ECOO 2022

6th European Congress on Odonatology

BOOK OF ABSTRACTS

27-30th June 2022 • Kamnik, Slovenia

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6th European Congress on Odonatology
27-30th June 2022 • Kamnik, Slovenia

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Slovene Dragonfly Society

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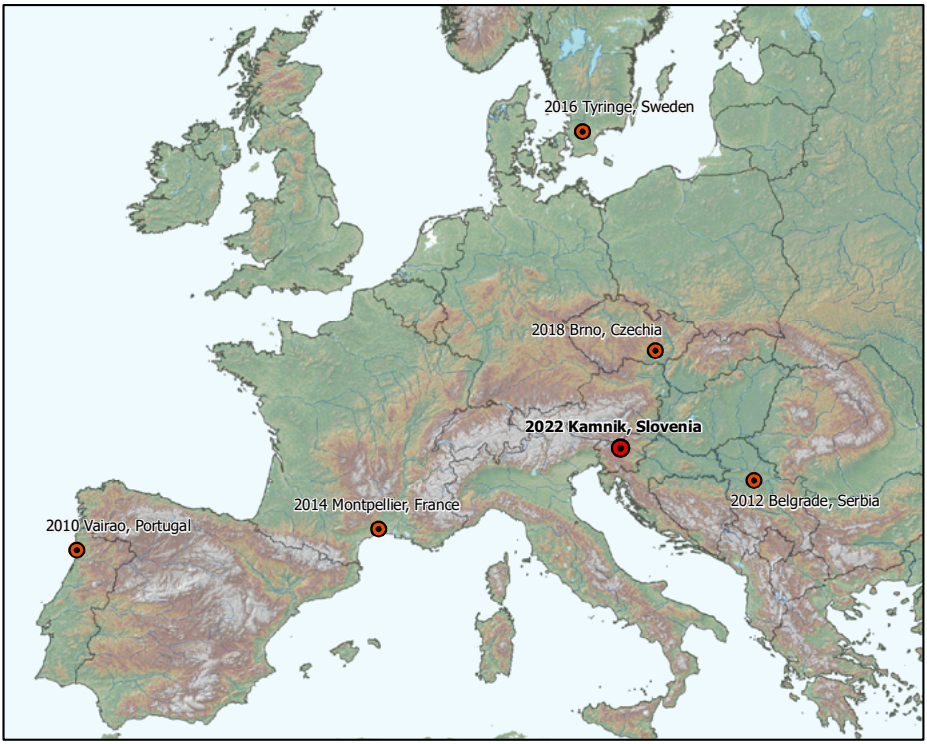
European Congress on Odonatology (ECOO)

The European Congress on Odonatology (ECOO) is a biennial European Dragonfly Symposium, held since 2010; the ECOO 2022 is the sixth congress to be held as it was postponed in 2020 due to COVID-19 outbreak.

The key objective of our congresses is to advance the science of odonatology in Europe (and the world), as well as of nature conservation, habitats protection, behavioural science, ecology, hydrobiology, etc. The ECOO explores opportunities and challenges for odonatologists to meet each other and to communicate new knowledge of such a beautiful and interesting science as odonatology certainly is. Our congresses link odonatology with the society and help science to deeply recognize and contribute to supporting joint dialogue and collaborative networks involving academicians, biologists, volunteers and all other people interested in dragonflies.

The ECOO welcomes all those who are working on or are interested in dragonflies at all levels.

https://ecoo2016.wordpress.com



First European Congress on Odonatology
July 2–5 2010 Vairão-Vila do Conde, PORTUGAL

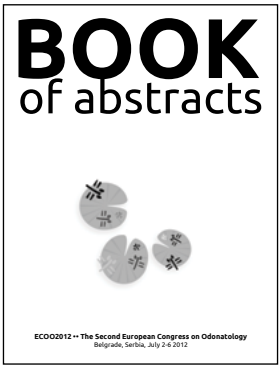
Second European Congress on Odonatology
July 2–6 2012 Belgrade, SERBIA

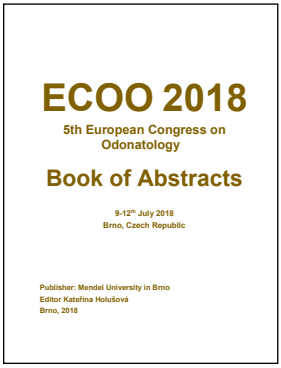
Third European Congress on Odonatology
July 7–10 2014 Montpellier, FRANCE

Fourth European Congress on Odonatology
July 11–14 2016 Tyringe, SWEDEN

Fifth European Congress on Odonatology
July 9–12 2018 Brno, CZECH REPUBLIC

Sixth European Congress on Odonatology
June 27–30 2022 Kamnik, SLOVENIA





ECOO 2022

6th European Congress on Odonatology

27-30th June 2022 • Kamnik, Slovenia

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Friday, 1.7. – Wednesday, 6.7.2022	Departure *or* Post-congress field trip

ECOO 2022

6th European Congress on Odonatology

27-30th June 2022 • Kamnik, Slovenia

Introductory keynote presentation

On the odonates, odonatology and odonatologists in Slovenia *

Damjan VINKO[1] , Ali ŠALAMUN[1,2] & Matjaž BEDJANIČ[1,3]

[1] Slovene Dragonfly Society, Verovškova 56, 1000 Ljubljana, SLOVENIA. Email: damjan.vinko@gmail.com; [2] Centre for Cartography of Fauna and Flora, Tacenska cesta 20, 1000 Ljubljana, SLOVENIA. Email: ali.salamun@ckff.si; [3] National Institute of Biology, Večna pot 111, 1000 Ljubljana, SLOVENIA. Email: matjaz.bedjanic@nib.si;

KEYWORDS: Odonata, dragonflies, damselflies, Slovene Dragonfly Society, Boštjan Kiauta, species list, database, research, European Congress on Odonatology

