

# DRAGONFLY FAUNA (INSECTA: ODONATA) OF THE BRIJUNI NATIONAL PARK, CROATIA

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The first systematic survey of the dragonfly fauna of the Brijuni National Park was carried out during the late spring and summer of 2016. A total of 13 species was recorded at two localities on the island of Veliki Brijun, 11 of them for the first time in the area. From the literature, one additional species was documented for the Park, amounting to a total of 14 Odonata species. The most common species was *Sympetrum meridionale* (Selys, 1841) while the rarest was *Anax parthenope* (Selys, 1839). Zoogeographical analysis showed the domination of the Holo-Mediterranean zoogeographical element. Four recorded species are listed in the Red book of Croatian Dragonflies, indicating the conservation value of the investigated habitats. Both of the wetland habitats surveyed, Brijuni Pond, and the saline lakes, proved to be very important habitats for the island's Odonata. Therefore, it is essential to protect those habitats and their biota by planning and conducting restoration activities in the near future.

**Key words:** species richness, Veliki Brijun, Brijuni pond, Saline, *Chalcolestes parvidens*

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Tijekom 2016. godine provedena je prva sustavna inventarizacija vretenaca Nacionalnog parka Brijuni. Ukupno je pronađeno 13 vrsta na dva lokaliteta na otoku Veliki Brijun, od čega je 11 vrsta po prvi puta zabilježeno za to područje. Prema literaturi još je jedna dodatna vrsta zabilježena u Nacionalnom parku, tako da Park broji ukupno 14 vrsta vretenaca. Najčešća vrsta je *Sympetrum meridionale* (Selys, 1841), a najrjeđa *Anax parthenope* (Selys, 1839). Zoogeografska analiza pokazala je dominaciju holomediteranskog zoogeografskog elementa. Četiri vrste vretenaca nalaze se u Crvenoj knjizi vretenaca Hrvatske, što upućuje na konzervacijsku vrijednost istraživanih staništa. Oba istraživana lokaliteta, Brijunska bara i Saline iznimno su važna staništa vretenaca brijunskog otočja te je potrebno spriječiti njihovu daljnju sukcesiju i izvesti revitalizaciju i obnovu staništa, kako bi se sačuvala bioraznolikost vretenaca te ostale flore i faune.

**Ključne riječi:** raznolikost vrsta, Veliki Brijun, Brijunska bara, Saline, *Chalcolestes parvidens*

## INTRODUCTION

Dragonflies (Odonata) are among the best-known insect groups with respect to their taxonomy and distribution, and, apart from butterflies, probably no other group of insects receives so much attention from the general public. This is especially true for the territory of Europe where the identification of adults, nymphs, and exuviae is facilitated by a variety of available literature (e.g. BROCHARD *et al.*, 2012; DIJKSTRA & LEWINGTON, 2006; SMALLSHIRE & SWASH, 2014). The same is true for their Red List status, at both European (KALKMAN *et al.*, 2010) and local levels (BELANČIĆ *et al.*, 2008).

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All dragonflies are predators that feed on small invertebrates, both as nymphs and adults. Accordingly, they play a crucial role in freshwater ecosystems and incorporate a rich phenotypic and ecological diversity within one single insect order. Therefore, they represent excellent candidates for ecological and evolutionary studies (BYBEE *et al.*, 2016).

A large number of Odonata species are considered endangered at the moment. According to the European Red Book of Dragonflies, the populations of a quarter of European dragonfly species have negative population trends, meaning that their populations are declining in the long run (KALKMAN *et al.*, 2010). In the Croatian Red Book of Dragonflies, 16 species belong to endangered categories (critically endangered, endangered, vulnerable), 12 species to almost endangered species (NT), and six of them to species with insufficient data for quality endangerment assessment (DD) (BELANČIĆ *et al.*, 2008).

As in most European countries, studies of the Croatian dragonfly fauna started in the second half of the 19th century (CARRARA, 1846). However, large areas of the country remained under-surveyed, and sometimes are still without any data (BELANČIĆ *et al.*, 2008; ŠTIH *et al.*, 2020; VILENICA *et al.*, 2011; VILENICA & DIJKSTRA, 2014; VILENICA & MIHOČI, 2018). Similar lack of data is present in all three biogeographical regions of Croatia, the Alpine, the Continental, and the Mediterranean region (which includes the Adriatic islands) (EEA, 2015).

