New data and the overview of dragonfly fauna (Insecta: Odonata) of Nevesinjsko polje

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Abstract: This paper provides the first overview of the dragonfly fauna of Nevesinjsko polje – one of the largest karst poljes in Bosnia and Herzegovina – and two small adjacent poljes, Lukavačko and Slato. Field surveys undertaken from 2012 to 2020 resulted in 40 species being recorded (63% of all Odonata fauna species recorded in the country). Of these, 12 species are reported for the first time for the study area. The most significant is the first record of *Coenagrion ornatum* (Selys, 1850), a species of European conservation concern, upon Nevesinjsko polje. The collected data represents an important contribution to the knowledge of the dragonfly fauna of karst poljes, which themselves represent biodiversity hotspots of the Dinaric Karst region.

Key words: Bosnia and Herzegovina, *Coenagrion ornatum*, distribution, karst poljes

INTRODUCTION

The Dinaric karst region that extends from Italy, over a large part of Slovenia, Croatia, Bosnia and Herzegovina, and Montenegro, and ending in Kosovo and northern Albania, is characterized by a high diversity of geomorphological, hydrological and ecological karstic phenomena (Bonacci, 1987; Mihevc et al., 2010; Redžić et al., 2011; Sket, 2012; Zupan Hajna, 2019). Within this area, karst poljes are one the most characteristic hydro-geomorphic phenomena. They are large depressions characterized by a flat floor, surrounded by steep slopes and covered with deposition that allows surface runoff (Gams, 1978; Prohić et al., 1998). Many of the poljes are oases in dry karstic landscapes, each with their own hydrological system, seasonal floodings, and watercourses that flow only within the poljes themselves, disappearing underground at their margins (Redžić et al., 2008; Bonacci, 2013). Of more than 130 poljes that exist in the Dinaric Alps, 57 are situated within Bosnia and Herzegovina (Sackl et al., 2014), including some of the largest and best-preserved ones (Redžić et al., 2008; Milanović, 2017). They are distributed from sea level up to 1,200 m AMSL (Stumberger et al., 2014).

Karst poljes are also habitats of international biodiversity value, and part of the so-called 'Mediterranean Basin biodiversity hotspot', characterized by a high variety of freshwater habitats, including wetlands, peat bogs, permanent and temporary lakes, ponds, rivers, streams and underground waterflows (Redžić et al., 2008; Sackl et al., 2014; Milanović, 2017). The biodiversity of karst poljes in Bosnia and Herzegovina has been the subject of many studies (e.g. Ritter-Studnička, 1974; Francuski et al., 2019; Matočec et al., 2019) attesting to these habitats being biodiversity hotspots for the region (e.g. Sket, 2012; Sackl et al., 2014; Reier et al., 2022; Delić et al., 2023). However, the biodiversity and ecological importance of many still remains insufficiently known (Stumberger et al., 2014).

For a long time, dragonfly fauna of Bosnia and Herzegovina remained only scarcely studied, but in the past 15 years the knowledge of Odonata in the country has been significantly improved, with many new studies resulting in important data and new records of species for the country (e.g. Jović et al., 2010; Bedjanič, 2011; Kulijer, 2012, 2014, 2015a, 2015b, 2017; Kulijer et al., 2012, 2013, 2016; Kulijer & Topić, 2013; Kulijer & Miljević, 2015). Currently, 64 Odonata species are known for Bosnia and Herzegovina (Kulijer & Miljević, 2015), and the most comprehensive overview of the country's dragonfly fauna has been provided by Kulijer et al. (2013).

Although numerous papers on dragonflies from karst waters in the Dinaric region have been published in recent years, many of these have focused on lotic waters (e.g. Pešić et al., 2017; Vilenica, 2017; Vilenica et al., 2022a, 2022b), while dragonfly studies that explore poljes as a whole, i.e. including the entire complex of habitats that occur in them, are few and far between (see, for example, Kulijer, 2012, 2013). A number of studies have confirmed the importance of karst poljes as important habitats for dragonflies in Bosnia and Herzegovina, including several species which are threatened or protected in Europe *Coenagrion ornatum* (Sélys, 1850), *Lindenia tetraphylla* (Vander Linden, 1825) and *Cordulegaster heros* Theischinger, 1979 (Kulijer, 2012, 2013, 2014, 2015b; Vilenica et al., 2021). However, the dragonfly fauna of these habitats is still scarcely known, and only a limited number of poljes in Bosnia and Herzegovina have been systematically investigated (Livanjsko polje, Hutovo blato, Ljubuško polje), with detailed data having only been published for Livanjsko polje (Kulijer, 2012, 2013, 2015b). The first data on dragonfly fauna of Nevesinjsko polje was published only recently. This was collected via several nationwide dragonfly field studies, particularly within the scope of the Balkan Odonatological Meeting (Jović et al., 2010; Kulijer et al., 2016; Tratnik et al., 2020).

The aim of this study was to compile all available data and to present the first overview of the dragonfly fauna of Nevesinjsko polje, one of the largest high-altitude karst poljes in Bosnia and Herzegovina.

MATERIALS AND METHODS

STUDY AREA

The study area is located in the north-eastern part of the Herzegovina region of Bosnia and Herzegovina (Fig. 1). In addition to Nevesinjsko polje (77.53 km^2), it also includes two small poljes to the southeast that are closely connected to Nevesinjsko polje – Lukavačko (3.3 km^2) and Slato (4.1 km^2) – as well as the hilly area that surrounds these poljes. Nevesinjsko polje is one of the largest periodically flooded karst poljes in Bosnia and Herzegovina, and is situated at an altitude of approximately 850 m AMSL. The northern part of the polje is under the strong influence of the mountain climate from the nearby high mountains of Velež, Prenj and Crvanj (Redžić et al., 2008; Stumberger et al., 2014). Administratively, the whole area belongs to the Republika Srpska entity.