Abstract. A brief overview of odonatological research in Slovenia from its origins in the second half of the 17th century to the present is provided. The importance of pioneer odonatological activities by Prof. Boštjan Kiauta and his mentorship as well as support to the work by younger Slovene odonatologists are highlighted. A checklist of 73 recorded dragonfly species for the country is given, together with their common Slovenian names. Diversity of dragonflies and their habitats in Slovenia is presented, with an overview map of 8,605 localities with dragonfly records, map of number of recorded Odonata species per 5x5 km squares and examples of currently known distributions of *Cordulegaster heros* Theischinger, 1979 and *Somatochlora meridionalis* Nielsen, 1935. Scope and activities of the Slovene Dragonfly Society, founded in 1992 with the aim to increase popularity of dragonflies and to connect dragonfly enthusiasts in Slovenia, are also presented, highlighting the importance of the national odonatological database, which contains over 61,500 faunistic data and is maintained jointly by the Slovene Dragonfly Society and the Centre for Cartography of Fauna and Flora. Although the protection of threatened dragonfly species in Slovenia is satisfactorily covered in legislative terms, some species experience, in reality, serious decline and ongoing encroachment upon their habitats, while systematic, state funded monitoring is not carried out. The beginning of the 6th European Congress on Odonatology (ECOO 2022), to be held between June 27th and 30th June 2022 in Kamnik, Central Slovenia, is announced.

Introduction

Slovenia is a small, green country south of the Alps, characterised by beautiful landscapes with rich fauna and flora. Its position at the junction of the Mediterranean, Pannonian, Alpine and Dinaric biogeographic regions, and the wealth of varied freshwater habitats are the main reasons for its diverse dragonfly fauna of 73 species.

** The present article and corresponding introductory keynote lecture, given at the 6th European Congress on Odonatology – ECOO 2022, Kamnik, Slovenia, are dedicated to the memory of our mentor and father of odonatology in Slovenia, Prof. Dr. Boštjan Kiauta (20th January 1937–26th March 2022).*

The origins of odonatological research in Slovenia date back to the second half of the 17th century, with some dragonfly presentations in the graphic art collection by J. W. von Valvasor (1685), followed in the second half of the 18th century by species descriptions and copper engravings in I. A. Scopoli's *Entomologia carniolica* (1763). However, odonatology in Slovenia has made a significant progress only in the early second half of the 20th century by Prof. Boštjan Kiauta's numerous accounts on the dragonfly fauna of our country (e.g. KIAUTA 1961, 1969; INOUE 2017; TYAGI 2019; WASSCHER et al. 2022).

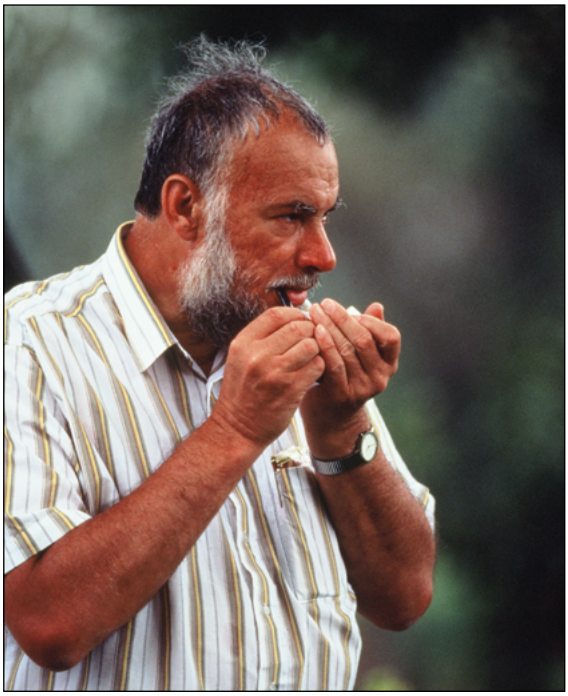


Figure 1. The father of odonatology in Slovenia, Prof. Dr. Boštjan Kiauta (1937–2022) – one of the greatest odonatologists of our time, a global odonatological authority and mentor in the broadest sense of the word, as well as honorary member of the Slovene Dragonfly Society. Photo: Roland Müller

After 1962, when Prof. Kiauta (Fig. 1) left Slovenia for the Netherlands due to political situation and limited career opportunities, it was only in the early 1990's that a lively resurgence of interest in dragonflies arose among some Slovene naturalists and biology students. Based on Prof. Kiauta's legacy and knowledge, and with his manifold active support, younger generations have significantly upgraded odonatological knowledge in the last 30 years. Starting with foundation of the Slovene Dragonfly Society (SOD) in 1992, the next milestone was reached in 1997, with the fieldwork and odonatological database formation led by Mladen Kotarac, culminating with the publication of the Atlas of the Dragonflies (Odonata) of Slovenia (KOTARAC 1997). Odonatology in Slovenia has steadily progressed through numerous activities of the Slovene Dragonfly Society and its members until today.

A brief account on diversity of dragonflies and their habitats in Slovenia

For a small country like Slovenia with a surface of only 20,271 km², 73 recorded dragonfly species (Tab. 1) clearly reflect great diversity of wetland habitats and a reasonably good general state of research (Figs. 2, 3). Increase in knowledge is evident from the bare number of species reported for the country in different periods (erroneous records and subspecies excluded): 58 by KIAUTA (1961, 1963), 66 by BEDJANIČ (1994), 68 by KOTARAC (1997), 71 by BEDJANIČ (2003, 2006), 72 by KOTARAC (2015) and 73 by VINKO & ŠALAMUN (2021). If in 1997 the odonatological database compiled by the Centre for Cartography of Fauna and Flora (CKFF) and Slovene Dragonfly Society (SOD) for the publication of *Atlas of the Dragonflies (Odonata) of Slovenia* contained 1,608 localities and 12,681 records (KOTARAC 1997), it grew substantially in the last 25 years with the current total of over 61,500 dragonfly records from over 8,600 localities across Slovenia (Fig. 2).