The Croatian part of the Adriatic Sea encompasses 79 islands, 525 islets, and 642 rocks and rocks awash, 1246 in total (DUPLANČIĆ *et al.*, 2004). While they comprise only about 5% of the total land area of the country, due to their position and climate they harbor an immense biodiversity of both vertebrates and invertebrates (e.g. HABELER, 2003; KRYŠTUFEK & KLETEČKI, 2007). Yet, systematic overviews of the islands' fauna are deficient for almost all invertebrates and most vertebrate groups. The most systematic invertebrate overview is that of the butterflies which showed that about 60% of all species present in Croatia occur on the islands (WITHRINGTON & VEROVNIK, 2008; VEROVNIK, 2011). No such overview was ever given for other invertebrates, including dragonflies. Surprisingly, only a few systematic overviews of the particular islands' dragonfly fauna exist, aimed mostly at the larger, and more easily accessible islands (e.g. St. QUENTIN, 1944).

The published data about dragonfly diversity are very scarce, and mostly include larger islands like Cres (St. QUENTIN, 1944; FRANKOVIĆ(A), 1997), Lošinj (ŠALAMUN & BEDJANIČ, 1997), Krk (St. QUENTIN, 1944; OLIAS & SERBEDIA, 1998; PONGRAC, 2000; BOGDANOVIĆ & GRGIĆ, 2015), Rab (St. QUENTIN, 1944; GEELLEN & OOMEN, 1965; MAUERSBERGER, 1994), Pag (FRANKOVIĆ & BEDJANIČ, 1998), Dugi Otok (FRAUENFELD, 1856; 1860; St. QUENTIN, 1944), Šolta (GEELLEN & OOMEN, 1965), Hvar (St. QUENTIN, 1944), Brač (WERNER, 1919), Korčula (RÖSSLER, 1900; ADAMOVIĆ, 1967; KOTARAC & BEDJANIČ, 1994; KOTARAC, 1999), Lastovo (GALVAGNI, 1902; TRILLAR & BEDJANIČ, 1999; DUBRAVČIĆ *et al.*, 2008), Mljet (RÖSSLER, 1900; ADAMOVIĆ, 1967) and Vis (GALVAGNI, 1902; St. QUENTIN, 1944). Recently a detailed survey was carried out in Lastovo Nature Park (ŠTIH *et al.*, 2020). The data relating to the fauna of smaller islands are even scarcer, dragonflies being known from only a few islands like Palagruža (GALVAGNI, 1902) and Lokrum (St. QUENTIN, 1944).

In the light of drastic changes in the land usage across the Adriatic coastline, and especially the islands, it is necessary to conduct systematic Odonata surveys. This is nowadays crucial as many freshwater habitats have already disappeared from the is-

lands and many are characterized by unfavorable environmental conditions (Sučić *et al.*, 2018).

The main aims of this study were to present the first overview of the Odonata fauna of the Brijuni National Park, Brijuni NP) in terms of diversity, conservation status and, zoogeographical analysis and to compare it with the better-surveyed islands of the northern Adriatic.

## MATERIALS AND METHODS

### Study area

The Brijuni National Park (NP) is located in the northern part of the Adriatic Sea, on the west coast of the peninsula of Istria, opposite the settlement of Fažana. The archipelago comprises 14 islands and islets with a total area of 33.9 km<sup>2</sup>. The two largest islands are Veliki Brijun (5.72 km<sup>2</sup>) and Mali Brijun (1.07 km<sup>2</sup>). The smaller islands are Sveti Marko, Gaz, Okrugljak, Supin, Gaul, Grunj, Vanga, Madona, Vrsar, Kozada, and St. Jerolim (JU Brijuni, 2016). The area of the Brijuni NP belongs to the Eumediterranean littoral belt of the Mediterranean region. The islands have a mild Mediterranean climate (Cf) without dry periods and with hot summers (ŠEGOTA & FILIPČIĆ, 2003). The mid-annual temperature is 17.4°C and the average annual precipitation is between 700 and 800 mm (ZANINOVIĆ, 2008).