DATA COLLECTION

The data was collected sporadically from a wide range of habitats (Fig. 2) during field excursions conducted between 2012 and 2020 (Tab. 1 & 2). It was previously partially published within the results of the Balkan Odonatological Meetings held in 2014 & 2020 (Kulijer et al., 2016; Tratnik et al.,

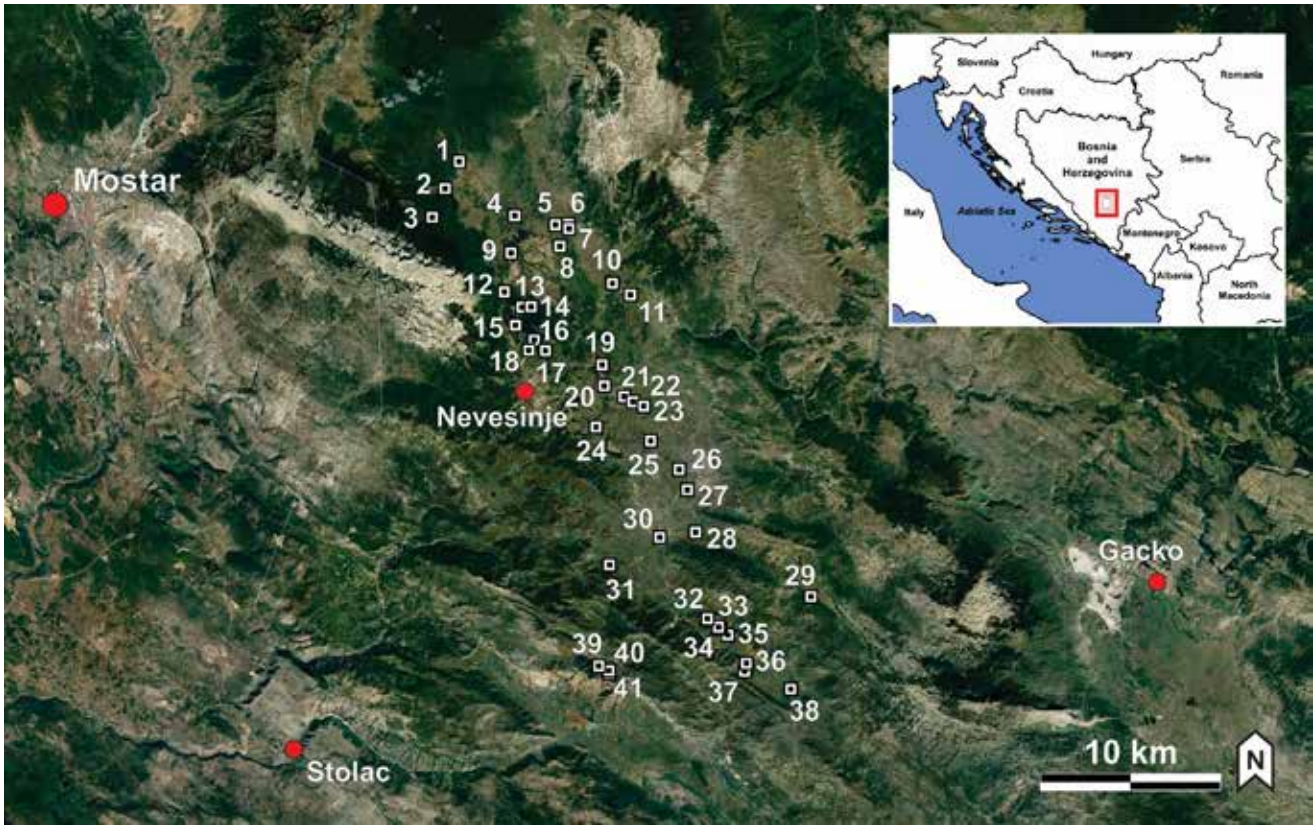

Figure 1. Geographical position of the Nevesinjsko polje study area and locations with dragonfly records.

2020). The study also incorporates the data collected within the International Biology Camp "Rujište 2017", the diploma thesis of Radenka Đurasović, as well as several other publications (Jović et al., 2010; Kulijer, 2015a), as well as data from the entomological collections of the National Museum of Bosnia and Herzegovina.

The data was mainly collected from adult specimens that were visually observed or caught with a hand net and identified in the field. Several voucher specimens were collected and deposited in the entomological collections of the National Museum of Bosnia and Herzegovina and the private collection of R. Đurasović. Larvae and exuviae were sampled sporadically, and identified in the laboratory afterwards.

RESULTS

A total of 293 records of 40 species were collected from 41 sites (Fig. 1, Tab. 1). This includes 181 unpublished records of 37 species, out of which 12 species are reported for the first time for the area. These are: *Calopteryx splendens* (Harris, 1780), *Calopteryx virgo* (Linnaeus, 1758), *Lestes barbarus* (Fabricius, 1798), *Coenagrion ornatum* (Selys 1850), *Ischnura pumilio* (Charpentier, 1825), *Aeshna isoceles* (Müller, 1767), *Aeshna mixta* Latreille, 1805, *Anax parthenope* (Selys, 1839), *Brachytron pratense* (Müller, 1764), *Cordulia aenea* (Linnaeus, 1758), *Libellula fulva* (Müller, 1764) and *Orthetrum brunneum* (Fonscolombe, 1837).

The oldest data on dragonflies of Nevesinjsko polje is to be found in the entomological collection of Viktor Apfelbeck, a small but historically significant dragonfly collection housed at the National Museum of Bosnia and Herzegovina (Kulijer & Marinov, 2010; Kulijer & Boudot, 2013; Kulijer et al., 2013). Three species from this region, *S. fusca*, *S. flaveolum* and *S. striolatum*, were found in the collection. The last two were collected in 1890, and represent the oldest known specimens from this area, and are among the oldest from Bosnia and Herzegovina in general. The list of all recorded species with locality numbers where they were recorded is presented in Tab. 2.

SYSTEMATIC ACCOUNT

Abbreviations used: M - male(s), F - female(s), MA - mature adult(s), Juv/Ten - juvenile(s)/teneral(s), Lar - larva(e), Cop - copula(e)/tandem(s), Ovip - ovipositing. The locality numbers correspond to those given in Tab. 2, as well as small letters in brackets used for new observations in cases of multiple dates per locality. The name(s) of the collector and determiner are given (if known) only in instances where specimens were not collected by the authors. References are only provided for published records.

Table 1. List of all locations with dragonfly records within the Nevesinjsko polje study area. References are only given for published data.