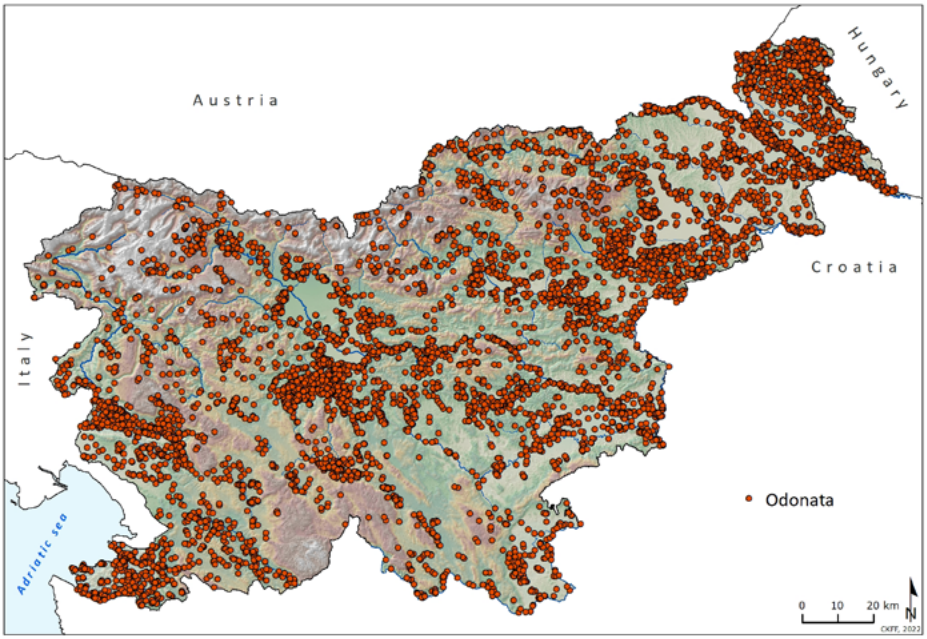


Figure 2. Overview map of 8,605 localities with dragonfly records in Slovenia. Map: CKFF

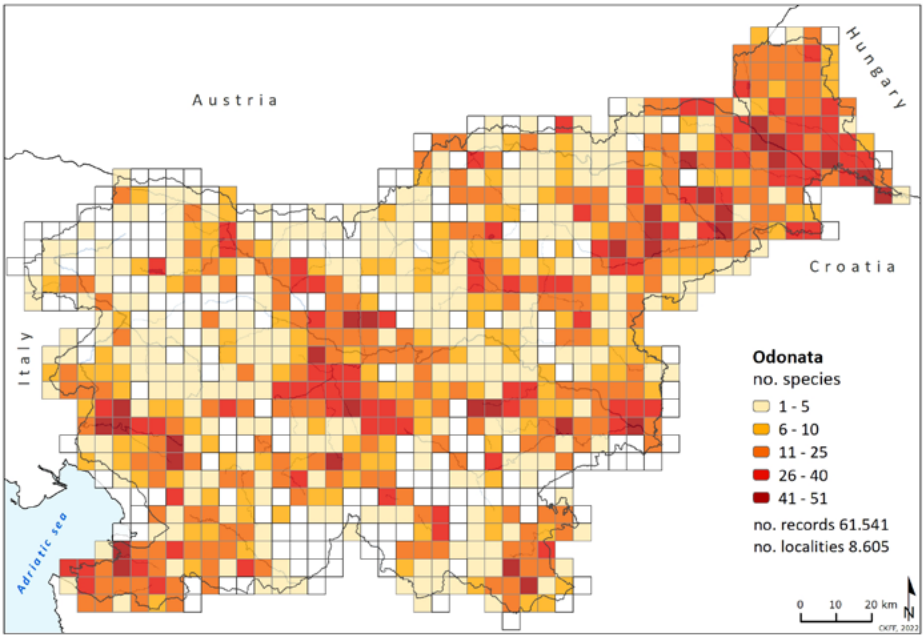


Figure 3. Overview map of recorded number of Odonata species per 5x5 km squares in Slovenia. Map: CKFF

Table 1. A checklist of 73 dragonfly species known for Slovenia from 2021. The common Slovene species' names were created by our renowned nature advocate, poet and writer Iztok Geister, also the founding member of Slovene Dragonfly Society (GEISTER 1999). They subtly reflect dragonflies' beauty, colouration, kinship, phenology, behaviour or habitat, or just the poet's playful admiration, and have been systematically used by Slovene odonatologists virtually unchanged since 1992, when the first draft was circulated.

Scientific name	Slovene name
ODONATA	**KAČJI PASTIRJI**
ZYGOPTERA	**ENAKOKRILI KAČJI PASTIRJI**
LESTIDAE	**ZVERCE**
Chalcolestes parvidens Artobolevsky, 1929	presenetljiva zverca
Chalcolestes viridis (Vander Linden, 1825)	zelena pazverca
Lestes barbarus (Fabricius, 1798)	grmiščna zverca
Lestes dryas Kirby, 1890	obrežna zverca
Lestes macrostigma (Eversmann, 1836)	južna zverca
Lestes sponsa (Hansemann, 1823)	obvodna zverca
Lestes virens (Charpentier, 1825)	loška zverca
Sympecma fusca (Vander Linden, 1820)	prisojni zimnik

