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INTERESTING RECORDS OF ODONATA IN FRIULI VENEZIA GIULIA (NORTH-EASTERN ITALY) IN THE THREE-YEAR PERIOD FROM 2016 TO 2018

INTERESSANTI SEGNALAZIONI DI ODONATA
IN FRIULI VENEZIA GIULIA (ITALIA NORD-ORIENTALE)
NEL TRIENNIO 2016-2018

Abstract - Thanks to the surveys of B. Kiauta and I. Pecile, the Odonata fauna of Friuli Venezia Giulia was relatively well known until the mid 1980s. In recent years, an effort has been made to collect new information for the “Atlas of the Odonata of the Friuli Venezia Giulia region”, a project established in 2009. In this paper, the most striking results of the 2016-2018 period are reported. Two species, *Coenagrion ornatum* (SELYS, 1850) and *Leucorrhinia pectoralis* (CHARPENTIER, 1825), must be inserted in the new regional list (with data collected since 2009), which now includes 64 species representing 67% of the Odonata fauna currently known for Italy. In particular, both *C. ornatum* and *L. pectoralis* are listed in the Annexes of the Habitats Directive. In addition, records relating to another 15 species are reported, among which are rare and threatened species or those of faunistic interest. The main factors threatening the survival of some species are discussed and the need to implement conservation projects is affirmed, in particular concerning: i) *Nehalennia speciosa* (CHARPENTIER, 1840); ii) *Cordulegaster heros* THEISCHINGER, 1979; and iii) some alpine species, including *Somatochlora alpestris* (SELYS, 1840) and *S. arctica* (ZETTERSTEDT, 1840).

Key Words: Damselflies, Dragonflies, Faunistic survey, Diversity, Conservation.

Riassunto breve - Grazie alle indagini di B. Kiauta e I. Pecile la fauna a Odonata del Friuli Venezia Giulia era relativamente nota fino a metà degli anni '80 del secolo scorso. Negli ultimi anni, è stato fatto uno ulteriore sforzo per raccogliere nuove informazioni nell'ambito del Progetto “Atlante degli Odonati della regione Friuli Venezia Giulia”, avviato nel 2009. Nel presente lavoro sono riportati i risultati più notevoli acquisiti nel periodo 2016-2018. Due ulteriori specie, *Coenagrion ornatum* (SELYS, 1850) e *Leucorrhinia pectoralis* (CHARPENTIER, 1825) devono essere incluse nel nuovo elenco regionale (con dati raccolti dal 2009), che ora comprende 64 specie che rappresentano il 67% della Odonatofauna attualmente conosciuta per l'Italia. In particolare, *C. ornatum* e *L. pectoralis* sono inclusi negli Allegati della Direttiva Habitat. Inoltre, sono riportate segnalazioni di altre 15 specie, tra quelle più rare, minacciate o comunque di interesse faunistico. Vengono discussi i principali fattori che mettono in pericolo la sopravvivenza di alcune specie e viene ribadita la necessità di mettere in atto progetti di conservazione, in particolare per quanto riguarda: i) *Nehalennia speciosa* (CHARPENTIER, 1840); ii) *Cordulegaster heros* THEISCHINGER, 1979; e iii) alcune specie alpine, quali *Somatochlora alpestris* (SELYS, 1840) e *S. arctica* (ZETTERSTEDT, 1840).

Parole chiave: Damigelle, Dragoni, Indagine faunistica, Biodiversità, Conservazione.

1. Introduction

The Odonata fauna of the Friuli Venezia Giulia region (FVG), in north-eastern Italy, was relatively well known after the publication of the seminal works of KIAUTA (1969) and PECILE (1984). In recent years, further effort has been made to collect new information for the “Atlas of the Odonata of the Friuli Venezia Giulia region”, a project that was commenced in 2009. The new regional list appeared in 2011 (FIORENZA et al. 2012) with 50 species. Later, on the basis of new records, two updates of the list were published (FIORENZA et al. 2013; ZANDIGIACOMO et al. 2015) (57 and 62 species respectively).

Of particular interest is the presence in FVG of two species with reproductive populations. *Nehalennia speciosa* (CHARPENTIER, 1840) is currently present only in the Lazzacco Peat bog (municipality of Pagnacco, UD), located in the morainic hills (FIORENZA & PECILE 2009; CHIANDETTI et al. 2014; ZANDIGIACOMO et al. 2015). The species occurs in several areas across Eurasia, but currently exists in extremely small and scattered localities where the available habitats show a dramatic decline (BERNARD & WILDERMUTH 2005). *Cordulegaster heros* THEISCHINGER, 1979, listed in the Annexes II and IV of the Habitats Directive, is present in some pre-alpine streams (BEDJANIĆ & ŠALAMUN

2003; CHIANDETTI et al. 2013, 2015). It is a central and south-eastern European species, locally common, but scattered. Its specific habitats (shaded streams in mountain areas) are continuing to decrease.

Two other important species are known for FVG only from old reports. *Coenagrion ornatum* (SELYS, 1850), listed in the Annex II of the Habitats Directive, was found in the “Monfalcone lagoon” (STROBL 1906) near Trieste (KIAUTA 1969) and Fusine near Tarvisio (PECILE 1984). Its range occurs from north-western Europe to south-western Asia. *Leucorrhinia pectoralis* (CHARPENTIER, 1825), listed in the Annexes II and IV of the Habitats Directive, was reported for a pond in the Karst area (KIAUTA 1969) and a pond in the pre-alpine area (PECILE 1983). Its range occurs from France and Sweden to western Siberia.

This note deals with the most interesting new records collected during the 2016-2018 period, related to rare or threatened species or those of faunistic interest for Friuli Venezia Giulia.

2. Materials and methods

In the three-year period from 2016 to 2018, several observations concerning Odonata adults were carried out in different sites across FVG as in previous surveys (FIORENZA et al. 2012, 2013; ZANDIGIACOMO et al. 2015). Digital cameras were used extensively to photograph specific details useful for the identification of the different species. Some adults were collected with an entomological net, identified on site and immediately released. In the case of particularly interesting records, for example involving species that had not been detected previously at sites considered new or unusual, further field research was carried out to confirm the results of the initial observations.

For the identification of the adults we referred to various manuals, in particular to the volumes of DIJKSTRA & LEWINGTON (2006), GRAND & BOUDOT (2006), BELLMANN (2013) and GALLIANI et al. (2014). Additionally, various experts in Odonata identification were consulted. Moreover, as comparison material, specimens already identified and present in the entomological collections of the Dipartimento di Scienze AgroAlimentari, Ambientali e Animali at the University of Udine, or the personal collections of a number of the authors were used.

The complete database of Odonata fauna recorded in the region is regularly updated by authors of this work and members of the Italian Society for the Study and Conservation of Dragonflies “Odonata.it”.

A large number of observations have also been entered into the “Ornitho” database, an internet platform for the collection and validation of records of several faunistic groups, in particular birds, reptiles, amphibians,

mammals and odonates (the latter in close cooperation with Odonata.it). The nomenclature used is according to RISERVATO et al. (2014a).