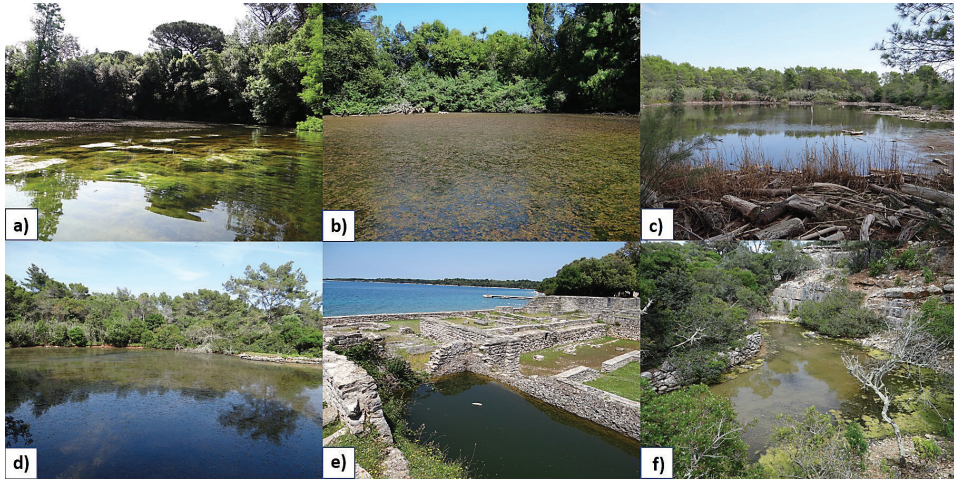
The main forest community on the islands is holm oak and black ash forest (*As. Fraxino orn-Qercetum ilicis* Horvatić/1956/1958) (JU Brijuni, 2016). Nowadays, the area is covered with various degradation stages of the forest. The grasslands on the islands were artificially created by deforestation, and nowadays they cover large surfaces of the islands. The main grassland community on the islands is the association *Lolio-Plantaginetum commutatae* Horvatić/1934/ 1963 (JU Brijuni, 2016).

Of the 14 islands belonging to the archipelago, wetland areas exist only on the islands Veliki Brijun and Mali Brijun. These include the Brijuni pond and the former saltern Saline Lakes on Veliki Brijun, as well as one shallow brackish pond on Mali Brijun. In the past, more ponds existed on the islands but were destroyed/filled? due to the problems with malaria in the 19<sup>th</sup> century (FATOVIĆ-FERENČIĆ, 2006).

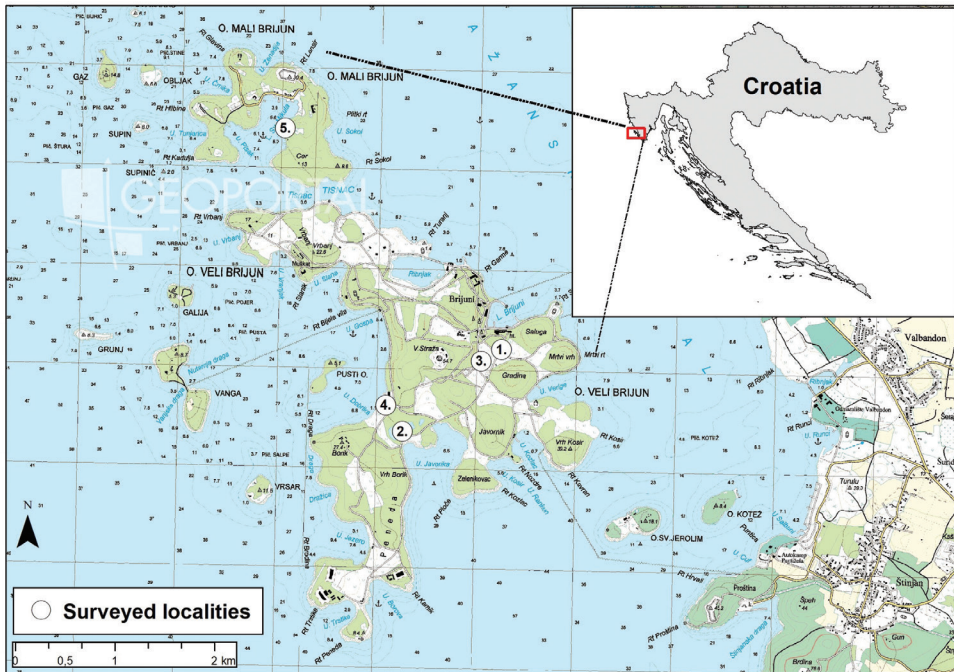
### Data collection

This survey was conducted between May and September 2016 on two islands, Veliki and Mali Brijun. The islands were visited on three occasions during nine field days. A total of five localities containing freshwater habitats were visited during this survey, four in Veliki and one on Mali Brijun (Tab. 1, Figs 1 & 2). Each locality on the island Veliki Brijun (Fig. 1a-e) was visited during each field day, while the locality on the island Mali Brijun was visited only once.