Scientific name	Slovene name
CALOPTERYGIDAE	**BLEŠČAVCI**
Calopteryx splendens (Harris, 1780)	pasasti bleščavec
Calopteryx virgo (Linnaeus, 1758)	modri bleščavec
PLATYCNEMIDIDAE	**PRESLIČARJI**
Platycnemis pennipes (Pallas, 1771)	sinji presličar
COENAGRIONIDAE	**ŠKRATCI**
Ceriagrion tenellum (de Villers, 1789)	rdeči voščenec
Coenagrion hastulatum (Sélys, 1850)	barjanski škratec
Coenagrion ornatum (Sélys, 1850)	koščični škratec
Coenagrion puella (Linnaeus, 1758)	travniški škratec
Coenagrion pulchellum (Vander Linden, 1825)	suhljati škratec
Coenagrion scitulum (Rambur, 1842)	povodni škratec
Enallagma cyathigerum (Charpentier, 1840)	bleščeči zmotec
Erythromma lindenii (Sélys, 1840)	prodni paškratec
Erythromma najas (Hansemann, 1823)	veliki rdečeokec
Erythromma viridulum (Charpentier, 1840)	mali rdečeokec
Ischnura elegans (Vander Linden, 1820)	modri kresničar
Ischnura pumilio (Charpentier, 1825)	bledi kresničar
Pyrrhosoma nymphula (Sulzer, 1776)	rani plamenec
ANISOPTERA	**RAZNOKRILI KAČJI PASTIRJI**
AESHNIDAE	**DEVE**
Aeshna affinis Vander Linden, 1820	višnjeva deva
Aeshna caerulea (Ström, 1783)	šotna deva
Aeshna cyanea (Müller, 1764)	zelenomodra deva
Aeshna grandis (Linnaeus, 1758)	rjava deva
Aeshna isoceles (Müller, 1767)	deviški pastir
Aeshna juncea (Linnaeus, 1758)	barjanska deva
Aeshna mixta Latreille, 1805	bleda deva
Aeshna subarctica Walker, 1908	mahovna deva
Aeshna viridis Eversmann, 1836	zelena deva
Anax ephippiger (Burmeister, 1839)	afriški minljivec
Anax imperator Leach, 1815	veliki spremljevalec
Anax parthenope (Sélys, 1839)	modroriti spremljevalec
Brachytron pratense (Müller, 1764)	zgodnji trstničar

Scientific name	Slovene name
GOMPHIDAE	**POREČNIKI**
Gomphus vulgatissimus (Linnaeus, 1758)	popotni porečnik
Lindenia tetraphylla (Vander Linden, 1825)	velika peščenka
Onychogomphus forcipatus (Linnaeus, 1758)	bledi peščenec
Ophiogomphus cecilia (Fourcroy, 1785)	kačji potočnik
Stylurus flavipes (Charpentier, 1825)	rumeni porečnik
CORDULEGASTRIDAE	**STUDENČARJI**
Cordulegaster bidentata Sélys, 1843	povirni studenčar
Cordulegaster heros Theischinger, 1979	veliki studenčar
CORDULIIDAE	**LEBDUHI**
Cordulia aenea (Linnaeus, 1758)	močvirski lebduh
Epitheca bimaculata (Charpentier, 1825)	nosna jezerka
Somatochlora alpestris (Sélys, 1840)	alpski lesketnik
Somatochlora arctica (Zetterstedt, 1840)	barjanski lesketnik
Somatochlora flavomaculata (Vander Linden, 1825)	pegasti lesketnik
Somatochlora meridionalis Nielsen, 1935	sredozemski lesketnik
Somatochlora metallica (Vander Linden, 1825)	kovinski lesketnik
LIBELLULIDAE	**PLOŠČCI**
Crocothemis erythraea (Brullé, 1832)	opoldanski škrlatec
Leucorrhinia caudalis (Charpentier, 1840)	mrtvični spreletavec
Leucorrhinia dubia (Vander Linden, 1825)	barjanski spreletavec
Leucorrhinia pectoralis (Charpentier, 1825)	dristavični spreletavec
Libellula depressa Linnaeus, 1758	modri ploščec
Libellula fulva Müller, 1764	črni ploščec
Libellula quadrimaculata Linnaeus, 1758	lisasti ploščec
Orthetrum albistylum (Sélys, 1848)	temni modrač
Orthetrum brunneum (Fonscolombe, 1837)	sinji modrač
Orthetrum cancellatum (Linnaeus, 1758)	prodni modrač
Orthetrum coerulescens (Fabricius, 1798)	mali modrač
Selysiothemis nigra (Vander Linden, 1825)	temni slaniščar
Sympetrum danae (Sulzer, 1776)	črni kamenjak
Sympetrum depressiusculum (Sélys, 1841)	stasiti kamenjak
Sympetrum flaveolum (Linnaeus, 1758)	rumeni kamenjak

Scientific name	Slovene name
Sympetrum fonscolombii (Sélys, 1840)	malinovordeči kamenjak
Sympetrum meridionale (Sélys, 1841)	sredozemski kamenjak
Sympetrum pedemontanum (Müller in Allioni, 1766)	pasasti kamenjak
Sympetrum sanguineum (Müller, 1764)	krvavordeči kamenjak
Sympetrum striolatum (Charpentier, 1840)	progasti kamenjak
Sympetrum vulgatum (Linnaeus, 1758)	navadni kamenjak

Just a few kilometres south of the Slovenian capital city Ljubljana, there is one of the most interesting areas in the country. Once the most famous marshland in southern Europe, the Ljubljana Moors (Ljubljansko barje) is today characterised by an extensive but beautiful agricultural landscape, criss-crossed by a dense and ecologically diverse network of drainage channels, ditches and streams (Fig. 4). Among the 51 species recorded, the largest Slovene population of *Somatochlora flavomaculata* and *Coenagrion ornatum* are of special interest. At the south-eastern outskirts of Ljubljansko barje, extensively managed fishponds in the Valley of Draga pri Igu Nature Reserve are also part of Natura 2000 site and Ljubljansko barje Landscape Park. No less than 49 dragonfly species have been listed for this area, including *Leucorrhinia pectoralis* and several other endangered or rare species (VINKO et al. 2020).

Figure 4. Extensively managed fishponds in the Valley of Draga pri Igu Nature Reserve, the locality of ECOO 2022 Mid-congress field trip to Ljubljansko barje moors Natura 2000 site. Photo: Ali Šalamun

Early summer is the best time to catch sight of the largest European dragonfly, *Cordulegaster heros* (Fig. 5). It favours small, slow- to moderate-flowing forest streams, typical of the hilly country leading down to the flatlands. As Slovenia is mostly hilly, *C. heros* is quite common and as a result of targeted research in the last two decades the number of known localities for the species has already exceeded 1,400 (Fig. 6).