The following abbreviations are used in the text: AM = Alexandro Minicò; AS = Andrea Solari; GN = Gessica Nadalon; IC = Ivan Chiandetti; OS = Ornella Sclauzero; RP = Renato Pontarini; TF = Tiziano Fiorenza. Acronyms of the region and the administrative districts: FVG = Friuli Venezia Giulia region; BS = Brescia; GO = Gorizia; MB = Monza and Brianza; MN = Mantova; PN = Pordenone; TS = Trieste; TV = Treviso; UD = Udine; VE = Venezia. Other abbreviations: ex./exx. = specimen/specimens; obs. = observavit/observaverunt.

3. Results and discussion

3.1. New species added to the list that have been noted previously in the region

Coenagrion ornatum (SELYS, 1850) (Fig. 1)

Records: 1♂, 25.V.2018, along the Menariolo Torrent (Muggia, TS) (8 m a.s.l.) (Fig. 2), a small stream tributary of the Rio Ospo (observation carried out near the protected regional area called “Biotopo dei Laghetti delle Noghere”), IC obs.

Notes: The observed specimen confirms the occurrence of *C. ornatum* within the territory of FVG. In the past, the species was reported by STROBL (1906) as “häufiger in den Lagunen von Monfalcone; Mai bis Juli”, by KIAUTA (1969) for “Triest”, and by PECILE (1984) for the mountain area of Tarvisio (“near Fusine”). At the moment it is not possible to speculate about reproductive events of the species at the site. The male observed was probably a vagrant individual, but the reproductive site of origin is likely not far from the site of observation. Within five to 10 kilometres from the discovery site, four sites, where the species was observed, are known in the south-western part of Slovenia in the Littoral region, along a line from Portorose/Portorož to Crisoglie/Hrastovlje (KOTARAC 1997). *C. ornatum* is not reported from the eastern plains of the Veneto region (DALLA VIA & ZANETTI 2015). The species is very rare in the Land of Carinthia (Austria) (considered as Critically Endangered, CR) (HOLZINGER & KOMPOSCH 2012) and rare in Slovenia (considered as Vulnerable, VU) (KOTARAC 1997). *C. ornatum* is listed in the Annex II of the Habitats Directive.

Leucorrhinia pectoralis (CHARPENTIER, 1825) (Fig. 3)

Records: 1♂, 17.V.2018, Rutte Piccolo (Tarvisio, UD) (800 m a.s.l.) (Fig. 4), an artificial pond, RP obs.

Notes: The observed specimen confirms the occurrence of the species within FVG after the old



Fig. 1 - Male of *Coenagrion ornatum*; 25.V.2018, Menariolo Torrent (Muggia, TS; photo by I. Chiandetti).

- *Maschio di Coenagrion ornatum*; 25.V.2018, Torrente Menariolo (Muggia, TS; foto I. Chiandetti).



Fig. 2 - Overview of the Torrente Menariolo stream (Muggia TS, 25.V.2018; photo by I. Chiandetti).

- *Panoramica del Torrente Menariolo* (Muggia, TS, 25.V.2018; foto I. Chiandetti).

records reported by KIAUTA (1969) for the Pond of Percedol in the Karst area, and by PECILE (1983) for Laghetto Minisini, a pond near Gemona del Friuli (UD). The found specimen must for now be considered a vagrant, but it is not possible to exclude occasional reproduction of the species at this site. The artificial pond of Rutte Piccolo, that has an area of approximately

150 m² and a maximum depth of about 2 m with, hosts a rich aquatic flora including *Nymphaea* sp., whereas *Typha latifolia*, *Carex* sp. and *Salix* spp. are present along the banks. Therefore, it seems suitable as a reproductive site for this species, but also for other Odonata. During the observations carried out on 17.V.2018, alongside the male of *L. pectoralis*, adults of *Sympecma fusca* (VANDER LINDEN, 1820), *Pyrrhosoma nymphula* (SULZER, 1776), *Coenagrion hastulatum* (CHARPENTIER, 1825) (see below), *Anax imperator* LEACH, 1815, *Libellula depressa* LINNAEUS, 1758 and *Sympetrum fonscolombii* (SELYS, 1840) were found. Moreover, emerging adults of *Coenagrion puella* (LINNAEUS, 1758), *A. imperator* and *L. quadrimaculata* LINNAEUS, 1758, and some exuviae of *Cordulia aenea* (LINNAEUS, 1758) were observed (IC obs.). At the same site, two specimens of *Aeshna grandis* (LINNAEUS, 1758) in tandem were found in 2017 (see below) and some adults of *Erythromma najas* (HANSEMAN, 1823) were observed in 2018 (see below). An occurrence site of *L. pectoralis* is known in the Gail valley (Carinthia) (HOLZINGER & KOMPOSCH 2012), not far from Rutte Piccolo (the distance between the two sites is approximately 10 km). The species is rare in Carinthia (considered as Endangered, EN) (HOLZINGER & KOMPOSCH 2012) and very rare in Slovenia (considered as Critically Endangered, CR) (KOTARAC 1997). *L. pectoralis* is listed in the Annexes II and IV of the Habitats Directive.

3.2. Species confirmed in the list that are rare or threatened or of faunistic interest

Chalcolestes parvidens (ARTOBOLEVSKY, 1929) (Fig. 5)

Records: Some exx., 15.IX.2016, Isola della Cona (Staranzano, GO) (1 m a.s.l.), a wet coastal area in the



Fig. 3 - Male of *Leucorrhinia pectoralis*; 17.V.2018, Rutte Piccolo (Tarvisio, UD; photo by R. Pontarini).

- *Maschio di Leucorrhinia pectoralis*; 17.V.2018, Rutte Piccolo (Tarvisio, UD; foto R. Pontarini).



Fig. 4 - Overview of the artificial pond at Rutte Piccolo (Tarvisio, UD; photo by I. Chiangetti).

- *Panoramica della pozza artificiale a Rutte Piccolo* (Tarvisio, UD; foto I. Chiangetti).

Regional Nature Reserve of the Isonzo River Mouth, TF obs.; some ♂♂ and ♀♀, 15.IX.2016, Isola di Sant'Andrea (Marano Lagunare, UD) (1 m a.s.l.), a wet coastal area with bushes facing the Marano lagoon, TF obs.; some exx., 24.IX.2016, Valle Cavanata (Grado, GO) (1 m a.s.l.), a wet coastal area included in a Regional Nature Reserve, IC obs.; some exx., 28.VIII.2017, Isola della Cona (Staranzano, GO), same site as before, TF obs.; 1♂, 30.IX.2017, near Palazzolo dello Stella (UD) (5 m a.s.l.), an artificial pond, IC obs.; 2♂♂, 07.X.2017, Laghetti delle Noghere (Muggia, TS) (8 m a.s.l.), a group of artificial ponds in a protected biotope, IC obs.; 1♂, 15.X.2017, Lago di Doberdò (Doberdò del Lago, GO) (7 m a.s.l.), a wet site in the Karst area included in a Regional Nature Reserve, IC obs.; 1♂, 15.X.2017, Laghetti delle Mucille (Ronchi dei Legionari, GO) (8

m a.s.l.), some artificial ponds, IC obs.; some exx., 23.VII.2018, Isola della Cona (Staranzano, GO), same site as before, TF obs.; some exx. ♂♂ and ♀♀ (some exx. in tandem), 14.XI.2018, Valle Cavanata (Grado, GO) (1 m a.s.l.), same site as before, TF obs.