The Brijuni pond is located near the main settlement on the island. The pond is inaccessible to visitors and wildlife as it is surrounded by a fence and dense woods through which routes that are now almost completely overgrown with vegetation and impassable used to run. Riparian vegetation has been developed only partially. The aquatic vegetation of the pond is quite abundant and the entire pool is covered with plants of the association *Ceratophyllo-Potamogetonetum crispum* H-ić and Micevski 1960 (PEHARDA DOBLANOVIĆ *et al.*, 2019) (Fig. 1a).



**Fig. 1.** Water habitats in the Brijuni NP. a), b) Veliki Brijun Island, Brijuni pond, located near the settlement, c), d) Veliki Brijun Island, former saltern saline lake, e) Veliki Brijun Island, water basin within ruins, f) Mali Brijun Island, brackish pond.



**Fig. 2.** Surveyed localities on the islands Veliki and Mali Brijun.



The Saline Lakes wetland area is located in the bay of the island, near Cape Gro-mača. In the Middle Ages, this area was used for salt production. Nowadays, it encompasses three marshy, partially brackish lakes. The first two lakes were created by drainage and irrigation activities in 1960, while the third lake was created in 1973. The shore of the first lake is almost completely covered with sedge, and at its center, there is a tiny island surrounded by reed beds (Fig. 1c). The second lake is almost surrounded by reed beds (as *Phragmitetum australis* Soó 1927) (PEHARDA DOBLANOVIĆ *et al.*, 2019), while the third lake is located deeper in the forest and surrounded by shrubs and trees, without any aquatic vegetation on its banks.

The two artificial habitats on Veliki Brijun, the basin and abandoned swimming pool (localities 3 and 4) do not contain any aquatic vegetation.

The small pond on Mali Brijun is brackish and without coastal and aquatic vegetation (Fig. 1f).

Only adult dragonflies were investigated during this survey. The individuals were caught with an entomological net or observed visually in nature. Captured individuals were identified using DIJKSTRA & LEWINGTON (2006), photographed, and released. On average two to three hours were spent each day at each locality. All the adults of each species were counted during each visit, or in the cases of extremely numerous species, they were extrapolated using best-guess estimates.

Systematics follows the website Fauna Europaea (DE JONG *et al.*, 2014). The zoogeographical analysis followed STERNBERG (1998) and DIJKSTRA & LEWINGTON (2006). To gain a wider perspective about the dragonfly fauna of Brijuni, a comparison with the closest islands in the Kvarner region was done, based on the available literature.

## RESULTS

From the five visited localities, which are also the only freshwater habitats on the Brijuni Islands, dragonflies were observed at two of them, at Brijuni Pond and the Saline Lakes on Veliki Brijun Island. Of the five freshwater habitats present on the Brijuni Islands, dragonflies were observed at two of them, at Brijuni Pond and the Saline Lakes on Veliki Brijun Island. At the other three localities, not a single Odonata individual was observed.

A total of 13 species was recorded during this survey, 11 of which represent new records for the island (Tab. 2). The number of observed individuals per locality ranged from 1 to more than 300. At Brijuni Pond and the Saline Lakes, ten species were recorded. The most common species was *Sympetrum meridionale* (Selys, 1841) with several hundreds of observed individuals, while the rarest was *Anax parthenope* (Selys, 1839) with only two observed individuals (Tab. 2).

Four recorded species are listed in the Croatian Red List: *Chalcolestes parvidens* Artobolevisky, 1929 as data deficient (DD), *Anax parthenope*, *Sympetrum fonscolombii* (Selys, 1840), and *S. meridionale* as near threatened (NT) (BELANČIĆ *et al.*, 2008).