Figure 5. Slovenia is the best place to catch sight of *Cordulegaster heros*, the species endemic to South-Eastern Europe. Photo: Ali Šalamun

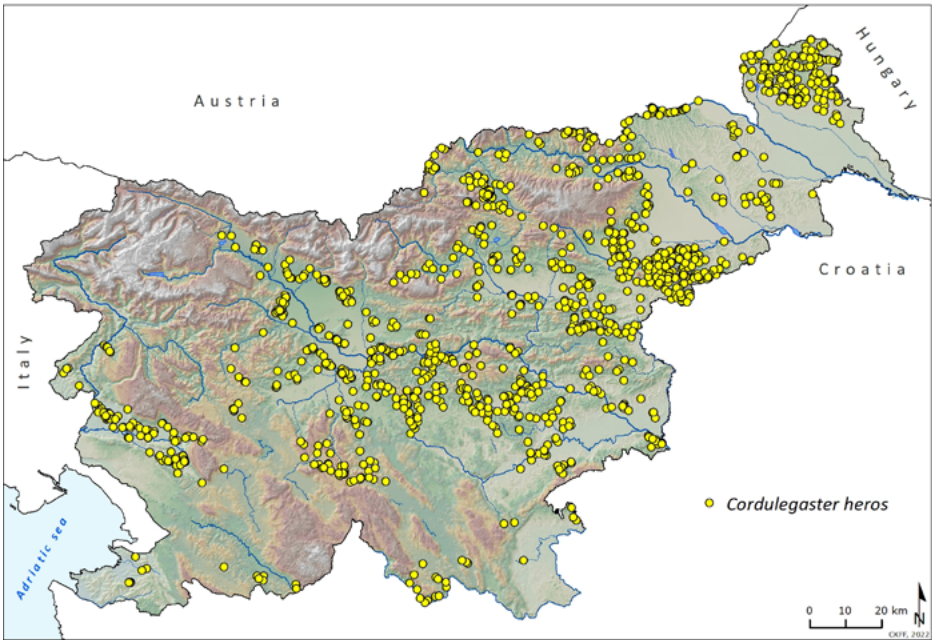


Figure 6. The distribution of *Cordulegaster heros* in Slovenia. The species is known from 1,427 localities. Out of a total of 2,073 faunistic records 77% represent larval records! Map: CKFF

With a little experience, it is almost impossible not to encounter this species, which is often accompanied by *Calopteryx virgo*, sometimes also by *Cordulegaster bidentata* and *Somatochlora meridionalis* (Fig. 7). The latter is also very common (Fig. 8), but prefers slightly larger, shaded and meandering streams in the lowlands. It is most frequently accompanied by *Calopteryx virgo*, *C. splendens*, *Platycnemis pennipes* and *Onychogomphus forcipatus*.

Figure 7. Male *Somatochlora meridionalis*, southeastern "sibling" of *S. metallica*. Photo: Matjaž Bedjanič

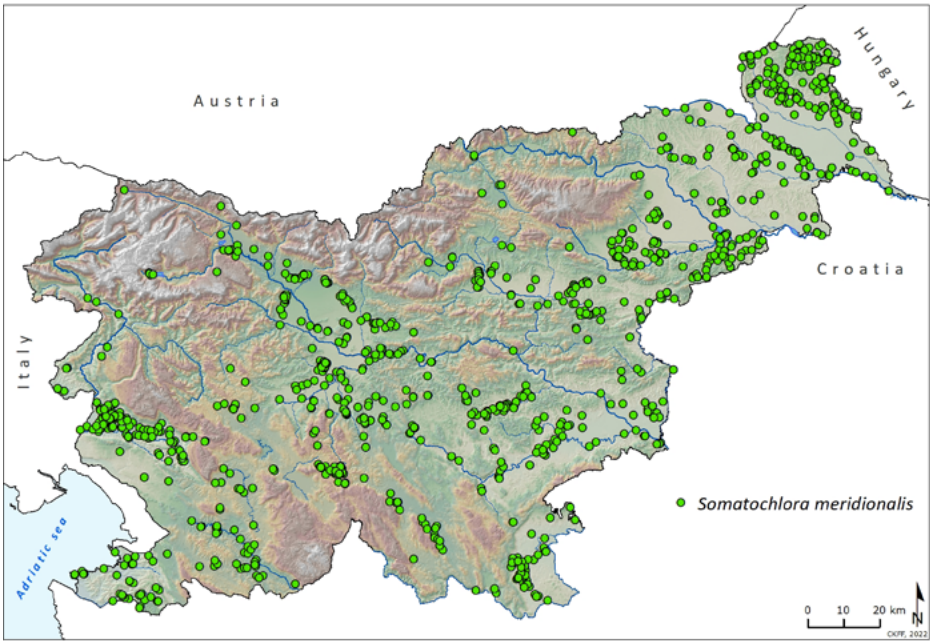


Figure 8. The distribution of *Somatochlora meridionalis* in Slovenia. Map: CKFF

As a country on the sunny side of the Alps, northern Slovenia also has some of the southernmost European peat bogs to offer. The Pokljuka and Jelovica Plateaus in the Julian Alps as well as Pohorje Mts. in the northeast are worth visiting for copious *Aeshna juncea*, *Somatochlora arctica* and *Leucorrhinia dubia* populations.

Less than an hour drive from Ljubljana to the south, one of the greatest Karst curiosities, the Intermittent Lake Cerknica, can be visited. With its constantly changing image and close to 40 recorded species it is always interesting for all nature lovers.

The Slovene coast in the south-west is quite crowded in summer, however, the end of June might be a good time to visit the old Sečovlje saltpans, the brackish lagoon and nature reserve Škocjanski zatok near Koper, or two claypit lakes at Fiesa near Piran. More than 40 dragonfly species have been recorded here, among which a rich population of *Ceriagrion tenellum* at Fiesa has to be mentioned.

In the north-east of Slovenia, extensive Petelinjek fishponds in the Ličenca Valley near Poljčane, the Podvinci fishponds near Ptuj, the Komarnik reservoir near Lenart, and the Medvedce reservoir south of Pragersko each harbour more than 40 species, the latter two even 49 species. May is the best time to observe *Epitheca bimaculata*, which has been recorded at more than 100 sites in this part of Slovenia. In June, more than 30 species can be easily encountered during the weekend, including *Leucorrhinia pectoralis*, *Aeshna isoceles* and *Erythromma najas*.