	Locality	Date	Latitude	Longitude	Altitude [m]
1	Lakat Police	1890	43.371667	18.068333	884
2	Tijesno, road to Veleško Lake	12.vi.2012	43.358889	18.058611	949
3	Veleško Lake	(a) 1986, (b) 30.vii.2017, Kulijer et al. (2016)	43.344722	18.05	1040
4	Pridvorci	12.vi.2012	43.345556	18.105833	864
5	Prijehode	30.iv.2012	43.341111	18.133333	840
6	Zlatac	12.vi.2012	43.341389	18.142222	843
7	Pokrivenik	12.vi.2012	43.339167	18.1425	839
8	Smrdan	12.vi.2012	43.330556	18.136389	846
9	Babova j., Sopilja	29.vi.2019	43.327222	18.103333	835
10	Duge njive, Postoljani, two small cattle ponds	Tratnik et al. (2020)			
11	Vrbovača pond, Krekovi	12.vi.2012, Tratnik et al. (2020)	43.306667	18.184167	904
12	Ristovina (Zlatac) ponds	(a) 15.v., (b) 15.vi., (c) 15.vii., (d) 17.vii., (e) 25.vii., (f) 10.viii., (g) 30.viii., (h) 07.ix.2015, (i) 30.vii.2017, Kulijer et al. (2016)	43.308056	18.098889	845
13	Nevesinjsko Lake, NE side	Kulijer et al. (2016), Tratnik et al. (2020)			
14	Srednja voda	(a) 15.vii., (b) 06.viii., (c) 07.ix.2015	43.300833	18.116944	843
15	Nevesinjsko Lake	(a) 15.vi., (b) 05.viii., (c) 15.viii., (d) 30.viii.2015, Jović et al. (2010)	43.291667	18.106389	846
16	Nevesinjsko Lake, SE side	Tratnik et al. (2020)			
17	Alagovac stream, Pomakovci	Tratnik et al. (2020)			
18	Logor	Jović et al. (2010)			
19	Kovačica pond, Batkovići	Tratnik et al. (2020)			
20	Bare, Batkovići, ponds	(a) 13.vi.2012, (b) 29.vi.2019	43.261944	18.166389	863
21	Boljkovače, ponds and wet meadows	(a) 13.vi.2012, (b) 29.vi.2019	43.256667	18.179722	849
22	Veljkovača, Šumački Stream	(a) 13.vi.2012, (b) 29.vi.2019	43.254167	18.185833	846
23	Bratački lug, Zalomka River	(a) 08.viii., (b) 11.viii.2015	43.251944	18.193056	845
24	Jezero, Žiljevo, small cattle pond	Tratnik et al. (2020)			
25	Zalužje, small cattle pond	Tratnik et al. (2020)			
26	Donje Budisavlje, stream near Zalomka River (both almost dry)	13.vi.2012, Tratnik et al. (2020)	43.220833	18.216944	832
27	Budisavlje, Zalomka River at the bridge (almost dry)	13.vi.2012	43.210833	18.2225	829
28	Donji Dražanj, pond beside the road to Slato polje	13.vi.2012	43.19	18.228056	881
29	Slato polje, pond	13.vi.2012	43.158333	18.305833	1037
30	Puddle beside the road near Donji Dražanj	13.vi.2012	43.1875	18.203889	841
31	Gornji Biograd, small water reservoir	28.0vi.2019	43.173889	18.17	860
32	Zavodka River, Ključani, Lukavačko polje	(a) 13.vi.2012, (b) 28.vi.2019	43.1475	18.235833	853
33	Udbina, small spring, Lukavačko polje	28.vi.2019	43.143348	18.243568	860
34	Zavodka River, Udbina, Lukavačko polje	13.vi.2012	43.142778	18.244722	862
35	Zavodka Stream, Lukavačko polje	28.vi.2019	43.139444	18.249722	865
36	Kljen stream, Lukavačko polje	13.vi.2012	43.125556	18.262222	891
37	Kljen, pond, Lukavačko polje	13.vi.2012	43.121667	18.261111	877
38	Donji Lukavac, Lukavačko polje, ponds and marshy meadows	13.vi.2012	43.112778	18.292222	869
39	Trusina, spring	28.vi.2019	43.124167	18.162778	947
40	Trusina, pond with vegetation	29.vi.2019	43.121944	18.169722	1010
41	Trusina, almost dry puddle	(a) 25.iv.2019, (b) 29.vi.2019	43.120556	18.169722	990