Notes: Also these new records indicate that the species is prevalent in coastal and lowland areas of FVG, as reported in previous surveys (ZANDIGIACOMO et al. 2015; UBONI et al. 2018). The appearance of adults is rather late (late July-mid November period) compared to other Odonata species. *C. parvidens* was observed at several sites on the eastern plains of the Veneto region (DALLA VIA & ZANETTI 2015). In Carinthia the species has been observed only recently (BRUNNER et al. 2013) and its conservation status is not known. In Slovenia the species is present in north-eastern areas and on



Fig. 5 - Female of *Chalcolestes parvidens*; 15.IX.2016, Isola della Cona (Staranzano, GO; photo by T. Fiorenza).

- Femmina di *Chalcolestes parvidens*; 15.IX.2016, Isola della Cona (Staranzano, GO; foto T. Fiorenza).



Fig. 6 - A couple of *Coenagrion hastulatum* in tandem; 17.VI.2017, Laghetto di Somdogna (Dogna, UD; photo by I. Chiandetti).

- Coppia di *Coenagrion hastulatum* in tandem; 17.VI.2017, Laghetto di Somdogna (Dogna, UD; foto I. Chiandetti).

the Adriatic coast including the nearby adjacent Karst plateau (OLIAS et al. 2007) and its conservation status is not known. However, the range of *C. parvidens* is not known precisely because of its similarity to the congeneric *C. viridis* (VAN DER LINDEN, 1825) and the

fact that the two species were often not distinguished. In some European locations, including north-eastern Italy, *C. parvidens* and *C. viridis* co-exist and they also produce hybrids (OLIAS et al. 2007).

Coenagrion hastulatum (CHARPENTIER, 1825) (Fig. 6)

Records: Some exx., 02.VII.2016, Laghetto di Somdogna (Dogna, UD) (1442 m a.s.l.), a mountain pond, IC obs.; 1♂, 02.VII.2016, Sella di Somdogna (Dogna, UD) (1389 m a.s.l.), two mountain pasture pools, IC obs.; 1♂ e 1♀ (in tandem), 17.VI.2017, Laghetto di Somdogna (Dogna, UD), same site as before, IC obs.; 1 ex., 19.V.2018, Rutte Piccolo (Tarvisio, UD) (800 m a.s.l.), an artificial pond, IC obs.

Notes: These new records confirm the occurrence of this boreo-alpine species in the north-eastern mountain areas of Friuli Venezia Giulia, as already reported (PECILE 1991; FIORENZA et al. 2013; ZANDIGIACOMO et al. 2015). The species is also present in the Gail valley (Carinthia) not far from the Tarvisio area (HOLZINGER & KOMPOSCH 2012). *C. hastulatum* is rare in Carinthia (considered as endangered, EN) (HOLZINGER & KOMPOSCH 2012). The species was considered as regionally extinct (RE) in Slovenia (KOTARAC 1997), however, in 1999 a breeding population was rediscovered in a pool in the Pohorje mountains in the north-eastern part of the country (BEDJANIČ & WELDT 2000).

Erythromma najas (HANSEMANN, 1823) (Fig. 7)

Records: 1♂, 27.V.2018, Rutte Piccolo (Tarvisio, UD) (800 m a.s.l.), an artificial pond, RP obs.; 2♂♂, 01.VI.2018, Rutte Piccolo (Tarvisio, UD), same site as before, RP obs.; 1♂, 03.VI.2018, Rutte Piccolo (Tarvisio, UD), same site as before, TF, IC & RP obs.



Fig. 7 - Male of *Erythromma najas*; 03.VI.2018, Rutte Piccolo (Tarvisio, UD; photo by T. Fiorenza).

- *Maschio di Erythromma najas*; 03.VI.2018, Rutte Piccolo (Tarvisio, UD; foto T. Fiorenza).



Fig. 8 - Male of *Aeshna grandis*; 08.VIII.2017, Rutte Piccolo (Tarvisio, UD; photo by R. Pontarini).

- *Maschio di Aeshna grandis*; 08.VIII.2017, Rutte Piccolo (Tarvisio, UD; foto R. Pontarini).

Notes: The species has already been reported for the same site in 2013 (ZANDIGIACOMO et al. 2015). However, only male specimens, probably vagrant, had been observed in this site. In the area there are other sites potentially suitable for the species and it is possible that it is present more constantly than has been detected

until now. *E. najas* was also found in the Gail valley (Carinthia) not far from the Tarvisio area (HOLZINGER & KOMPOSCH 2012). The species is common both in Carinthia (considered as Least Concern, LC) (HOLZINGER & KOMPOSCH 2012) and in Slovenia (considered as not threatened) (KOTARAC 1997).

Nehalennia speciosa (CHARPENTIER, 1840)

Records: Some ♂♂ and 1♀, 24.V.2016, Torbiera di Lazzacco (Pagnacco, UD) (189 m a.s.l.), a peat bog in the morainic hilly area in a protected biotope, IC & TF obs.; some exx., 24.VI.2016, Torbiera di Lazzacco (Pagnacco, UD), same site as before, TF obs.; some exx., 01.VII.2017, Torbiera di Lazzacco (Pagnacco, UD), same site as before, IC, TF, AM & AS obs.; 7 exx., 18.VI.2018, Torbiera di Lazzacco (Pagnacco, UD), same site as before, IC obs.; 1♀, 13.VII.2018, Torbiera di Lazzacco (Pagnacco, UD), same site as before, TF obs.

Notes: The surveys conducted in the three-year period 2016-2018 confirm the continuous presence of the species, at risk of local extinction, in the only site in FVG and north-eastern Italy. Torbiera di Lazzacco is an ecologically compromised site, as the surface of the peat bog is shrinking and a widespread invasion of bushes is observed, while in the nearby areas the forest increases. Therefore, it is imperative to carry out habitat restoration actions to support the small population of *N. speciosa*, as suggested by BERNARD & WILDERMUTH (2005). The nearby peat bog of Brazzacco (a historical reproductive site in the municipality of Moruzzo (UD), included in the same protected biotope), almost completely invaded by *Phragmites australis* and bushes, no longer hosts a population of *N. speciosa*. Recently, a reproductive population of *N. speciosa* has been



Fig. 9 - Male of *Anax ephippiger*; 17.IV.2016, Valle Grotari (Marano Lagunare, UD; photo by I. Chiandetti).

- *Maschio di Anax ephippiger*; 17.IV.2016, Valle Grotari (Marano Lagunare, UD; foto I. Chiandetti).

discovered in a peat bog at 550 m a.s.l. in the district of Varese, in Lombardy (north-western Italy) (AGUZZI et al. 2017). Therefore, in this latter site exist the second population of the species currently known in Italy. The species is very rare in Carinthia (considered as Critically Endangered, CR) (HOLZINGER & KOMPOSCH 2012), while in Slovenia it is not present (KOTARAC 1997).