Further to the east, the Mura River floodplain, with its oxbows and numerous gravel pits, represents another dragonfly hotspot with 56 dragonfly species recorded so far. Some of the older oxbows along the border section of the Mura, near Petišovci, are inhabited by both *Chalcolestes viridis* and *C. parvidens*, and some even support the endangered *Aeshna viridis*, *Leucorrhinia caudalis* and *L. pectoralis*, while *Aeshna isoceles* and *Coenagrion pulchellum* are quite common.

This short introduction to the Slovene dragonfly fauna is rounded up with an official ECOO 2022 teaser – Slovenia is definitely the best place in Europe to see the enigmatic *Cordulegaster heros* and *Somatochlora meridionalis*! And last but not least, the immediate vicinity of ECOO 2022 venue in Kamnik can boast the type locality of the only Slovene "endemic" dragonfly – in 2008, a new fossil genus and species *Sloveniatrum robici* was described from nearby Tunijce hills and its age was estimated at around 11.6 and 12.7 Myr before present.

Conservation of dragonflies and their habitats in Slovenia

The protection of threatened dragonfly species in Slovenia is satisfactorily covered by legislation, although solely on paper. Altogether, 39 species or 53% of the dragonfly fauna is red-listed by the *Rules on the classification of endangered plant and animal species in the red list*, adopted in 2002. Unfortunately, the mentioned national Red List, prepared in 2000, is out of date and its revision is badly needed.

Figures 9-12. Some of the most beautiful and/or characteristic dragonfly habitats in Slovenia: Škocjanski zatok Nature Reserve near Koper on the Slovenian coast, western Slovenia (*top left*); Šijec peat bog on the Pokljuka Plateau in the Julian Alps, northern Slovenia (*middle left*); Stream in the Ličenca Valley near Poljčane, northeastern Slovenia (*right*); Old oxbow along the Croatian border section of the Mura River near Petišovci, northeastern Slovenia (*bottom*). Photos: Matjaž Bedjanič

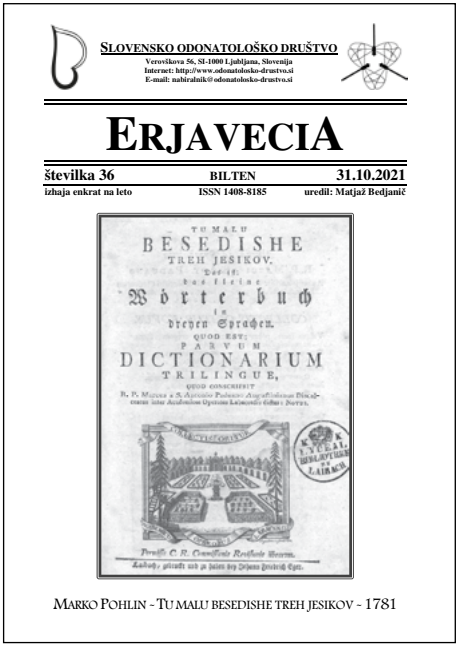
Since 2004, all of the most endangered and/or internationally protected species of dragonflies are officially protected in Slovenia. A total of 23 dragonfly species recorded in Slovenia are listed in the *Decree on Protected Wild Animal Species*, while habitats of 15 species are, or at least should be, legally protected. Out of the species, listed on the Annexes of the EU's Habitats Directive, *Coenagrion ornatum* (Ann. II; qualifying species at 8 Natura 2000 sites), *Ophiogomphus cecilia* (Ann. II and IV; qualifying species at 7 Natura 2000 sites), *Cordulegaster heros* (Ann. II and IV; qualifying species at 23 Natura 2000 sites) and *Leucorrhinia pectoralis* (Ann. II and IV; qualifying species at 6 Natura 2000 sites), as well as *Stylurus flavipes* (Ann. IV), *Aeshna viridis* (Ann. IV) and *Leucorrhinia caudalis* (Ann. IV) occur in Slovenia. *Lindenia tetraphylla* (Ann. II and IV), known only by an old record of a single, probably vagrant animal, was not considered in the process of SCI areas nominations.

In reality, despite "paper protection" listed above, some dragonfly species in Slovenia experience a serious decline and encroachment upon their habitats, while systematic, state funded monitoring is not carried out. For 11 species, accounting for 15% of the whole dragonfly fauna or 48% of all protected dragonfly species in Slovenia, we have had no data on their occurrence since 2014! Four of them, viz. *Lestes macrostigma*, *Coenagrion hastulatum*, *Aeshna caerulea* and *Somatochlora alpestris* have not been recorded in the present millennium. More systematic odonatological research is essential for nature conservation purposes, comprehensive evaluation of current situation and setting of conservation priorities. The update of the old red list is necessary, and the state should immediately start investing more in the odonatological knowledge, as well as in the active implementation of measures for the conservation of endangered species and their habitats.

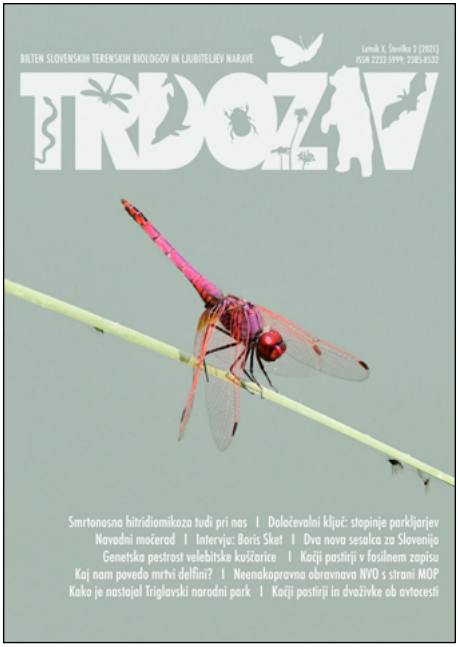
Slovene Dragonfly Society and ECOO 2022

The Slovene Dragonfly Society (SOD) was founded in 1992 with the aim to increase popularity of dragonflies and to connect dragonfly enthusiasts in Slovenia. In 30 years, the society has had over a 150 members and has implemented several tens of different projects. With 89 members in 2021, our main missions are to carry out research into the occurrence and threats of dragonflies in Slovenia, educate people about these beautiful insects, protect them and their habitats, as well as to exercise advocacy on the topic of nature and dragonfly conservation. Together with the Centre for Cartography of Fauna and Flora we maintain the odonatological database, which contains over 61,500 faunistic data from over 8,600 localities across Slovenia.