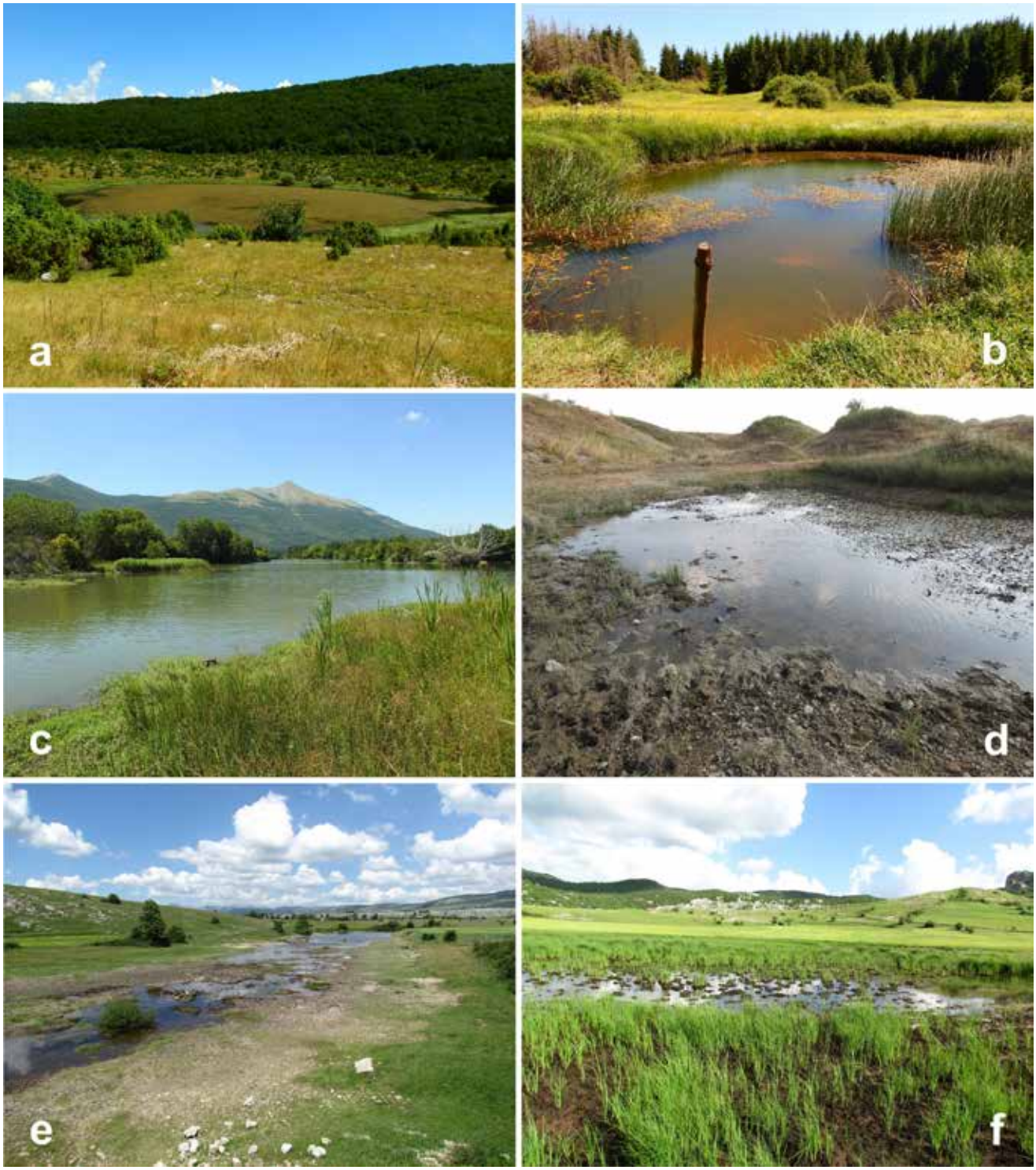

Figure 2. Surveyed habitats in the Nevesinjsko polje study area: a) Loc. 3. Veleško Lake (30.vii.2017), b) Loc. 9. Babova j., Sopilja (29.vi.2019), c) Loc. 16. Nevesinjsko Lake, SE side (02.viii.2020), d) Loc. 25. Zalužje (01.viii.2020), e) Loc. 27. Budisavlje, Zalomka River (13.vi.2012) f) Loc. 38. Donji Lukavac, Lukavačko polje (13.vi.2012) (photo: D. Kulijer).

Table 2. The checklist of Odonata species from the Nevesinjsko polje study area with reference to observation sites. The locality numbers correspond to those given in Table 1. The names of new species for the area are given in bold.

	Species	Localities	Total
CALOPTERYGIDAE			
1	***Calopteryx splendens*** (Harris, 1782)	9	1
2	***Calopteryx virgo*** (Linnaeus, 1758)	9, 14(a)	2
LESTIDAE			
3	*Chalcolestes viridis* (Vander Linden, 1825)	12(d), 16	2
4	***Lestes barbarus*** (Fabricius, 1798)	3(b), 12(g,i), 22(b), 37	4
5	*Lestes dryas* Kirby, 1890	3(b), 7, 8, 9, 10, 12(a), 13, 16, 17, 19, 20(b), 21(a,b), 22(a,b), 26, 32(b), 35, 38	17
6	*Lestes sponsa* (Hansemann, 1823)	3(b), 12(c,i), 13, 23(a)	4
7	*Lestes virens* (Charpentier, 1825)	12(g), 13	2
8	*Sympecma fusca* (Vander Linden, 1820)	1, 3(b), 13, 14(b), 16	5
COENAGRIONIDAE			
9	***Coenagrion ornatum*** (Sélys, 1850)	8	1
10	*Coenagrion puella* (Linnaeus, 1758)	3(b), 7, 8, 9, 10, 11, 12, 15, 16, 18, 20(a,b), 21(a,b), 22(a,b), 26, 27, 31, 32(b), 36, 38, 40	20
11	*Coenagrion scitulum* (Rambur, 1842)	10, 19, 20(b), 31	4
12	*Enallagma cyathigerum* (Charpentier, 1840)	3(b), 12(c,i), 13, 15, 20(b), 29, 30, 32b	8
13	*Erythromma lindenii* (Selys, 1840)	9, 13, 15, 16, 22(b)	5
14	*Erythromma viridulum* (Charpentier, 1840)	16	1
15	*Ischnura elegans* (Vander Linden, 1820)	3(b), 10, 11, 12(b), 13, 15, 16, 17, 18, 19, 20(b), 24, 25, 32(a,b), 37	15
16	***Ischnura pumilio*** (Charpentier, 1825)	8, 11(a), 29, 32(b), 35, 38	6
17	*Pyrrhosoma nymphula* (Sulzer, 1776)	8, 9, 12, 15, 18, 32, 33, 36	8
PLATYCNEMIDIDAE			
18	*Platycnemis pennipes* (Pallas, 1771)	9, 13, 15(b), 16, 17, 22(b)	6
AESHNIDAE			
19	*Aeshna affinis* Vander Linden, 1820	2, 9, 13, 16, 19, 32(b)	6
20	*Aeshna cyanea* (Müller, 1764)	12(d,i), 13, 14(c)	3
21	***Aeshna isoceles*** (Müller, 1767)	9	1
22	***Aeshna mixta*** Latreille, 1805	3(b)	1
23	*Anax imperator* Leach, 1815	3(b), 9, 11, 12(e,i), 13, 15(a), 16, 19, 20(a,b), 22(a,b), 23(b), 32(b)	12
24	***Anax parthenope*** Selys, 1839	22(b)	1
25	***Brachytron pratense*** (Müller, 1764)	8	1
CORDULIIDAE			
26	***Cordulia aenea*** (Linnaeus, 1758)	3(b)	1
27	*Somatochlora flavomaculata* (Vander Linden, 1825)	9, 13, 16	3
28	*Somatochlora meridionalis* Nielsen, 1935	9, 12(d), 15(b), 16	4
LIBELLULIDAE			
29	*Libellula depressa* Linnaeus, 1758	3(b), 4, 6, 7, 8, 9, 10, 11, 12(f,i), 13, 15, 16, 17, 18, 19 20(a,b), 21(a,b), 22(a,b), 23(b), 26, 28, 30, 31, 32(b), 34, 35, 36, 37, 38, 40, 41(a,b)	31
30	***Libellula fulva*** (Müller 1764)	9, 12(d)	2
31	*Libellula quadrimaculata* Linnaeus, 1758	3(a,b), 12(d), 13, 21(a), 22(b), 32(b), 38	7
32	***Orthetrum brunneum*** (Fonscolombe, 1837)	8, 15(b), 22(b), 39	4
33	*Orthetrum cancellatum* (Linnaeus, 1758)	3(b), 13, 15, 16, 19	5
34	*Orthetrum coerulescens* (Fabricius, 1798)	9, 15,	2
35	*Sympetrum flaveolum* (Linnaeus, 1758)	1, 3(b), 9, 13, 17, 22(b), 26, 32(a,b), 34, 37, 38	11
36	*Sympetrum fonscolombii* (Selys, 1840)	5, 11, 12(h), 15(d), 20(a), 22(b), 30	7
37	*Sympetrum meridionale* (Selys, 1841)	16	1
38	*Sympetrum sanguineum* (Müller, 1764)	3(b), 9, 12(i), 13, 15, 16, 17, 26, 31, 34, 40	11
39	*Sympetrum striolatum* (Charpentier, 1840)	1, 3(b), 12(f), 15(c)	4
40	*Crocothemis erythraea* (Brullé, 1832)	3	1