Aeshna grandis (LINNAEUS, 1758) (Fig. 8)

Records: 1♂, 23.VII.2016, along the Rio Lussari (Tarvisio, UD) (1000 m a.s.l.), a mountain stream, IC obs.; 1♂ and 1♀ (in tandem), 08.VIII.2017, Rutte Piccolo (Tarvisio, UD) (800 m a.s.l.), an artificial pond, RP obs.; 1♂, 09.VIII.2017, Rutte Piccolo (Tarvisio, UD), same site as before, IC obs.; 1♀ (in oviposition), 09.VIII.2017, Rutte Piccolo (Tarvisio, UD), same site as before, RP obs.; 1 ex., 21.VI.2018, Val Filza bassa, loc. Gacceman, Ugovizza (Malborghetto-Valbruna, UD) (1280 m a.s.l.), a clearing in a spruce forest, RP obs.; 1♀, 16.VII.2018, Coccau (Tarvisio, UD) (800 m a.s.l.), a clearing in a mixed forest near the Rio dei Carri, RP obs.

Notes: Adults in tandem and ovipositing females were observed for the first time in Friuli Venezia Giulia. Given the suitability of the Rutte Piccolo pond, it is possible that the species reproduced locally. The species had already been reported, in the Tarvisio area, by KIAUTA (1971), PECILE (1991) and ZANDIGIACOMO et al. (2015). *A. grandis* is also present in the Gail valley (Carinthia) not far from the Tarvisio area (HOLZINGER & KOMPOSCH 2012). The species is common in Carinthia (considered as Least Concern, LC) (HOLZINGER & KOMPOSCH 2012), while in Slovenia it is present only at a few sites with small populations (considered as Vulnerable, VU) (KOTARAC 1997).

Anax ephippiger (BURMEISTER, 1839) (Fig. 9)

Records: 1♀, 16.IV.2016, Paludi del Corno (Gonars, UD) (14 m a.s.l.), a wet area in a protected biotope, IC obs.; 1 M, 17.IV.2016, Aussa Corno (Carlino, UD) (0 m a.s.l.), an artificial pond, IC obs.; 1♂, 17.IV.2016, Valle Grotari (Marano Lagunare, UD) (0 m a.s.l.), a wet coastal area in a Regional Nature Reserve, IC obs.; some exx. (including a couple in tandem and in oviposition), 18.IV.2016, area of "ripristini" (Bertiolo, UD) (22 m a.s.l.), a wet area subjected to environmental restoration included in the protected area called "Biotopo delle Risorgive di Virco", OS obs.; 2♂♂, 19.IV.2016, Magredi di San Quirino (San Quirino, PN) (155 m a.s.l.), a wet meadow with *Schoenus nigricans* near the Cellina River (right bank), TF obs.; 1♂, 25.IV.2016, Paludi del Corno (Gonars, UD), same site as before, IC obs.; 1♂, 15.V.2016, Paludi del Corno (Gonars, UD), same site as before, IC obs.

Notes: The species is strongly migratory from the arid regions of Africa and Asia, and occasionally spreads to Central and Northern Europe (DIJKSTRA & LEWINGTON 2006; BOUDOT et al. 2009). Therefore, the adults found in April and May 2016 in coastal and lowland areas of FVG are probably vagrants, although there is the possibility that the species might occasionally reproduce in this region. In 2017, adults of *A. ephippiger* were observed also in Spilimbergo (PN) (UBONI et al. 2018). Previously, the occurrence of *A. ephippiger* in FVG was reported as scattered records: i) in 1998, in two localities in the Karst area (BOGNOLO & PECILE 1995); ii) in 2007 at Trieste (UBONI 2008); iii) in 2008, in the Regional Nature Reserve of the Isonzo River Mouth (MEKKES, 2008); iv) in 2010, an exuvia was found in the Lisert brackish area, near Monfalcone (GO), indicating a reproductive event, the first observed



Fig. 10- Male of *Cordulegaster heros*; 07.VII.2017, Savorgnano del Torre (Povoletto, UD; photo by I. Chiandetti).

- *Maschio di Cordulegaster heros*; 07.VII.2017, Savorgnano del Torre (Povoletto, UD; foto I. Chiandetti).

in NE Italy (UBONI et al. 2018). In the Veneto region, occasionally *A. ephippiger* adults were observed in some sites on the eastern plains (DALLA VIA & ZANETTI 2015); in 2016, a couple of adults of *A. ephippiger* in tandem and in oviposition were photographed by R. Pellizzon (20.IV.2016) in the “Natura 2000” site named “Cave di Noale”, in a restored plain area with several artificial pools (Noale, VE) (M. Dalla Via, pers. comm). The species occurs in Carinthia only as vagrant adults (HOLZINGER & KOMPOSCH 2012), while in Slovenia it is rare (considered as Vulnerable, VU) (KOTARAC 1997).

Cordulegaster heros (THEISCHINGER, 1979) (Fig. 10)

Records: 1♂, 03.VII.2016, along the Rio Storto near Savorgnano del Torre (Povoletto, UD) (200 m a.s.l.), a small stream, IC obs.; 1♂, 17.VII.2016, along the Rio Rabagnolo near Sedilis (Tarcento, UD) (288 m a.s.l.), a small stream, IC obs.; 1♂, 01.VII.2017, along the Rio Storto near Savorgnano del Torre (Povoletto, UD), same site as before, IC, TF, AM & AS obs.; 2♂♂, 09.VII.2017, near Campeglio (Torreano di Cividale, UD) (210 m a.s.l.), a small stream on the bottom of a narrow valley called “Busa di Culigna”, IC obs.; 1♂, 09.VII.2017, along the Rio Storto near Savorgnano del Torre (Povoletto, UD), same site as before, IC obs.; 1♂, 22.VI.2018, along the Rio Storto near Savorgnano del Torre (Povoletto, UD), same site as before, IC obs.; 3♂♂, 28.VII.2018, along the Rio Smiardar near Cormons (Cormons, GO) (100 m a.s.l.), a small stream in a protected area, IC obs.; 2♂♂, 10.VIII.2018, Bosco di Plessiva (Cormons, GO) (90 m a.s.l.), a woody area near the Fidri Stream, IC obs.

Notes: The observed males confirm the occurrence of *C. heros* in the Torre Torrent basin, where it probably reproduces, considering the favourable ecological characteristics of several foothill streams. For now, only

an emerging adult has been detected at the Savorgnano del Torre site in the Rio Storto basin (ZANDIGIACOMO et al. 2015), indicating that this area represents a breeding site. In order to conserve the species in FVG (listed in the Annexes II and IV of the Habitats Directive), a protected area (pSIC IT3330010 - Valle del Rio Smiardar, an area of 193 hectares) was established in 2016 in the territory of the municipality of Cormons (GO) along the Smiardar Stream, a tributary of the Isonzo River. In Italy, *C. heros* was observed only in Friuli Venezia Giulia. The species is rare in Carinthia (considered as Endangered, EN) (HOLZINGER & KOMPOSCH 2012), while in Slovenia it is present in several sites but considered as Vulnerable (VU) (KOTARAC 1997).

