphylla* are rare in Europe (Boudot & Kalkman 2015, Dijkstra 2006), this site is at least regionally very important for conservation of the species.

***Cordulegaster heros* Theischinger 1979** – Another species from Annexes II and IV of the EU Habitats Directive (Council Directive 92/43/EEC) was recorded at five

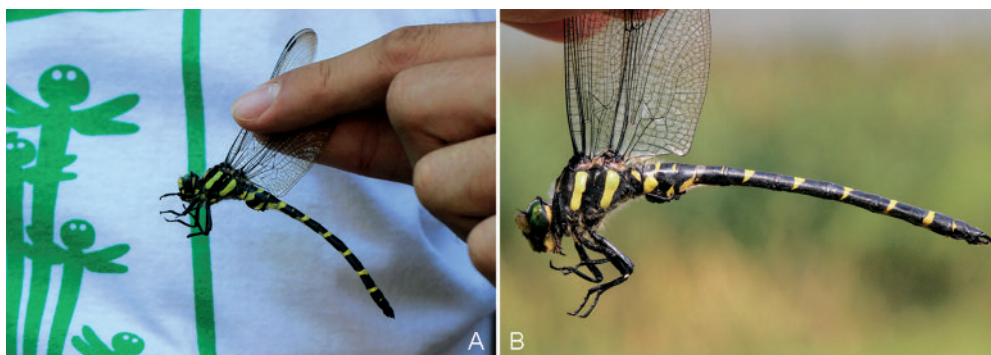


**Fig. 5:** Two parts of Dojran Lake: north-western (L14, A), where *Lindenia tetraphylla* exuviae were recorded, and western (L15, B), where reproduction of *Selysiothemis nigra* was confirmed, 9.8.2015 (photo O. Brauner).

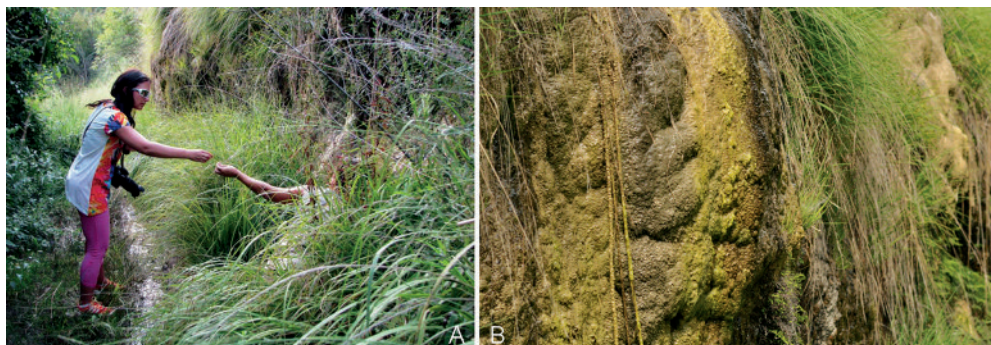
sites in both investigated parts of the country, with altitudes from 145 m to 805 m above sea level. Larvae of *C. heros* were recorded at Crna Reka River (L36) and Satoka Reka River (L26) rivers and at an inflow of Belovodičko Lake (L39). Adult male was recorded at a stream flowing into Paljurci Lake (L11) and together with *C. microstigma* at Raec River (L20, Fig. 11A). All sites correspond to species requirements.

*Cordulegaster heros* (Fig. 6A) extends from central to south-east Europe throughout the Balkan Peninsula (Boudot & Kalkman 2015), so new data in R. Macedonia on species distribution is expected as its preferred habitat is present throughout most parts of the country. The species is typical for lower altitudes (Holuša & Krivan 2012) and extends to suitable habitats in the Macedonian lowlands (Bedjanič et al. 2008, Jović 2009, Jović & Mihajlova 2009). Therefore, gaps in its range throughout R. Macedonia are caused by lack of surveys in the country.