Zoogeographical analysis showed the domination of the Holo-Mediterranean zoogeographical element (53.8%), followed by Ponto-Mediterranean (23.1 %) and Atlantic-Mediterranean (15.4 %) while the smallest share (7.7 %) was determined for Eurasian elements (Tab. 2).

**Tab. 1.** Surveyed localities on the islands of Veliki and Mali Brijun, along with coordinates, altitudes, and dates of Odonata surveys.

	Locality	WGS84 E	WGS84 N	Altitude (m a.s.l.)	Dates of visits
1.	Veliki Brijun Island, Brijuni Pond	44.914664	13.769855	8	25.-27.05.2016., 8.-10.08.2016., 26.-28.09.2016.
2.	Veliki Brijun Island, complex of Saline Lakes	44.906986	13.757572	0	25.-27.05.2016., 8.-10.08.2016., 26.-28.09.2016.
3.	Veliki Brijun Island, abandoned swimming pool	44.913577	13.767283	9	25.-27.05.2016., 8.-10.08.2016., 26.-28.09.2016.
4.	Veliki Brijun Island, water basin within ruins	44.909312	13.755346	2	25.-27.05.2016., 8.-10.08.2016., 26.-28.09.2016.
5.	Mali Brijun Island, brackish pond	44.933998	13.741423	3	26.05.2016.

The comparison of the Odonata diversity of the Brijuni NP with that of other islands in the northern Adriatic is given in Tab. 3. The island of Cres had the most similar number of species (16) but differed greatly in comparison to the number of species/km<sup>2</sup> which was 0.04 in Cres but 2.44 in Veliki Brijun. In that respect, Veliki Brijun had the greatest number of species/km<sup>2</sup> of all the six islands compared.

**Tab. 2.** Systematic list of recorded species and the total number of observed individuals per locality in the Brijuni NP, species status in the Red book of Croatian dragonflies (BELANČIĆ *et al.*, 2008), and zoogeographical affiliation (STERNBERG, 1998; DIJKSTRA & LEWINGTON (2006).

	Odonata species	Brijuni pond (nr. of individuals)	Saline (nr. of individuals)	Croatian red book*	Zoogeographical affiliation
1.	<i>Coenagrion puella</i> (Linnaeus, 1758)	5	/	/	Ponto-Mediterranean
2.	<i>Coenagrion scitulum</i> (Rambur, 1842)	46	/	/	Atlantic-Mediterranean
3.	<i>Erythromma viridulum</i> (Charpentier, 1840)	>300	2	/	Atlantic-Mediterranean
4.	<i>Ischnura elegans</i> (Vander Linden, 1820)	4	1	/	Euroasian
5.	<i>Chalcolestes parvidens</i> Artobolevsky, 1929	34	30	DD	Ponto-Mediterranean
6.	<i>Aeshna affinis</i> Vander Linden, 1820	/	4	/	Holomediterranean
7.	<i>Anax imperator</i> Leach, 1815	10	7	/	Holomediterranean
8.	<i>Anax parthenope</i> (Selys, 1839)	1	1	NT	Ponto-Mediterranean
9.	<i>Crocothemis erythraea</i> (Brullé, 1832)	20	4	/	Holomediterranean
10.	<i>Orthetrum cancellatum</i> (Linnaeus, 1758)	7	/	/	Holomediterranean
11.	<i>Sympetrum fonscolombii</i> (Selys, 1840)	/	24	NT	Holomediterranean
12.	<i>Sympetrum meridionale</i> (Selys, 1841)	22	>200	NT	Holomediterranean
13.	<i>Sympetrum striolatum</i> (Charpentier, 1840)	/	2	/	Holomediterranean
	Number of species per locality:	10	10		

**Tab. 3.** Odonata species richness of the Brijuni NP compared with species richness of other north Adriatic islands.

	Island	Surface/km <sup>2</sup>	Number of species	Species/km <sup>2</sup>	Literature
1.	Veliki Brijun	5.72	14	2.44	PUSCHNIG, 1913, 1914; this survey
2.	Cres	405.78	16	0.04	ST. QUENTIN, 1944; FRANKOVIĆ, 1997(a)
3.	Lošinj	74.37	2	0.03	ŠALAMUN & BEDJANIČ, 1997
4.	Krk	405.78	41	0.10	ST. QUENTIN, 1944; MATONIČKIN, 1987; FINKENZELLER, 2010; OLIAS & SERBEDIA, 1998; BOGDANOVIĆ & GRGIĆ, 2015
5.	Rab	86.11	7	0.08	ST. QUENTIN, 1944; GEELEN & OOMEN, 1965; MAUERSBERGER, 1994;
6.	Pag	284.18	23	0.08	FRANKOVIĆ & BEDJANIČ, 1998