Somatochlora alpestris (SELYS, 1840)

Records: 1♂ and 1♀, 24.VII.2016, near Passo Pura (Ampezzo, UD) (1428 m a.s.l.), a mountain pond, IC obs.; 1♂ and 1♀, 24.VIII.2016, near Passo Lodinut (Paularo, UD) (1800 m a.s.l.), two adjacent mountain peat bogs, IC obs.; 1 M, 27.VIII.2016, near Passo Val d’Inferno (Forni Avoltri, UD) (1987 m a.s.l.), a mountain peat bog, IC obs.; 1♂, 05.VIII.2018, slope of the Monte Palone (Sauris, UD) (1837 m a.s.l.), a mountain peat bog, IC obs.

Notes: The findings of males and females of this boreo-alpine species in some mountain ponds and peat bogs confirm its high-mountain range (PECILE 1983; ZANDIGIACOMO et al. 2015). Therefore, it is necessary to protect these natural ponds and peat bogs as well as the mountain pasture pools.

The species is rare in Carinthia (considered as Vulnerable, VU) (HOLZINGER & KOMPOSCH 2012), while it is considered as Regionally Extinct (RE) in Slovenia (KOTARAC 1997).



Fig. 11 - Male of *Somatochlora arctica*; 09.IX.2018, Torbiera Scichizza (Tarvisio, UD; photo by I. Chiandetti).

- *Maschio di Somatochlora arctica*; 09.IX.2018, Torbiera Scichizza (Tarvisio, UD; foto I. Chiandetti).

Somatochlora arctica (ZETTERSTEDT, 1840) (Fig. 11)

Records: 1♂, 07.VIII.2016, Torbiera Scichizza near Fusine (Tarvisio, UD) (850 m a.s.l.), a peat bog in a protected biotope, IC obs.; 1♂, 27.VIII.2016, near Passo Val d'Inferno (Forni Avoltri, UD) (1987 m a.s.l.), a peat bog, IC obs.; some exx., 08.VII.2017, Torbiera Scichizza near Fusine (Tarvisio, UD), same site as before, IC & TF obs; 1 ex., 23.VII.2017, same site as before, RP obs.; 1♂, 05.VIII.2017, same site as before, TF obs.; 1♂, 06.VIII.2018, same site as before, IC obs.; 1♂, 09.IX.2018, same site as before, IC obs.

Notes: The findings of adults in some mountain peat bogs, in particular in the Torbiera Scichizza, confirm the high-mountain range of this boreo-alpine species (PECILE 1983, 1991; ZANDIGIACOMO et al. 2015). Therefore, it is absolutely necessary to protect these natural pools and peat bogs. The species is very rare both in Carinthia (considered as Endangered, EN) (HOLZINGER & KOMPOSCH 2012) and in Slovenia (considered as Critically Endangered, CR) (KOTARAC 1997).

Somatochlora meridionalis NIELSEN, 1935

Records: 1♂, 31.VII.2016, Lago di Doberdò (Doberdò del Lago, GO) (7 m a.s.l.), a lake in a wet site in a Karst area included in a Regional Nature Reserve, IC obs.; some exx., 07.VIII.2016, Palude di Borgo Pegoraro (Moruzzo, UD) (180 m a.s.l.), a peat bog in the morainic hilly area included in a protected biotope, TF obs.; 1♂, 31.VIII.2017, Torbiera Scichizza near Fusine (Tarvisio, UD) (850 m a.s.l.), a peat bog in a protected biotope, RP obs.

Notes: The findings of adults in some scattered localities, from the coast and lowland to Karst and mountain (BOGNOLO & PECILE 1995; UBONI 2008;

ZANDIGIACOMO et al. 2015), suggest the relatively wide range across Friuli Venezia Giulia. The species is rare in Carinthia (considered as Endangered, EN) (HOLZINGER & KOMPOSCH 2012), while it is common in Slovenia, where it is mostly associated with running waters (KOTARAC 1997).

Sympetrum danae (SULZER, 1776)

Records: 1♂, 14.VIII.2017, near the Pass of Fusine (Tarvisio, UD) (847 m a.s.l.), a wet meadow, IC obs.

Notes: *S. danae* is a widespread northern holarctic species, present in North America and in Eurasia. In Italy the species is found only in the alpine areas of the northern regions (RISERVATO et al. 2014a). In Friuli Venezia Giulia all records, including the one reported here, come from the Tarvisio area, particularly near Fusine and the Scichizza Peat bog (MINELLI 1977; ZANDIGIACOMO et al. 2015). The species is rare both in Carinthia (considered as Vulnerable, VU) (HOLZINGER & KOMPOSCH 2012) and in Slovenia (considered as Critically Endangered, CR) (KOTARAC 1997).

Sympetrum depressiusculum (SELYS, 1841) (Fig. 12)

Records: Some exx., 20.VI.2016, 11.VIII.2016, 23.VIII.2016 and 26.VIII.2016, Magredi del Meduna (Vivaro, PN) (115 m a.s.l.), some ponds along the Meduna River, TF obs.; 1♂, 16.VII. 2017, Magredi del Meduna (Vivaro, PN), same site as before, TF obs.; some exx., 26.VIII.2016, Laghetti di Villanova (San Daniele del Friuli, UD) (111 m a.s.l.), some ponds near the Tagliamento River, IC obs.; some exx., 23.VII.2017, Laghetti di Villanova (San Daniele del Friuli, UD), same site as before, IC obs.; 1♂, 14.VIII.2017, Fusine (Tarvisio, UD) (847 m a.s.l.), a wet meadow, IC obs.;



Fig. 12- Female of *Sympetrum depressiusculum*; 19.VIII.2017, Titiano (Precenico, UD; photo by I. Chiandetti).

- Femmina di *Sympetrum depressiusculum*; 19.VIII.2017, Titiano (Precenico, UD; foto I. Chiandetti).



Fig. 13 - Male of *Sympetrum vulgatum*; 02.X.2017, Lake Ospedaletto (Gemona del Friuli; photo by T. Fiorenza).

- Maschio di *Sympetrum vulgatum*; 02.X.2017, Lago di Ospedaletto (Gemona del Friuli; foto T. Fiorenza).

some exx, 19.VIII.2017, Titiano (Precenico, UD) (5 m a.s.l.), some ponds on the plain, IC obs.

Notes: In Friuli Venezia Giulia, the species is present mostly in the plains or in hilly areas (PECILE, 1989; ZANDIGIACOMO et al. 2015; this paper). The discovery of a specimen in a mountain area also suggests that the species is relatively euryoecious. We have observed the continuous presence of adults at some sites, such as the Villanova and the Titiano ponds (ZANDIGIACOMO et al. 2015; this paper). *S. depressiusculum* is present at several sites on the eastern plains of the Veneto region (DALLA VIA & ZANETTI 2015). The species is very rare both in Carinthia (considered as Critically Endangered, CR) (HOLZINGER & KOMPOSCH 2012) and in Slovenia (considered as Critically Endangered, CR) (KOTARAC 1997).