Family CALOPTERYGIDAE

Calopteryx splendens (Harris, 1782)
Loc. 9: >10MA;
Calopteryx virgo (Linnaeus, 1758)
Loc. 9: >10MA; **Loc. 14(a)**: 1M;

Family LESTIDAE

Chalcolestes viridis (Vander Linden, 1825)
Loc. 12(d): 1M; **Loc. 16**: Tratnik et al., 2020;
Lestes barbarus (Fabricius, 1798)
Loc. 3(b): 2M; **Loc. 12(g)**: 1M, **(i)**: 1M; **Loc. 22(b)**: 1M; **Loc. 37**: 3Juv/Ten;
Lestes dryas Kirby, 1890
Loc. 3(b): 1M,1F, Kulijer et al., 2016; **Loc. 7**: <10MA,>10Juv/Ten; **Loc. 8**: 3Juv/Ten; **Loc. 9**: >100MA; **Loc. 10**: Tratnik et al., 2020; **Loc. 12(a)**: 1F, Tratnik et al., 2020; **Loc. 13**: Kulijer et al., 2016, Tratnik et al., 2020; **Loc. 16**: Kulijer et al., 2016; **Loc. 17**: Kulijer et al., 2016; **Loc. 19**: Kulijer et al., 2016; **Loc. 20(b)**: >20MA,<Juv/Ten; **Loc. 21(a)**: 1F, **(b)**: >10MA; **Loc. 22(a)**: 1F, **(b)**: >10MA; **Loc. 26**: 1F; **Loc. 32(b)**: 2M,1F; **Loc. 35**: 1M; **Loc. 38**: >10MA,>Juv/Ten;
Lestes sponsa (Hansemann, 1823)
Loc. 3(b): >100MA, Tratnik et al., 2020; **Loc. 12(c)**: 1M, **(i)**: 3M,1F, Kulijer et al., 2016; **Loc. 13**: Tratnik et al., 2020, Tratnik et al., 2020; **Loc. 23(a)**: 1M;
Lestes virens (Charpentier, 1825)
Loc. 12(g): 1M; **Loc. 13**: Kulijer et al., 2016;
Sympecma fusca (Vander Linden, 1820)
Loc. 1: 2M leg. Apfelbeck, 2F leg. unknown; **Loc. 3(b)**: 2Juv/Ten; **Loc. 13**: Kulijer et al., 2016; **Loc. 14(b)**: 1M; **Loc. 16**: Tratnik et al., 2020;

Family COENAGRIONIDAE

Coenagrion ornatum (Selys, 1850)
Loc. 8: 2M,2F,2Cop;
Coenagrion puella (Linnaeus, 1758)
Loc. 3(b): >10MA,>10Cop, Kulijer et al., 2016; **Loc. 7**: 2M; **Loc. 8**: 1M; **Loc. 9**: >10M,<10Cop,<10Ovip; **Loc. 10**: Tratnik et al., 2020; **Loc. 11**: >100MA,>10Cop,>10Ovip, Tratnik et al., 2020; **Loc. 12**: Kulijer et al., 2016; **Loc. 15**: Jović et al., 2010; **Loc. 16**: Tratnik et al., 2020; **Loc. 18**: Jović et al., 2010; **Loc. 20(a)**: >10MA,>10Cop,>10Ovip, **(b)**: >10MA; **Loc. 21(a)**: >10MA,>10Cop,>10Ovip, **(b)**: <10MA; **Loc. 22(a)**: >10MA,>10Cop,>10Ovip, **(b)**: >10MA,<10Cop,<10Ovip; **Loc. 26**: 5M,3F; **Loc. 27**: 1M; **Loc. 31**: <10MA,<10Cop; **Loc. 32(b)**: >10MA,>10Cop; **Loc. 36**: 2M; **Loc. 38**: 1F; **Loc. 40**: 1M;
Coenagrion scitulum (Rambur, 1842)
Loc. 10: Tratnik et al., 2020; **Loc. 19**: Tratnik et al., 2020; **Loc. 20(b)**: 3M; **Loc. 31**: >10MA,>10Cop,>10Ovip;
Enallagma cyathigerum (Charpentier, 1840)
Loc. 3(b): >100MA,>10Cop,<10Juv/Ten, Kulijer et al., 2016; **Loc. 12(c)**: 1F, **(i)**: 1M,1Cop, Kulijer et al., 2016; **Loc. 13**: Kulijer et al., 2016; **Loc. 15**: Jović et al., 2010; **Loc. 20(b)**: 3MA; **Loc. 29**: 1M; **Loc. 30**: 1M,1Cop; **Loc. 32(b)**: >10M;
Erythromma lindenii (Selys, 1840)
Loc. 9: <10MA; **Loc. 13**: Kulijer et al., 2016, Tratnik et al., 2020; **Loc. 15**: Jović et al., 2010; **Loc. 16**: Tratnik et al., 2020; **Loc. 22(b)**: 5M;
Erythromma viridulum (Charpentier, 1840)
Loc. 16: Tratnik et al., 2020;
Ischnura elegans (Vander Linden, 1820)
Loc. 3: Kulijer et al., 2016; **Loc. 10**: >10MA; **Loc. 11**: Tratnik et al., 2020; **Loc. 12(b)**: 1F, Kulijer et al., 2016; **Loc. 13**: Kulijer et al., 2016, Tratnik et al., 2020; **Loc. 15**: Jović et al., 2010; **Loc. 16**: >10MA,>10Juv/Ten; **Loc. 17**: >10MA; **Loc. 18**: Jović et al., 2010; **Loc. 19**: >100MA; **Loc. 20(b)**: 5MA; **Loc. 24**: 8MA; **Loc. 25**: 1MA; **Loc. 32(a)**: 1M, **(b)**: 3MA; **Loc. 37**: 2M;
Ischnura pumilio (Charpentier, 1825)
Loc. 8: 1M,1Juv/Ten; **Loc. 11(a)**: 2M,<10MA,5Cop; **Loc. 29**: 1M; **Loc. 32(b)**: 7MA,1Ovip; **Loc. 35**: 1M; **Loc. 38**: 1M;
Pyrrhosoma nymphula (Sulzer, 1776)
Loc. 8: 30MA; **Loc. 9**: 2M,1F; **Loc. 12(c)**: 1M; **Loc. 15**: Jović et al., 2010; **Loc. 18**: Jović et al., 2010; **Loc. 32(b)**: 1M; **Loc. 33**: 1M,1F; **Loc. 36**: 1M;