## DISCUSSION

This study increased our knowledge about the Odonata assemblages in freshwater habitats of Adriatic islands, which is generally scarce, and outdated with a few recent exceptions (FRANKOVIĆ & BOGDANOVIĆ, 2010; ŠTIH *et al.*, 2020). For the Brijuni National Park, the only published data dates back to the early 20<sup>th</sup> century when only three species were recorded: *Sympecma fusca* (Vander Linden, 1820), *Sympetrum striolatum* (Charpentier, 1840), and *Crocothemis erithraea* (Brullé, 1832) (PUSCHING, 1913, 1914). The last two species were confirmed during our survey, but we did not observe the previously recorded *S. fusca*. This is a Holomediterranean species that inhabits various freshwater habitats, including small ponds and streams (DIJKSTRA & LEWINGTON, 2006), and is present in most parts of Croatia (BOUDOT & DOMMANGET, 2015). As the habitats for this species are present on the island, the reconfirmation of this species in the future is expected, especially with field visits conducted earlier in the year.

Combining the literature data, and the results of this survey, 14 Odonata species are currently known for Brijuni Islands. This number represents 20% of the 71 Odonata species in Croatia (FRANKOVIĆ & BOGDANOVIĆ 2009; FINKENZELLER 2010) and could be considered as relatively high regarding the small number of available habitats.

In comparison with other islands in the northern Adriatic, Krk, the island with the largest surface area, had the highest number of recorded species (i.e. 41). This is not surprising as the island is already well known for its insect diversity due to the large surface and variety of habitat types (HABELER, 2003). The two islands with the lowest number of species are also the least surveyed ones, Lošinj and Rab, with two and seven recorded species, respectively (Tab. 3). In terms of species richness, Veliki Brijun is in the fourth place among the analyzed islands, most probably due to its small surface area but with two adequate habitats for Odonata (containing diverse water microhabitats and well-developed aquatic vegetation). It is more than certain that with additional surveys on some Adriatic islands, additional species will be revealed. That is especially true for the island of Rab, which contains a rather large number of different wetlands (Sučić *et al.*, 2018) and is still highly under-surveyed in terms of Odonata diversity. However, for the comparison to be more accurate, it is essential to conduct systematic surveys on other Adriatic islands as the current knowledge concerning most of them is far from satisfactory.

From the five visited locations, three of them were not appropriate for dragonflies. The two other artificial habitats on Veliki Brijun, the basin and abandoned swimming pool were not appropriate for the dragonflies as they do not contain any water vegetation or fauna. The locality on Mali Brijun Island is brackish and it seems that it contains water only after heavy rains. No adults were observed at the locality or anywhere in the vicinity. Accordingly, the locality was deemed inappropriate for the development of dragonflies and was not visited during consequent field visits.

In comparison with other analyzed islands, the dragonfly fauna of Veliki Brijun Island, as well as Brijuni NP can now be considered as well-known, even though only two of the five surveyed localities were suitable for dragonflies. Both of them harbored the same number of species, i.e. ten, but the species composition and abundance were different (Tab. 2). The differences in Odonata assemblages are related to the differences in those two habitats, e.g. high differences in vegetation structure and microhabitat composition were observed. Brijuni Pond is very eutrophic, and as such, provides an adequate habitat for species preferring densely submerged and rich coastal vegetation such as *Erythromma viridulum* (Charpentier, 1840) or *Coenagrion* spp. (SMALLSHIRE & SWASH, 2014). On the other hand, the Saline Lakes are almost completely devoid of such vegetation and the mentioned species were there observed in very low numbers. On the Saline Lakes, the genus *Sympetrum* was the most numerous with a large number of observed specimens, both as teneral and adults. This is most probably due to their broad ecological habitat preference allowing them to inhabit and reproduce in different freshwater habitats (DIJKSTRA & LEWINGTON, 2006).