Sympetrum vulgatum (LINNAEUS) (Fig. 13)

Records: 1♀, 16.VIII.2016, near Casso (Erto and Casso, PN) (735 m s.l.m.), a small wet area created by a landslide of part of Mount Toc into Lake Vajont IC obs.; 1♂, 17.VIII.2016, Palude Vuarbis (Cavazzo Carnico, UD) (286 m s.l.m.), a wet area, IC obs.; 1♂, 05.VIII.2017, Rutte Piccolo (Tarvisio, UD) (800 m a.s.l.), an artificial pond, IC obs.; 1♂, 31.VIII.2017, Rutte Piccolo (Tarvisio, UD), same site as before, RP obs.; 1♂, 02.X.2017, Lake Ospedaletto (or Laghetto Minisini) (Gemona del Friuli, UD) (208 m s.l.m.), a small lake of glacial origin with a rich riparian vegetation (in particular *Carex elata* and *Fragmites australis*) in a protected area (ZSC IT3320013 - Lago Minisini e Rivoli Bianchi), TF obs.; 1♀, 24.VII.2018, the mountain



Fig. 14 - Female of *Selysiothemis nigra*; 01.VII.2017, Laghetto del Parco delle Dote (Azzano Decimo, PN; photo by T. Fiorenza).

- *Femmina di Selysiothemis nigra*; 01.VII.2017, Laghetto del Parco delle Dote (Azzano Decimo, PN; foto T. Fiorenza).

plateau of Priesnig (Tarvisio, UD) (732 m a.s.l.), some ponds on a golf course, RP obs.

Notes: This species is widely present from central-eastern Europe to eastern Asia, but in Italy it is only found in the hilly and mountain areas of northern regions. In Friuli Venezia Giulia the species has been reported by KIAUTA (1969) only on the basis of old unconfirmed reports, by PECILE (1984) for Lake Ospedaletto (or Laghetto Minisini), by PECILE (1989) for Lake Ragogna (or Lake San Daniele) (adults observed in August 1981 and 1982), by UBONI (2008) for the Trieste Karst, and recently by FIORENZA et al. (2013) for Lake Ragogna and the Lazzacco Peat bog. The new findings reported here confirm the occurrence of the species in several hilly and mountain areas of Friuli Venezia Giulia. The species is common in both Carinthia (HOLZINGER & KOMPOSCH 2012) and Slovenia (KOTARAC 1997).

Leucorrhinia dubia (VANDER LINDEN, 1825)

Records: Some exx., 02.VII.2016, Laghetto di Somdogna (Dogna, UD) (1442 m a.s.l.), a mountain pond, IC obs.; 1♂, 17.VI.2017, Laghetto di Somdogna (Dogna, UD), same site as before, IC obs.; 1♂, 02.VII.2017, slopes of the Col dell'Orso (Malborghetto-Valbruna, UD) (1726 m a.s.l.), a mountain wet area near the border with Austria, TF obs.; 1♂, 05.VIII.2018, Laghi di Festons (Sauris, UD) (1833 m a.s.l.), some mountain ponds, IC obs.

Notes: These new findings confirm the occurrence of this boreo-alpine species mostly in north-eastern mountain areas of Friuli Venezia Giulia, as already reported (MINELLI 1977; ZANDIGIACOMO et al. 2015). The species is rare in both Carinthia (considered as Endangered, EN) (HOLZINGER & KOMPOSCH 2012)

and Slovenia (considered as Critically Endangered, CR) (KOTARAC 1997).

Selysiothemis nigra (VANDER LINDEN, 1825) (Fig. 14)

Records: 1♀, 29.VI.2016, Aussa Corno (Carlino, UD) (1 m a.s.l.), near an artificial pond in an industrial area, IC obs.; some exx., 01.VII.2017, Laghetto del Parco delle Dote (Azzano Decimo, PN) (10 m a.s.l.), an artificial pond in an urban area, IC, TF, GN, AM & AS obs.

Notes: These new findings confirm the recent and permanent populations of the species in north-eastern Italy (ZANDIGIACOMO & BUIAN 2011; ZANDIGIACOMO et al. 2015; UBONI et al. 2015). The recent observation of the species in the artificial lake of the Parco delle Dote at Azzano Decimo (PN) suggest a continuous occurrence of the species in the site from 2013 when several exuviae were detected for the first time (Uboni et al. 2015). *S. nigra* was recently observed in several sites on the eastern plains of the Veneto region (DALLA VIA & ZANETTI 2015). The species has a very scattered distribution in the Mediterranean area and for now it is not present either in Austria or Slovenia.

4. Final comments

The observations carried out in the three-year period considered allowed us to detect the presence of two new species that are to be included in the new list of the Odonata of Friuli Venezia Giulia: *C. ornatum* and *L. pectoralis*. These findings do not indicate the occurrence of reproductive populations of the two species in the territory of Friuli Venezia Giulia. However, these important records confirm observations that were conducted in the region several decades ago. Adults

Family	Species	IUCN category for Italy	Occurrence in FV
Corduliidae	<i>Epithea bimaculata</i>	RE	no
Coenagrionidae	<i>Nehalennia speciosa</i>	CR	yes
Lestidae	<i>Sympecma paedisca</i>	CR	no
Coenagrionidae	<i>Erythromma najas</i>	EN	yes
Lestidae	<i>Lestes macrostigma</i>	EN	no
Libellulidae	<i>Leucorrhinia pectoralis</i>	EN	yes
Libellulidae	<i>Sympetrum depressiusculum</i>	EN	yes
Aeshnidae	<i>Aeshna grandis</i>	VU	yes
Aeshnidae	<i>Aeshna subarctica</i>	VU	no
Coenagrionidae	<i>Ischnura fountainei</i>	VU	no
Libellulidae	<i>Sympetrum flaveolum</i>	VU	yes

Tab. I - List of most threatened Odonata species in Italy, with indication of those present in Friuli Venezia Giulia (elaborated from Riservato et al. 2014b). RE = Regionally Extinct; CR = Critically Endangered; EN = Endangered; VU = Vulnerable.
- *Elenco delle specie di Odonati più minacciate in Italia, con indicazione di quelle presenti in Friuli Venezia Giulia (rielaborazione da Riservato et al. 2014b). RE = Estinta nella Regione; CR = In Pericolo Critico; EN = In Pericolo; VU = Vulnerabile.*

(probably migrants or vagrants) of the two species were observed, but not larvae or exuviae. Also the findings related to the other 15 Odonata species, which are either rare, threatened or of high conservation interest, were significant.

Therefore, currently the Odonata species present in the region (ZANDIGIACOMO et al. 2015; this papers) comprise 64 (67%) of the 95 species known for Italy (RISERVATO et al. 2014a; Odonata.it 2018). Four species, *C. ornatum*, *Lindenia tetraphylla* (VANDER LINDEN, 1825), *C. heros*, and *L. pectoralis*, are listed in the Annexes of the Habitats Directive.