***Cordulegaster bidentata* Sélys 1843** – This most wide-ranging endemic dragonfly species to Europe was during our survey recorded at two sites, with one



**Fig. 6:** Side views of *Cordulegaster heros* (A) and *C. bidentata* (B) (photo O. Brauner).



**Fig. 7:** Locality at Drenovska Klisura Gorge (L28, A) where *Cordulegaster insignis* and *C. bidentata* were recorded, 11.8.2015, with the breeding habitat of *C. insignis* at the same site (B) – petrifying spring with tufa formation, 23.6.2013 (photo D. Kolčakovski, A and D. Dinova, B).

male at each (Fig. 6B). While Raec River (L28) at 220 m above sea level seems suitable habitat for the species, its presence at Sini Virovi Swamp (L43) was less expected. Although at Sini Virovi Swamp at 750 m above sea level, few springs and shorter streams suitable for the species are present. The species was already confirmed for Ohrid area (Boshamer et al. 2006, Bedjanić et al. 2008), as well as for other regions throughout the country (Peters & Hackethal 1986, Adamović 1990, Jović & Mihajlova 2009). According to Peters & Hackethal (1986) *C. bidentata* is supposed to be widespread in more hilly, colder areas of the country. It is thus sparsely present in R. Macedonia, limited mostly to the high mountains (Jović & Mihajlova 2009).

***Cordulegaster insignis* Schneider 1845** – We recorded another *Cordulegaster* species from the *bidentata* group. At the streamlet flowing into Raec River next to the unpaved road by the river at 220 m above sea level (L28, Fig. 7) a dead male was found, together with foraging *C. bidentata* male. From the site, *C. insignis* was already known (Kitanova et al. 2013). The habitat is petrifying spring with tufa formation (Cratoneurion), overgrown with grassy vegetation (Fig. 7B). Up to now, only two sites for this species in R. Macedonia are known (Kitanova et al. 2013).

Distribution of *C. insignis* is restricted to small portion of far south-east Europe and continues to south-west Asia (Kulijer & Boudot 2013). In the European part of its range is generally uncommon and is considered as one of the rarer species of dragonflies in Europe (Boudot et al. 2015). According to Dijkstra (2006) and Holuša & Krivan (2012) *C. insignis* is confined to small and shallow shaded streams and springs with rocky pools and sand beds in cultivated landscape and in forest complexes with rich stands of vegetation, but occasionally inhabits larger and deeper waters. It has only rarely been observed in still waters (Boudot et al. 2015). The habitat requirements of this species are similar to those of *C. bidentata*, but *C. insignis* tends to occupy them at lower and warmer altitudes (Holuša & Krivan 2012).



***Somatochlora flavomaculata* (Vander Linden 1825)** – The southern border of this species' European range runs over south-west France, north Italy, Austria, Slovenia and Hungary (Bedjanič et al. 2008). Further to the south, only scattered populations are known from southern Italy and the Balkans and there is a lack of recent data from most of the Balkan Peninsula countries (Boudot & Kalkman 2015). Situation in R. Macedonia is similar, where after 1990 *S. flavomaculata* is reported only from few sites in north-western, north-eastern and south-eastern parts of the country (Boudot & Kalkman 2015, Vinko 2012).

Our records originate from the same area (south-west R. Macedonia) as the first record of this species for the country which was based on a specimen collected near Struga in 1925 (Bedjanič et al. 2008). Recent presence of *S. flavomaculata* is confirmed also for Mavrovo National Park (Dinova pers. comm.). We observed few males at Sini Virovi Swamp (L43: 1, L44: 3), where another also rare species for R. Macedonia, *Sympetrum flaveolum* was spotted. Both sites in Sini Virovi Swamp (also known as Belčiško Blato Swamp) are typical for *S. flavomaculata*. This unique and rare habitat for R. Macedonia is similar with that in NP Mavrovo – a stream with associated wet meadows, peat bogs and marshy areas where willow and alder woodlands are present (Melovski & Matevski 2008).

***Somatochlora meridionalis* Nielsen 1935** – The species is nearly endemic to Europe (Dijkstra 2006). Its main range extends over most of south-east Europe, with



**Fig. 8:** *Somatochlora meridionalis* male found at the inflow of the Belovodičko Lake (L39), 13.8.2015 (photo O. Brauner).

high densities of populations known from Slovenia to Montenegro, in Bulgaria and the European part of Turkey (Boudot & Kalkman 2015). In Hungary, Romania, Serbia, Albania, Greece and in R. Macedonia the species has a more scattered occurrence (Boudot & Kalkman 2015). Although it typically breeds in streams and brooks (Dijkstra 2006), a single female along Prilep Lake (L22) and a male specimen at Belovodičko Lake (L39, Fig. 2A) (both central R. Macedonia) were found patrolling along completely stagnant water. Other characteristics of the water body (at least partly shaded, devoid of aquatic vegetation, muddy bottom, shaded inflow) seem to match the requirements of *S. meridionalis*. Additional male (Fig. 8) was caught at a forest stream south from Belovodičko Lake (an inflow of the lake), together with *C. heros* female and two *A. cyanea* males. Both mentioned sites are situated at around 750 m above sea level, which is not characteristic for the species, but was already recorded (Marinov 2007). Previously, *S. meridionalis* was known from south-east and south-west R. Macedonia (Peters & Hackethal 1986, Adamović 1990, Boshamer et al. 2006), therein our data from the central part of the country shows the species is most probably widespread throughout the country.