Since 1995, we have regularly published the Slovene Dragonfly Society's annual bulletin – *Erjavecia* (Fig. 13), which comprises close to 1,700 pages of various odonatological material and all sorts of information on the Society's activities, odonatology and dragonflies in Slovenia, together with regular updates to Slovene odonatological bibliography, which contains nearly 1,400 titles. Together with seven other Slovenian NGOs, we co-publish a popular semi-annual magazine *Trdoživ* that focuses on nature



MARKO POHLIN - TU MALU BESEDISHE TREH JESIKOV - 1781



Figures 13 & 14. Two bulletins published by the Slovene Dragonfly Society (SOD) – *Erjavecia* (left – no. 36 / 2021) and *Trdoživ* (right – vol. 10(2) / 2021). The logo of SOD (top left corner of Erjavecia front cover) represents a stylized copula of mating dragonflies, while the front cover of the last issue of *Trdoživ* (right – vol. 10(2) / 2021) is garnished by the Violet Dropwing *Trithemis annulata*, the latest addition of the year 2021 to the species list of Slovenian odonates.

in Slovenia (Fig. 14). In 1997, we co-published the groundwork on Slovenian odonata – *Atlas of the Dragonflies (Odonata) of Slovenia with the Red Data List*.

With a long tradition, we cooperate each year with several Biological Research Camps for university students and other youth, organized mostly in Slovenia, and co-organize BioBlitz Slovenia.

Our activities and interests are also international, most notably by (co)organising the annual *Balkan OdonatOlogical Meeting* (BOOM) since 2011, which has twice been hosted also in Slovenia. We also organized the *1st Odonatological Symposium of the Alpine-Adriatic Region* (1994, Maribor) and the *14th International Symposium of Odonatology* (1997, Maribor).

Members of the Slovene Dragonfly Society are especially honoured and proud to be the hosts of the *6th European Congress on Odonatology* (ECOO) to be held in June 2022 in Kamnik, Central Slovenia.

Acknowledgements

The authors express gratitude to the members of the Slovene Dragonfly Society – Slovensko odonatološko društvo for their manifold help, enthusiasm and splendid company in the field and beyond. Special thanks for all support and help to all fellow odonatologists and other colleagues from Slovenia and abroad, involved in the organization of the 6th European Congress on Odonatology (ECOO 2022) in Slovenia.

Literature

BEDJANIČ, M., 1994. Seznam odonatne favne Slovenije. *Acta entomologica slovenica* 2: 43-54.

BEDJANIČ, M., 2003. Kačji pastirji - Odonata. *In:* Sket, B., M. Gogala & V. Kuštor (Eds.), Živalstvo Slovenije, pp. 281-289, Tehniška založba Slovenije, Ljubljana.

BEDJANIČ, M., 2006. Regional guide to dragonflies: Slovenia. *In:* K-D. B., Dijkstra (Ed.) & R. Lewington (Illustr.), Field guide to the Dragonflies of Britain and Europe, pp. 55-56, British Wildlife Publishing, Dorset.

GEISTER, I., 1999. Seznam slovenskih imen kačjih pastirjev (Odonata). *Exuviae* 5/1: 1-5.

INOUE, K., 2017. Bastaan Kiauta – octogenarian (1937–2017). *Odonatologica* 46(1/2): 1-24.

KIAUTA, B., 1961. Prispevek k poznavanju odonatne favne Slovenije. *Biološki Vestnik* 8: 31-40.

KIAUTA, B., 1963. *Lindenia tetraphylla* v.d.Lind. und *Somatochlora metallica meridionalis* Nielsen aus Nordwestistrien (Jugoslawien) (Odonata: Gomphidae, Corduliidae). *Beiträge zur naturkundlichen Forschung in Südwestdeutschland* 22(1): 65-66.

KIAUTA, B., 1969. Predlog za zavarovanje nekaterih redkih ali ogroženih vrst kačjih pastirjev (Odonata) v Sloveniji. *Varstvo Narave* 6: 121-130.

KOTARAC, M., 1997. *Atlas kačjih pastirjev (Odonata) Slovenije z Rdečim seznamom: projekt Slovenskega odonatološkega društva*. Center za kartografijo favne in flore, Miklavž na Dravskem polju. 205 str.

KOTARAC, M., 2015. Slovenia. *In*: J.-P. Boudot & V. J. Kalkman (Eds.), Atlas of the European dragonflies and damselflies, pp. 48, 329-337, KNNV Publishing, the Netherlands.

TYAGI, B. K., 2019. *Dr Bastiaan Kiauta: Odonatologist and Polymath: His Life, Works and Universe*. Scientific Publishers, Jodhpur. xiv+ 334 str.

VINKO, D., A. ŠALAMUN, A. TRATNIK, N. ERBIDA, A. PIRNAT, M. BAHOR, D. KABLAR, P. KOGOVŠEK, N. ŠRAMEL, M. HOSTNIK, N. KRELJ, N. ŠABEDER, N. TIVADAR, J. SNOJ & M. BEDJANIČ, 2020. Favna kačjih pastirjev (Odonata) naravnega rezervata Ribniki v dolini Drage pri Igu (Ljubljansko barje, osrednja Slovenija). *Natura Sloveniae* 22(2): 5-28.

VINKO, D. & A. ŠALAMUN, 2021. First record of Violet Dropwing *Trithemis annulata* (Palisot de Beauvois, 1807) (Odonata: Libellulidae) in Slovenia. *Natura Sloveniae* 23(2): 25-37.