Moreover, Brijuni Pond is also characterized by a deep layer of mud, which will result in the slow disappearance of the pond if it is not regularly maintained. Also, the surrounding forest vegetation prevents the development of riparian vegetation such as reeds, which is necessary for life cycle completion of many Odonata (i.e. it is important both adults and nymphs) (ASKEW, 2004). The reeds are nowadays developed on a very limited part of the pond, and due to the very dense shrubs and trees providing shadow over them, they are likely to disappear in the near future.

On the other hand, the habitat in the Saline Lakes is very suitable for *Sympetrum* spp. as several dozens, both teneral and adult, individuals were observed there. Yet, one of three Saline Lakes is now almost completely covered with reed beds, with limited amounts of open water, which is essential for the adults' foraging and feeding (CORBET & BROOKS, 2008).

Four of the recorded species are present in the Red Book of Dragonflies of Croatia (BELANČIĆ *et al.*, 2008), indicating the conservation value of the investigated habitats. Three of them *Anax parthenope*, *Sympetrum fonscolombii*, and *Sympetrum meridionale* are listed as near threatened (NT) and one, *Chalcolestes parvidens* as data deficient (DD).

*Chalcolestes parvidens* is a west Mediterranean species locally distributed in the Balkan peninsula (DIJKSTRA & LEWINGTON, 2006). The occurrence of this species was not surprising, as it has been recently found on several other Adriatic islands (e.g. FRANKOVIĆ & BOGDANOVIĆ, 2010). Its distribution in Croatia is still not very well understood (see FRANKOVIĆ, 1997(b); BELANČIĆ *et al.*, 2008), due to misidentification with the similar, *Chalcolestes viridis* (Vander Linden, 1825), from which it may be reliably distinguished only by the examination of the male or female genitals (DIJKSTRA & LEWINGTON, 2006). *Chalcolestes parvidens* inhabit small ponds and lakes, surrounded by dense vegetation (DIJKSTRA & LEWINGTON, 2006). It was recorded on both localities on Veliki Brijun Island, where also tandems and individuals in copulation were observed.



Furthermore, a near threatened *Anax parthenope* was so far recorded in isolated populations across Croatia (BELANČIĆ *et al.*, 2008; BOGDANOVIĆ *et al.*, 2008; DUMONT, 1977; FRANKOVIĆ, 1998; OLIAS & SERBEDIA, 1998). During our survey, only two male individuals were observed on the Veliki Brijun Island, one per locality. The Saline habitat corresponds to the species' habitat preferences: large standing water bodies (DIJKSTRA & LEWINGTON, 2006). With further surveys, including the investigation of nymphs, the species could be confirmed as a resident on the island.

The two additional near threatened (NT) species, *Sympetrum fonscolombii* and *Sympetrum meridionale* are rather common in standing water-bodies along the whole Croatian coastal area (BELANČIĆ *et al.*, 2008), including the Brijuni Islands.

As expected, the zoogeographical analysis of the species recorded on Veliki Brijun showed the domination of Mediterranean elements, which was expected due to the geographical position of the study area as well the general distribution of the dragonfly species in the Mediterranean region (BOUDOT & DOMMANGET, 2015).

Due to the small size of the island, it is not surprising that the number of species/km<sup>2</sup> is larger on Veliki Brijun than in the other five islands. Indeed, this can be an indication of two things. Firstly, even a small number of small, but suitable, freshwater habitats can contain a large number of dragonfly species (ASKEW, 2004), and secondly, most of the islands (except for Krk (St. QUENTIN, 1944; MATONIČKIN, 1987; FINKENZELLER, 2010; OLIAS & SERBEDIA, 1998; BOGDANOVIĆ & GRGIĆ, 2015) are still not sufficiently surveyed and should be targets of additional surveys in the future.

This survey can be used as a baseline for future surveys of the Odonata species richness and status of their populations within the Brijuni National Park. Two of the five existing freshwater habitats are suitable for the development of various dragonfly species; therefore, they must be properly maintained and conserved for the future. While the current status of both freshwater habitats on the islands is at the moment favorable for dragonflies, it is likely they will deteriorate within a short time without conservation activities. Mediterranean freshwater habitats are among the most endangered habitats in the Mediterranean (ZACHARIAS & ZAMPARAS, 2010), thus, the protected area should maintain the habitats and keep them in a favorable state. Hence, habitat restoration actions should be planned and conducted in the near future.

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