Family PLATYCNEMIDIDAE

Platycnemis pennipes (Pallas, 1771)
Loc. 9: >100MA,>10Cop,>100Ovip; **Loc. 13**: Kulijer et al., 2016, Tratnik et al., 2020; **Loc. 15(b)**: 1F; **Loc. 16**: Tratnik et al., 2020; **Loc. 17**: Tratnik et al., 2020; **Loc. 22(b)**: 1M;

Family AESHNIDAE

Aeshna affinis Vander Linden, 1820
Loc. 2: 1M; **Loc. 9**: 3M; **Loc. 13**: Tratnik et al., 2020; **Loc. 16**: Tratnik et al., 2020; **Loc. 19**: Tratnik et al., 2020; **Loc. 32(b)**: 1M;
Aeshna cyanea (Müller, 1764)
Loc. 12(d): 1M,1F, **(i)**: 4M, Kulijer et al., 2016; **Loc. 13**: Kulijer et al., 2016; **Loc. 14(c)**: 1M,1F;
Aeshna isoceles (Müller, 1767)
Loc. 9: 15MA;
Aeshna mixta Latreille, 1805
Loc. 3(b): 1M;
Anax imperator Leach, 1815
Loc. 3(b): 5M,2Ovip, Kulijer et al., 2016; **Loc. 9**: 12M; **Loc. 11**: 1Ovip, Tratnik et al., 2020; **Loc. 12(e)**: 1M, **(i)**: 2M, Kulijer et al., 2016; **Loc. 13**: Tratnik et al., 2020; **Loc. 15(a)**: 1M, Jović et al., 2010; **Loc. 16**: Tratnik et al., 2020; **Loc. 19**: Tratnik et al., 2020; **Loc. 20(a)**: 1M, **(b)**: 1M; **Loc. 22(a)**: 3M,1Ovip **(b)**: 4M,1F; **Loc. 23(b)**: 1M; **Loc. 32(b)**: 5M,2F,2Ovip;
Anax parthenope (Selys, 1839)
Loc. 22(b): 1M;
Brachytron pratense (Müller, 1764)
Loc. 8: 2M;

Family CORDULIIDAE

Cordulia aenea (Linnaeus, 1758)
Loc. 3(b): 2M;
Somatochlora flavomaculata (Vander Linden, 1825)
Loc. 9: 3M; **Loc. 13**: Tratnik et al., 2020; **Loc. 16**: Tratnik et al., 2020;
Somatochlora meridionalis Nielsen, 1935
Loc. 9: 10M,1Ovip; **Loc. 12(d)**: 1M, Kulijer et al., 2016; **Loc. 15(b)**: 1M; **Loc. 16**: Tratnik et al., 2020;