***Sympetrum vulgatum* (Linnaeus 1758)** – As one of the least common *Sympetrum* species in the Balkan Peninsula (Boudot et al. 2009), *S. vulgatum* is considered rare also in R. Macedonia (Bedjanič & Bogdanović 2006). In south of its range, its distribution is restricted to higher elevations (Kalkman et al. 2015), as was confirmed also in our survey. Previously, the species was for R. Macedonia reported from Prespa Lake area (Karaman 1979, 1984–85). The species is also present in north-east and north-west Greece near the border with R. Macedonia (Lopau 2010, Kalkman et al. 2015).

At the fishpond with a streamlet in the central part of the country near Oreovec at 850 m above sea level (L40, Fig. 2B) two *S. vulgatum* exuviae and five males were recorded, representing a new population of this species for the country. From the locality, we report *S. vulgatum* together with three *S. fonscolombii* males and more than 15 imagines of both sexes of *Sympetrum meridionale* (Sélys 1841), *Sympetrum sanguineum* (Müller 1764), *Sympetrum striolatum* (Charpentier 1840) each. For *S. meridionale* and *S. striolatum* more than 20 exuviae each were collected.

***Selysiothemis nigra* (Vander Linden 1825)** – Our records of adults and exuviae for this species (Fig. 9) at Dojran Lake (L14–L16) and at Done Popov Lake (L3) are thus far the first documented report for *S. nigra* for R. Macedonia. All prior literature either did not contain any data on *S. nigra* for the country, were too vague in the general statements of species' distribution as Macedonia (not clear if they pertained to the country or to the folk region on the Balkans) or did not specify any particular location. Consequently for R. Macedonia there are no available published records of *S. nigra*. Karaman (1979) lists the species for the country, although it was not detected during her intensive work and also no reference is given. Beschovski (1994) also mentions *S. nigra* for R. Macedonia, this data was later recalled by Beschovski (Marinov pers. comm.) in Beschovski & Marinov (2007). However, Beschovski & Gashtarov



**Fig. 9:** *Selysiotthemis nigra* female at Dojran Lake (L14), 9.8.2015 (photo J.-J. Mekkes).

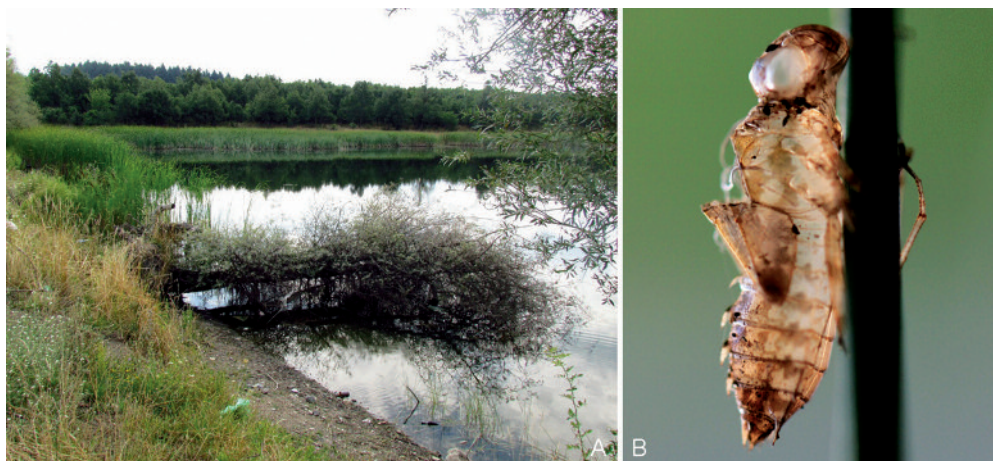
(1997) conclude cited literature in previous publications referred “Macedonia” exclusively to the northern province of Greece and not to R. Macedonia within the nowadays borders. Surprisingly, Beschovski later on again included *S. nigra* for R. Macedonia (Beschovski & Marinov 2007). As the species is reported from south-west Bulgaria near the town of Melnik (Beschovski & Gashtarov 1997) and north-east Greece (Boudot et al. 2009), species’ presence in R. Macedonia is not at all surprising. In Greece, the species was also observed in vicinity of the border with R. Macedonia at Ardzan Lake near Dragomir in the province of Kilis (Campion 1919) and at several other sites in northern part of the country (Campion 1918, 1921, Lopau 2010). Peters & Hackethal (1986) already predicted *S. nigra* as a species most probably found at Dojran Lake in the future. Previous to our survey, *S. nigra* was already recorded at Dojran Lake and in the lower Vardar River valley (Dinova & Jović pers. comm.), only no report is given.