The data relating to *N. speciosa* indicate the precariousness of the population in the only reproductive site in Friuli Venezia Giulia (the Lazzacco Peat bog) due to environmental changes in the peat bog, in particular the widespread growth of bushes. Hence, there is an urgent need to undertake conservation actions for i) the control of the expansion of shrubby vegetation in and around the Lazzacco Peat bog; ii) the restoration of conditions favourable to recolonization by *N. speciosa* in the adjacent Brazzacco Peat bog, a historical site of occurrence; iii) the establishment of a corridor without arboreal and shrubby vegetation between the peat bogs of Lazzacco and Brazzacco to encourage natural migration of adults to the neighbouring site.

The new findings of *C. heros* adults in the Torre Torrent basin also suggest the presence of reproductive sites in this area, as well as in some streams of the Isonzo River basin. Therefore, further investigations to identify such reproductive sites are necessary so that they may be established as protected areas in the same way as the "Valle del Rio Smiardar". It should be noted that in recent years the Groina Torrent and its tributary streams (municipalities of Gorizia and S. Floriano del Collio, GO), where the presence of a reproductive population of *C. heros* was known (BEDJANIČ & ŠALAMUN 2003), have been severely altered in recent years by substantial engineering works to strengthen the banks of the waterways, and these activities probably did not consider the presence of two other species listed in the

Habitats Directive: *Austropotamobius pallipes* complex (Decapoda, Astacidae) and *Rana latastei* Boulenger (Amphibia, Ranidae) (BEDJANIČ & ŠALAMUN 2003; KUCLER 2008). Additionally, it is very likely that the Farneto Torrent in Trieste, where larvae and adults of *C. heros* had been found in 2007 (UBONI et al. 2007), does not currently host a population of the species due to strong urban water pollution (C. Uboni, pers. comm.). This supposition is supported by the fact that during three surveys conducted recently along the Farneto Torrent (one in July 2017 and two in June 2018) no adults of *C. heros* were observed (T. Fiorenza, pers. obs.).

Unfortunately, in the three-year period of the present survey no specimens of *L. tetraphylla* were detected. The last observation by C. Uboni refers to a male (probably vagrant) detected in 2010 in the brackish area of Lisert (Monfalcone, GO) (ZANDIGIACOMO et al. 2015; UBONI et al. 2018).

In any case, in Friuli Venezia Giulia, six of the 11 most threatened Odonata species for Italy, according to IUCN criteria (RISERVATO et al. 2014b), were observed (Tab. I), indicating the importance to wildlife of many regional areas and breeding sites.

Finally, for conservation reasons, actions to safeguard still or flowing waters where many species develop, are to be implemented. Peat bogs, natural pools, mountain/alpine pasture pools and pre-alpine streams are at high risk, mainly due to water pollution phenomena, lack of careful landscape management and climate change. Three of the regional territories in which it is urgent to plan for environmental restorations or to create new freshwater habitats are:

- the mountain Tarvisio area for some boreo-alpine stenotherms, such as *S. alpestris* and *S. arctica*, which are threatened mostly by global warming (DE KNIJF et al. 2011; OERTLI et al. 2014);
- the southern slopes of the Julian Prealps for *C. heros*;
- the morainic hills for *N. speciosa*.

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References

- AGUZZI, S., G. BOGLIANI, V. ORIOLI & N. PILON. 2017. *Nehalennia speciosa* rediscovered in northwestern Italy (Odonata: Coenagrionidae). *Notulae Odonatol.* 8: 337-40.
- BEDJANIČ, M. & S. WELDT. 2000. Rediscovery of *Coenagrion hastulatum* (Charpentier, 1825) in Slovenia (Zygoptera: Coenagrionidae). *Exuviae* 7 (1): 25-9.
- BEDJANIČ, M., & A. ŠALAMUN. 2003. Large golden-ringed dragonfly *Cordulegaster heros* Theischinger, 1979, new for the fauna of Italy (Odonata: Cordulegastridae). *Natura Sloveniae* 5 (2): 19-29.
- BELLMANN, H. 2013. *Guida alle libellule. Tutte le specie dell'Europa centrale e meridionale*. Roma: Ricca editore.
- BERNARD, R., & H. WILDERMUTH. 2005. *Nehalennia speciosa* (Charpentier, 1840) in Europe: a case of a vanishing relict (Zygoptera: Coenagrionidae). *Odonatologica* 34: 335-78.
- BOGNOLO, E., & I. PECILE. 1995. La fauna odonatologica del Carso triestino, del Carso goriziano e di alcune località limitrofe. *Atti Mus. Civ. St. Nat. Trieste* 46: 145-71.
- BOUDOT, J.-P., V.J. KALKMAN, M. AZPILICUETA AMORIN, T. BOGDANOVIC, A. CORDERO RIVERA, G. DEGABRIELE, J.L. DOMMANGET, S. FERREIRA, B. GARRIGOS, M. JOVIC, M. KOTARAC, W. LOPAU, M. MARINOV, N. MIHOKOVIC, E. RISERVATO, B. SAMRAOUI & W. SCHNEIDER. 2009. *Atlas of the Odonata of the Mediterranean and North Africa*. Libellula Supplement 9.
- BRUNNER, H., W.E. HOLZINGER & B. KOMPOSCH. 2013. Die Östliche Weidenjungfer (*Lestes parvidens*) neu für Kärnten, mit Ergänzungen und Korrekturen zu den »Libellen Karntens«. *Carinthia II* 203/123: 343-48.
- CHIANDETTI, I., C. DEL BIANCO & T. FIORENZA. 2013. *Cordulegaster heros* Theischinger, 1979, a new species for the fauna of the province of Udine, north-eastern Italy (Odonata, Cordulegastridae). *Boll. Mus. St. Nat. Venezia* 64: 21-7.
- CHIANDETTI, I., T. FIORENZA & P. ZANDIGIACOMO. 2014. *Nehalennia speciosa* (Charpentier): una specie a rischio di estinzione sul territorio italiano. *Boll. Soc. Natur. "Silvia Zenari"* 37: 113-21.
- CHIANDETTI, I., T. FIORENZA, C. DEL BIANCO & P. ZANDIGIACOMO. 2015. Distribuzione delle libellule del genere *Cordulegaster* Leach in Friuli Venezia Giulia (Odonata, Cordulegastridae). *Boll. Soc. Natur. "Silvia Zenari"* 38: 69-84.
- DALLA VIA, M. & M. ZANETTI. 2015. *Atlante delle libellule della Pianura veneta orientale*. Padova: ADLE Edizioni.
- DE KNIJF, G., U. FLENER, C. VANAPPELGHEM, C.O. MANCI, V.J. KALKMAN & H. DEMOLDER. 2011. The status of two boreo-alpine species, *Somatochlora alpestris* and *S. arctica*, in Romania and their vulnerability to the impact of climate change (Odonata: Corduliidae). *Int. J. Odonatol.* 14: 111-26.
- DIJKSTRA, K.D.B. & R. LEWINGTON. 2006. *Field guide to the dragonfly of Britain and Europe*. British Wildlife Publishing (UK).
- FIORENZA, T., & I. PECILE. I. 2009. The pigmy damselfly *Nehalennia speciosa* is still part of the odonate fauna of Italy (Insecta, Odonata, Coenagrionidae). *Boll. Mus. Civ. St. Nat. Venezia* 60: 17-27.
- FIORENZA, T., C. DEL BIANCO, I. CHIANDETTI, C. UBONI & P. ZANDIGIACOMO. 2012. Gli Odonati del Friuli Venezia Giulia: risultati di uno studio triennale. *Boll. Soc. Natur. "Silvia Zenari"* 35: 109-22.
- FIORENZA, T., I. CHIANDETTI, C. DEL BIANCO, I. MAIORANO, G. NADALON, C. UBONI & P. ZANDIGIACOMO. 2013. Gli Odonati del Friuli Venezia Giulia: aggiornamento della checklist. *Boll. Soc. Natur. "Silvia Zenari"* 36: 117-31.
- GALLIANI, C., R. SCHERINI, A. PIGLIA, & D. MERLINI. 2014. *Odonati d'Italia. Guida al riconoscimento e allo studio di libellule e damigelle*. Linnea's eBooks.
- GRAND, D., & J.-P. BOUDOT. 2006. *Les libellules de France, Belgique et Luxembourg*. Mèze (France): Biotope edition, Parthenope Collection.
- HOLZINGER, W., & B. KOMPOSCH. 2012. *Die Libellen Kärntens*. Sonderreihe Natur Kärnten, Band 6. Klagenfurt: Naturwissenschaftlicher Verein für Kärnten.
- KIAUTA, B. 1969. Survey of the Odonate fauna of the autonomous region Friuli-Venezia Giulia (Northern Italy). *Atti Mus. Civ. St. Nat. Trieste* 26: 177-247.
- KIAUTA, B. 1971. Predation by ants, *Formica fusca* L. and *F. polyctena* Bondr. on the emerging dragonfly, *Aeshna juncea* (L.) and its teratological consequences. *Tombo* 14 (1-2): 1-16.
- KOTARAC, M. 1997. *Atlas kačjih pastirjev (Odonata) Slovenije z Rdečim seznamom, Atlas of the dragonflies (Odonata) of Slovenia with the Red Data List*. Atlas faunae et florae Sloveniae 1. Center za kartografijo favne in flore, Miklavž na Dravskem polju.
- KUCLER, S., cur. 2008. *L'ecosistema fluviale nel Collio goriziano*. Legambiente del Friuli Venezia Giulia onlus. Gorizia: Tipografia Grafica Goriziana.
- MEKKES, J.-J. 2008. *Le libellule della Riserva Naturale Foce dell'Isonzo*. Web site of Stazione Biologica Isola della Cona (SBIC) <http://www.sbic.it/index.php?page=odonatilibellule> (last access July 28, 2018).
- MINELLI, A. 1977. La fauna di tre ambienti umidi del Tarvisiano (Ricerche zoologiche nel Tarvisiano, 1). *Atti Ist. Ven. Sci. Lett. Arti* 135: 203-31.
- ODONATA.IT. 2018. *Specie*. Web site of the Società Italiana per lo Studio e la Conservazione delle Libellule Onlus. <http://www.odonata.it/libe-italiane/> (last access September 16, 2018).
- OERTLI, B., C. ILG, S. ANGÉLIBERT, J. BOLLIGER, J. CROVADORE, E. DEMIERRE, C. JULLIAND, A. FINGER-STICH, C. FORRÈ, P.-A. FROSSARD, F. LEFORT, M. MAYENCOURT, U. PIANTINI & S. SCHMID. 2014. Freshwater biodiversity under warming pressure in the Alps: a methodological framework for prioritization of restoration areas for small waterbodies. *Eco. mont.* 6: 23-34.
- OLIAS, M., F. WEIHRAUCH, M. BEDJANIČ, N. HACET & M. MARINOV. 2007. *Lestes parvidens* and *L. viridis* in