Family LIBELLULIDAE

Crocothemis erythraea (Brullé, 1832)
Loc. 3: Kulijer et al., 2016;
Libellula depressa Linnaeus, 1758
Loc. 3(b): 1M; **Loc. 4**: 5M,2Cop; **Loc. 6**: 1M; **Loc. 7**: 1M; **Loc. 8**: 1M,1F; **Loc. 9**: 10M; **Loc. 10**: Tratnik et al., 2020; **Loc. 11**: 5M, Tratnik et al., 2020; **Loc. 12(f)**: 1M,1F, **(i)**: 2M, Kulijer et al., 2016; **Loc. 13**: Kulijer et al., 2016; **Loc. 15**: Jović et al., 2010; **Loc. 16**: Tratnik et al., 2020; **Loc. 17**: Tratnik et al., 2020; **Loc. 18**: Jović et al., 2010; **Loc. 19**: Tratnik et al., 2020; **Loc. 20(a)**: 2M, **(b)**: 3M; **Loc. 21(a)**: 10M,2F,1Cop,1Ovip, **(b)**: 5M,1F; **Loc. 22(a)**: 20M, **(b)**: 10M,2F; **Loc. 23(b)**: 1M,1F; **Loc. 26**: 1M; **Loc. 28**: 1M,1Ovip; **Loc. 30**: 2M; **Loc. 31**: 3M; **Loc. 32(b)**: 13M,2F,2Cop; **Loc. 34**: 1M; **Loc. 35**: 1M; **Loc. 36**: 1M; **Loc. 37**: 2M; **Loc. 38**: 2M; **Loc. 40**: 1F; **Loc. 41(a)**: 1Lar, **(b)**: 1Lar;
Libellula fulva (Müller, 1764)
Loc. 9: >100MA,>10Cop; **Loc. 12(d)**:1F;
Libellula quadrimaculata Linnaeus, 1758
Loc. 3(a): 1Juv/Ten leg. Paštar R., **(b)**: 5MA; **Loc. 12(d)**: 1F; **Loc. 13**: Kulijer et al., 2016; **Loc. 21(a)**: 2M; **Loc. 22(b)**: 1M; **Loc. 32(b)**: 1M; **Loc. 38**: 1F;
Orthetrum brunneum (Fonscolombe, 1837)
Loc. 8: 3M; **Loc. 15(b)**: 1M; **Loc. 22(b)**: 1M; **Loc. 39**: 1M;
Orthetrum cancellatum (Linnaeus, 1758)
Loc. 3(b): 5M; **Loc. 13**: Kulijer et al., 2016; **Loc. 15**: Jović et al., 2010; **Loc. 16**: Tratnik et al., 2020; **Loc. 19**: Tratnik et al., 2020;
Orthetrum coerulescens (Fabricius, 1798)
Loc. 9: 12M,1Juv/Ten; **Loc. 15**: Jović et al., 2010;
Sympetrum flaveolum (Linnaeus, 1758)
Loc. 1: 1F leg. et det. unknown; **Loc. 3(b)**: 50MA,10Cop,2Ovip, Kulijer et al., 2016; **Loc. 9**: >10MA; **Loc. 13**: Kulijer et al., 2016, Tratnik et al., 2020; **Loc. 17**: Tratnik et al., 2020; **Loc. 22(b)**: 2Juv/Ten; **Loc. 26**: Tratnik et al., 2020; **Loc. 32(a)**: 1F, **(b)**: 10MA; **Loc. 34**: 5MA; **Loc. 37**: 10Juv/Ten; **Loc. 38**: Kulijer, 2015a;
Sympetrum fonscolombii (Selys, 1840)
Loc. 5: <10MA leg. Dervović I.; **Loc. 11**: 1M; **Loc. 12(h)**: 1M,1F, Kulijer et al., 2016; **Loc. 15(d)**: 1M,1F; **Loc. 20(a)**: 1M; **Loc. 22(b)**: 1M; **Loc. 30**: 1M;
Sympetrum meridionale (Selys, 1841)
Loc. 16: Tratnik et al., 2020;
Sympetrum sanguineum (Müller, 1764)
Loc. 3(b): 2M, Kulijer et al., 2016; **Loc. 9**: 1M; **Loc. 12(i)**: 3M, Kulijer et al., 2016; **Loc. 13**: Kulijer et al., 2016, Tratnik et al., 2020; **Loc. 15**: Jović et al., 2010; **Loc. 16**: Tratnik et al., 2020; **Loc. 17**: Tratnik et al., 2020; **Loc. 26**: 1M; **Loc. 31**: 1M; **Loc. 34**: 1F; **Loc. 40**: 1F,1MA;
Sympetrum striolatum (Charpentier, 1840)
Loc. 1: 1M leg. et det. unknown; **Loc. 3(b)**: 5MA, Kulijer et al., 2016; **Loc. 12(f)**: 1M, Kulijer et al., 2016; **Loc. 15(c)**: 1M, Jović et al., 2010;

DISCUSSION

Local faunal studies are important in gaining better knowledge of species' distribution, their biology and ecology, and especially for the assessment of threats and the establishment of an effective system for the protection of their populations and habitats. Although it was not possible to cover all habitats in this large and diverse area – nor all seasonal aspects of many sites – through this study, the number of 40 recorded species (63% of all dragonfly species of the country) (Kulijer & Miljević, 2015) represents a valuable contribution to the knowledge of species distribution in these specific and sensitive karst habitats, as well as throughout the country. The most important such contribution is arguably the first record of *Coenagrion ornatum* (Selys 1850) for Nevesinjsko polje. This is a species of European conservation concern, protected by the European Habitats Directive (Annex II) and a near threatened (NT) species in the European Red List of Dragonflies (Kalkman et al., 2010). As the species is already known to occur across the karst poljes of Herzegovina and southwest Bosnia, this finding is of little surprise (Kulijer, 2012, 2014; Kulijer et al., 2013). As *C. ornatum* is mainly found in May & June, becoming scarce or disappearing altogether by or during early July (Boudot & Kulijer, 2015) and the main investigations were conducted later in the year (Tab. 1; Jović et al., 2010; Kulijer et al., 2016; Tratnik et al., 2020), we believe the species may well have a much wider presence throughout Nevesinjsko polje. Additional surveys focused on *C. ornatum* should be carried out, particularly in the northern part of the polje, where a greater number of potentially favourable habitats exist (Fig. 3). The species is known to inhabit both natural streams and artificial canals in many karst poljes in Bosnia and Herzegovina (Kulijer, 2012, 2014; Kulijer et al., 2013), with sound knowledge of its distribution being important for the identification of Natura 2000 protected areas for this species in Bosnia and Herzegovina.

The majority of recorded species are widespread throughout the country (Kulijer et al., 2013). The most frequent were *L. depressa* (31 sites), *C. puella* (20), *L. dryas* (17) and *I. elegans* (15) (Tab. 2). Three of them, *C. puella*, *I. elegans* and *L. depressa*, are habitat generalists, present in wide range of stagnant and slow flowing water habitats (Boudot & Kalkman, 2015), while *L. dryas* is the second most common species of the genera in the country, being particularly

Figure 3. *Coenagrion ornatum* (Selys 1850) habitat in Nevesinjsko polje, Loc. 8 (12.vi.2012).

abundant at higher altitudes (Kulijer et al., 2013). It is also a summer species abundant in temporary waters that are widely represented among the surveyed locations.

During the study, ten species were recorded at only a single location, namely: *C. splendens, C. ornatum, E. viridulum, A. mixta, A. isosceles, A. parthenope, B. pratense*, *C. aenea, S. meridionale* and *C. erythraea*. The low representation of these species, which are in general very common and widespread throughout the country (Kulijer et al., 2013), can be explained by a number of factors: The first is a lack of fieldwork in the early spring and autumn seasons – all surveys were conducted from mid-June to mid-August (Tab. 1; Jović et al., 2010; Kulijer et al., 2016; Tratnik et al., 2020). The largest freshwater habitat in the study area, the Nevesinjsko Lake was mostly investigated in late summer, when most spring species were no longer present. A second reason is the lack of permanent flowing waters in the study area. Finally, these results also demonstrate that the data on the dragonfly fauna of this large and diverse area is still insufficient, and that further research is needed.