*Selysiotthemis nigra* is distributed throughout most of the Mediterranean Basin, but scattered (Boudot et al. 2009), although from Europe generally comparatively little information on the species’ ecology with regards to larval habitats and life cycle is available (Uboni et al. 2015). Records from north-east Italy from artificial lakes approximately 40 km inland represent the northernmost evidence worldwide of species’ breeding (Uboni et al. 2015). In the Balkan Peninsula, it is mostly confined to the Adriatic and Mediterranean coasts, where presumably the main hotspots for the species in Europe exist (Kalkman & Bogdanovic 2015). Most records of *S. nigra* are from shallow ponds and lakes, also from brackish habitats (Kalkman

& Bogdanovic 2015), while some records from Italy indicate that the species is able to reproduce also at perennial and deep man-made water bodies (Uboni et al. 2015) and concrete water tanks (Kalkman & Bogdanovic 2015). While the species typical for the coastal areas can be occasionally highly nomadic (Boudot et al. 2009), it was not presumed to be found further inland (Dijkstra 2006). Although in Europe adult individuals are reported far from the coast and even far from the water, but without a proof of its reproduction (Kulijer et al. 2012, De Knijf et al. 2013, Kalkman & Bogdanovic 2015).

During the BOOM, both adults and exuviae were recorded. Three sites are located at one of the largest lakes in the country Dojran Lake, approximately 60 km inland at 160 m above sea level. At western side of the lake three exuviae and a male were discovered south from Nov Dojran (L15, Fig. 5B) and a male near Star Dojran (L16). On the north to north-western side of the lake (L14, Fig. 5A) more than 80 adults of both sexes were flying by the water and at adjacent grasslands, shrubs and farmlands. Females were more abundant near the lakebed, while males at reed. Juveniles of both sexes were also present in lake's vicinity.

Approximately 110 km inland at 920 m above sea level at finely vegetated shallow reservoir in Vitačevo *S. nigra* exuvia was observed (Fig. 10). Done Popov Lake is surrounded by forest, aquatic vegetation is rich, no inflow is present. A total of 16 dragonfly species were recorded on the site: *Lestes barbarus* (Fabricius 1798), *P. pennipes*, *Erythromma lindenii* (Sélys 1840), *E. viridulum*, *S. sanguineum* together with *Enallagma cyathigerum* (Charpentier 1840), *I. elegans*, *I. pumilio*, *Anax imperator* Leach, 1815, *Anax parthenope* (Sélys 1839), *Libellula depressa* Linnaeus 1758, *O. albistylum*, *O. cancellatum*, *S. fonscolombii*, *C. erythraea* and *S. nigra*, for all of them also their reproduction was confirmed.



**Fig. 10:** Done Popov Lake (L3, A) where *Selysiothemis nigra* exuvia (B) was recorded together with 15 other dragonfly species, 8.8.2015 (photo D. Kulijer, A and O. Brauner, B).



## Conservation perspective

Among recorded species *C. microstigma*, *C. heros* and *C. bidentata* are included in the European Red List of Dragonflies (Kalkman et al. 2010) as near threatened (NT) species, *L. tetraphylla* as vulnerable (VU) and *C. insignis* as endangered (EN). In the Mediterranean Red list (Boudot et al. 2009) *C. microstigma*, *L. tetraphylla*, *C. bidentata*, *C. insignis*, *S. vulgatum* are listed as near threatened species and *C. heros* as vulnerable. Two species, *L. tetraphylla* and *C. heros*, are protected by the European Habitats Directive (Council Directive 92/43/EEC).

Additionally, several recorded species, i.e. *C. parvidens*, *A. cyanea*, *C. microstigma*, *C. insignis*, *S. flavomaculata*, *S. meridionalis*, *S. flaveolum*, *S. vulgatum* and *S. nigra*, are rare or have restricted distribution in R. Macedonia (Boudot & Kalkman 2015).