- southeastern Europe: a chorological analysis (Odonata: Lestidae). *Libellula* 26 (3-4): 243-72.
- PECILE, I. 1983. Interessanti catture di Odonati nel Friuli-V. Giulia. *Gortania, Atti Mus. Fr. St. Nat.* 4: 163-75.
- PECILE, I. 1984. *Libellule*. Udine: Carlo Lorenzini Editore.
- PECILE, I. 1989. Note sul popolamento odonatologico del Lago di Ragogna (Italia nord-orientale). *Gortania, Atti Mus. Fr. St. Nat.* 10: 193-204.
- PECILE, I. 1991. La fauna odonatologica di alcuni ambienti umidi delle Alpi e Prealpi friulane (Italia nord-orientale). *Gortania, Atti Mus. Fr. St. Nat.* 12: 305-12.
- RISERVATO, E., A. FESTI, R. FABBRI, C. GRIECO, S. HARDERSEN, G. LA PORTA, F. LANDI, M.E. SIESA & C. UTZERI. 2014a. *Atlante delle libellule italiane. Preliminare*. Società Italiana per lo studio e conservazione delle libellule Odonata.it. Latina: Edizioni Belvedere.
- RISERVATO E., R. FABBRI, A. FESTI, C. GRIECO, S. HARDERSEN, F. LANDI, C. UTZERI, C. RONDININI, A. BATTISTONI & C. TEOFILI. 2014b. *Lista Rossa IUCN delle libellule italiane*. Roma: Comitato italiano IUCN e Ministero dell'Ambiente e della Tutela del Territorio e del Mare.
- STROBL, P.G. 1906. Neuropteroiden (Netzflügler) Steiermarks (und Niederösterreichs). *Mitt. nat.-wiss. Ver. f. Steiermark* 42: 225-66.
- UBONI, C. 2008. *Contributo alla conoscenza degli Odonati (Hexapoda, Odonata) nella provincia di Trieste*. Tesi di laurea, Università degli Studi di Trieste, Dipartimento di Biologia.
- UBONI, C., N. BRESSI & A. COLLA. 2007. Una popolazione di *Cordulegaster heros* Theischinger, 1979 in Italia (Odonata, Cordulegasteridae). *Atti Mus. Civ. St. Nat. Trieste* 53: 207-11.
- UBONI, C., G. NADALON & A. SCHRÖTER. 2015. Evidence of breeding of *Selysiotthemis nigra* in the regions of Friuli Venezia Giulia and Veneto, northeastern Italy (Odonata: Libellulidae). *Notul. Odonatol.* 8 (5):117-55.
- UBONI C., P. MERLUZZI, L. POLDINI, E. RISERVATO & E. PIZZUL. 2018. First data on the reproduction of the Vagrant Emperor *Anax ephippiger* in North-Eastern Italy, Friuli Venezia Giulia Region (Odonata Aeshnidae). *Boll. Soc. It. Entomol.* 150 (3): 101-6
- ZANDIGIACOMO, P., & F.M. BUIAN. 2011. Reperti di *Selysiotthemis nigra* (Odonata, Libellulidae) lungo il litorale Alto-Adriatico. *Boll. Soc. Natur. "Silvia Zenari"* 34: 77-84.
- ZANDIGIACOMO, P., I. CHIANDETTI, T. FIORENZA, G. NADALON & C. UBONI. 2015. Odonata of Friuli Venezia Giulia: second update of the Checklist and further remarks. *Gortania. Botanica, Zoologia* 36: 33-44.

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