The records were gathered from 41 localities distributed between altitudes of 829 and 1,040 m AMSL (Tab. 1, Fig. 1 & 2). The site at the lowest elevation in the study area is Zalomka River near Budisavlje, Loc. 27 (829 m AMSL), while the highest point is at Veleško Lake, Loc. 3 (1,040 m AMSL). In terms of species richness, the following locations had the highest species diversity: Loc. 9: Babova j., Sopilja (18 species); Loc. 12: Ristovina (18); Loc. 3: Veleško Lake (17); Loc. 13: Nevesinjsko Lake, NE side (17); Loc. 16: Nevesinjsko Lake, SE side (16) and Loc. 15: Nevesinjsko Lake (15). All of these locations are situated in the north-western part of the study area, where the most important dragonfly habitats are concentrated. For Nevesinjsko Lake itself (Locs. 13, 15 & 16), a total of 27 species was reported (66% of all the species found in the study area). Due to their large size and rich and diverse vegetation, Nevesinjsko and Veleško lakes support significant dragonfly communities. Many rivers and streams in karst poljes are only temporary, drying out in the summer period (Bonacci, 2015; Bonacci et al., 2019), and this is precisely the case for the Zalomka river, the largest watercourse in the study area. As a result, the presence of dragonfly fauna is limited, and mainly restricted to small ponds and pools that remain in the riverbed. A considerable number of small bodies of water – like many cattle ponds in the poljes – are also temporary and not suited to sustaining significant dragonfly communities (e.g. Fig. 2d).

We compared our results with those of studies of the dragonfly fauna of Livanjsko polje, the only other karst polje in Bosnia and Herzegovina for which significant data on Odonata fauna are published, with this polje also being situated at a higher altitude, as with Nevesinjsko polje (Kulijer, 2012, 2013). This comparison showed major similarities in terms of the number and composition of species. In Livanjsko polje, 42 species were found (Kulijer, 2012, 2013), compared to 40 in Nevesinjsko (with 98% of species from Nevesinjsko polje also being found in Livanjsko polje). The most common species in Nevesinjsko polje (Tab. 2) were also among the most common in Livanjsko polje (Kulijer, 2012), with the only notable differences in species composition being *Lestes sponsa* (Hansemann, 1823) found only in Nevesinjsko polje, and *Gomphus vulgatissimus* (Linnaeus, 1758), *Onychogomphus forcipatus* (Linnaeus, 1758) and *Orthetrum albistylum*

(Selys, 1848), which were only observed in Livanjsko polje. *Lestes sponsa* is common in mountain areas in southern Europe, including Bosnia and Herzegovina, where it inhabits wide range of standing and well-vegetated unshaded waters (Boudot & Raab, 2015). The habitats in Nevesinjsko polje, situated at higher altitudes and under stronger influence of the mountain climate, are quite suitable for this species, which is expected to be present in Livanjsko polje as well. The absence of *G. vulgatissimus* and *O. forcipatus* from Nevesinjsko polje can be explained by the scarcity of permanent flowing waters, while for *O. albistylum* the reasons could be the altitude and water temperature, particularly as the larger stagnant water habitats are situated in the colder north-western part of the polje, and the species is known to be less tolerant to cold water (Kalkman & Ambrus, 2015).

For other poljes in Bosnia and Herzegovina, published data is much more scarce (Kulijer, 2013), with Hutovo Blato being the only such area with more detailed knowledge (43 known species), but this area is hardly comparable with Nevesinjsko polje. Hutovo Blato is a permanent Mediterranean wetland situated at sea level, making it significantly different to most other karst poljes in Bosnia and Herzegovina (Kulijer, 2013, 2014, 2015b; Bukvić & Kulijer, 2021).

There is still no national Red List of dragonflies for Bosnia and Herzegovina. While dragonflies are included in the two entity-level regional red lists, these have been poorly drafted in regard to dragonflies, and do not reflect actual threat statuses of the species, either in the entities or at the national level (Kulijer, 2017). The Red List of Protected Species of Flora and Fauna of Republika Srpska lists 46 dragonfly species, but does not provide any threat category for any of these. With the exception of *A. isoceles*, *A. parthenope, B. pratense*, *S. flavomaculata* and *L. fulva*, all recorded species are included in this Red List (Službeni glasnik Republike Srpske, 2012). The second document to cover threatened and protected species in Republika Srpska, the Act on Strictly Protected and Protected Wild Species, does not include any of the recorded species (Službeni glasnik Republike Srpske, 2020).

Our records represent a valuable contribution to the knowledge of the dragonfly fauna of karst poljes, biodiversity hotspots of Bosnia and Herzegovina and the wider Dinaric Alps. We believe that future surveys will certainly result in the identification of more species and expand the knowledge on dragonfly fauna in Nevesinjsko polje. Such surveys should focus on the north-western part of Nevesinjsko polje, with a specific focus on Nevesinjsko Lake and the marshy habitats in its vicinity, as well on the canals and other small watercourses in the north, where *C. ornatum* was found, and primarily be undertaken in the spring months.

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SAŽETAK

U ovom radu dat je prvi pregled faune vilinih konjica Nevesinjskog polja, jednog od najvećih kraških polja u Bosni i Hercegovini, kao i dva susjedna mala polja, Lukavačko i Slato, koja su sa Nevesinjskim poljem blisko povezana. Terenska istraživanja koja su provedena od 2012. do 2020. godine rezultirala su sa 40 zabilježenih vrsta (63% faune vilinih konjica Bosne i Hercegovine). Od toga broja ovih 12 vrsta zabilježeno je prvi put na istraživanom području: ***Calopteryx splendens*** (Harris, 1780), ***Calopteryx virgo*** (Linnaeus, 1758), ***Lestes barbarus*** (Fabricius, 1798), ***Coenagrion ornatum*** (Selys, 1850), ***Ischnura pumilio*** (Charpentier, 1825), ***Aeshna isoceles*** (Müller, 1767), ***Aeshna mixta*** (Latreille, 1805), ***Anax parthenope*** (Selys, 1839), ***Brachytron pratense*** (Müller, 1764), ***Cordulia aenea*** (Linnaeus, 1758), ***Libellula fulva*** (Müller, 1764) i ***Orthetrum brunneum*** (Fonscolombe, 1837). Najznačajniji je prvi nalaz ***C. ornatum***, vrste od evropskog konzervacijskog značaja, pronađen u Nevesinjskom polju. Prikupljeni podaci važan su doprinos poznavanju faune vilinih konjica kraških polja, vruće tačke biodiverziteta dinarskog krša.

Ključne riječi: Bosna i Hercegovina, ***Coenagrion ornatum***, distribucija, kraška polja