Raec River in Drenovska Klisura Gorge (L20, L28, Fig. 7, 11A) proved to be very interesting site considering the diversity of dragonfly fauna. The area is a narrow, semi-deep, canyon-type creek valley in limestone bedrock. The substrate of the riverbed is made up of a mixture of mud, gravel and leaf litter with dead twigs, with stones and submerged moss also present. Irregularly small pools with slower water flow occur. The river is partly shaded, with well insulated larger sections. When at least one side of the riverbed is covered with trees, the other is covered with well-developed aquatic vegetation, herbs and shrubs. 13 species of dragonflies were discovered there; both *Calopteryx* spp., *I. elegans*, *P. pennipes*, *O. forcipatus*, three *Orthetrum* spp. and *S. fonscolombii*. Most interesting is the finding of *C. microstigma* and all three in the survey recorded *Cordulegaster* spp. Exuviae were recovered only of *C. microstigma*, no larvae were sampled. Even though *C. microstigma* and *Cordulegaster* spp. have similar habitat requirements they generally tend to occupy different sites, at different altitudes. As stated in previous section, *C. heros* is typical for lower altitudes, *C. insignis* tends to occupy sites at lower and warmer altitudes, while *C. bidentata* prefers higher elevations and colder habitats. *Caliaeschna microstigma* is present in various altitudes, but prefers colder waters. Habitat of the Raec River about 5 km downstream (L21, Fig. 11B) changes. It has a wider riverbed, more rocks (also bigger) are present in the substrate, water flow is faster, water is shallower. The presence of *C. microstigma* and one *Cordulegaster* sp. (recovered one wing) was confirmed at this site. Drenovska Klisura Gorge is proclaimed as a Natural Monument on a national level (Category III according to IUCN classification) and dragonfly fauna present in the area should be taken as priority when considering development management measures in the future.

Beside the sites with the presence of species of European concern also several other sites are interesting when considering conservation of aquatic habitats and dragonfly species.

Belčiško Blato Swamp (L43, L44) has a higher diversity (12 spp.) and host some rare dragonfly species in the Balkans such as *S. flavomaculata*, *C. bidentata*, *S. flaveolum*. The swamp has a suitable habitat which can support a stable dragonfly populations, especially for rare *S. flavomaculata*. Belčiško Blato Swamp is proposed as a Natural Monument on a national level (Melovski et al. 2011). The relict wetland communities that are present there are preserved in a fragmentary state (only seven



**Fig. 11:** Raec River in Drenovska Klisura Gorge (A: L20, B: L21), where three *Cordulegaster* species and *Caliaeschna microstigma* were recorded, 10.8.2015 (photo D. Kulijer).

smaller marshes still exist) and their flora and fauna species are of the most endangered (Fifth... 2014). Recommendation was made to designate Belčiško Blato Swamp for protected area under special management regime, so appropriate management measures for protection of dragonfly community and habitats should be developed and included in the management plan for this area.

The site with the most recorded species, Belovodičko Lake (L39, Fig. 2A) beside *C. heros* hosts *E. lindenii*, *S. meridionalis*, *A. parthenope*, *Aeshna affinis* Vander Linden 1820 and *A. cyanea*.

Altogether for fishpond north from Crnićani (L17) 18 species are reported by this study and by Vinko (2012, pers. comm.): *S. fusca*, *P. pennipes*, *E. cyathigerum*, *I. elegans*, *I. pumilio*, *Aeshna isocoles* (Müller 1767), *Aeshna mixta* Latreille 1805, *A. cyanea*, *Anax ephippiger* (Burmeister 1839), *A. imperator*, *A. parthenope*, *C. erythraea*, *L. depressa*, *O. albistylum*, *O. cancellatum*, *S. fonscolombii*, *S. sanguineum*, *S. striolatum*. From latter, *A. ephippiger* was not recorded during our survey.

Together with diverse fishpond near Oreovec (L40, Fig. 2B) sites mentioned in this section have to be taken in consideration as the sites of at least wider regional importance for conservation of odonates.

## Conclusions

The faunistic results of the BOOM 2015 present a significant improvement in the knowledge of the dragonfly fauna of R. Macedonia. They confirm the importance of the BOOM for the odonatological research in the Balkans, in addition to educational role and cooperation of odonatologists from Balkan countries.

In many aspects, R. Macedonia is still an uncharted territory and certainly holds many important new discoveries. We hope that our manuscript will contribute to more systematic research of dragonflies in R. Macedonia and hopefully also to the conservation of its rich flora and fauna.

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