WASSCHER, M. T., A. G. ORR & H. J. DUMONT, 2022. In memoriam Bastiaan Kiauta (20th January 1937 – 26th March 2022). *Odonatologica* 51(1/2): 1-9.

ZESSIN, W., J. ŽALOHAR & T. HITIJ, 2008. A new fossil dragonfly (Insecta,Odonata, Libellulidae) of the Miocene (Lower-Sarmatian) of the Tunjice Hills, Slovenia. *Virgo – Mitteilungsblatt des Entomologischen Vereins Mecklenburg* 11(1): 86-96.

ECOO 2022

6th European Congress on Odonatology

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Abstracts of Oral Presentations

Molecular phylogeny of the Neotropical subfamily Palaemnematinae (Zygoptera: Platystictidae), focusing on *Palaemnema* from Colombia

Vanessa AMAYA-VALLEJO[1], Emilio REALPE[2] & Melissa SÁNCHEZ-HERRERA[3]

[1,2] Aquatic Ecology and Zoology Laboratory, Los Andes University, Bogotá, COLOMBIA. [1] Email: stolenseason@gmail.com; [2] Email: erealpe@uniandes.edu.co; [3] Neotropical biodiversity evolution genetics, phylogeography and ecology research group, Rosario University, Bogotá, COLOMBIA. Email: melsanc@gmail.com;

KEYWORDS: biodiversity, damselflies, phylogenetics, taxonomy, Odonata

The phylogenetic position of the Neotropical subfamily Palaemnematinae inside the family Platystictidae was established and the relationships between different species of *Palaemnema* were proposed, using the markers COI, 16S and 28S and applying the Maximum Likelihood and Bayesian Inference phylogenetic approaches. Those relationships were reinforced with the establishment of diagnostic morphologic characters and distributional information, in order to propose a hypothesis for the origin of Palaemnematinae and the diversification of *Palaemnema* in the Neotropics. Some unidentified adults and larvae of *Palaemnema* were included, wanting to confirm them as possible new species and to establish accurate life-stages' correspondences using an integrative approach, combining morphologic, phylogenetic and ecological information. The phylogenetic reconstructions confirmed the monophyly of Platystictidae and positioned Palaemnematinae as the sister group of the subfamily Protostictinae. Palaemnematinae appeared as monophyletic and could have originated from Protostictinae after the separation of Laurasia and Gondwana. Inside Palaemnematinae, there are two well-defined clades: The Central American clade and the South American clade. The position of the Central American clade species of *Palaemnema* in the phylogeny suggest that they appeared more recently than the South American ones, being the genus that possibly originated in Venezuela, then diversified in Colombia and finally dispersed to other countries. Colombia has the highest number of *Palaemnema* species and this diversification could be attributed to allopatric speciation processes caused by the particular geography of the country. Although the established relationships are quite useful and offered some highlights in the possible diversification of the genus, with the clades also supported by shared morphologic diagnostic characters, some of the phylogenetic relationships between *Palaemnema* species remained unclear. The existence of the proposed new species *Palaemnema* sp. nov. 1 and *Palaemnema* sp. nov. 2 was confirmed along with the rediscovery of *Palaemnema carmelita*, not reported since its description in 1918, and the larva-adult correspondence for these species was accurately established, confirming the effectivity of the integrative approach in the description of new species. The subfamily Palaemnematinae is evaluated from a deeper phylogenetic perspective for the first time, setting a starting point for the future addressing of the neotropical platystictids through complementary phylogenetic, phylogenomic and biogeographical analyses.

Proposition and first results of a standardised protocol based on exuviae collection to monitor three dragonfly species of community interest (Insecta: Odonata): *Macromia splendens*, *Oxygastra curtisii* and *Gomphus graslinii*

Loan ARGUEL[1], Alice S. DENIS[2,3], Samuel DANFLOUS[4], Nicolas GOUIX[5], Frédéric SANTOUL[6], Laëtitia BUISSON[7], Baptiste CHARLOT[8], François LÉGER[9], Leslie CAMPOURCY[10], Clément DECAUX[11] & Laurent PELOZUELO[12]

[1,2,6,7,12] Laboratoire d'Ecologie fonctionnelle et Environnement, CNRS – INPT – UPS, Université Paul Sabatier, Bâtiment 4R1, 118 Route de Narbonne, 31062 Toulouse Cedex 09, FRANCE. [1] Email: loan.arguel@univ-tlse3.fr; [2] Email: alice.denis@outlook.com; [6] Email: frederic.santoul@univ-tlse3.fr; [7] Email: laetitia.buisson@univ-tlse3.fr; [12] Email: laurent.pelozuelo@univ-tlse3.fr; [3,4,5,8] Conservatoire d'Espaces Naturels d'Occitanie, BP 57611, 75 Voie du TOEC, 31076 Toulouse Cedex 3, FRANCE. [3] Email: alice.denis@outlook.com; [4] Email: samuel.danflous@cen-occitanie.org; [5] Email: nicolas.gouix@cen-occitanie.org; [8] Email: baptiste.charlot@cen-occitanie.org; [9] Chargé d'études Ecologie – Agence MTDA – Antenne Bordeaux, 74, Avenue Georges Bonnac, 33000 Bordeaux, FRANCE. [9] Email: francois.leger@mtda.fr; [10] Chargée de mission – LPO Occitanie – Délégation territoriale Aveyron, 10, rue du couvent – Cruéjouls, 12340 Palmas d'Aveyron, FRANCE. [10] Email: leslie.campourcy@lpo.fr; [11] Chargé de mission Milieux Naturels, EPAGE du bassin du Viaur, 10 Cité du Paradis, 12800 Naucelle, FRANCE. [11] Email: clement.decaux@epage-viaur.com;

KEYWORDS: survey method, field protocol, conservation, riverine community, Natura 2000

Collection of quantitative data regarding the presence and abundance of insect species is essential to document population trends and promote action in favour of their conservation. This is relevant for all odonate species, especially for species with an unfavourable conservation status, listed on the annexes of the Habitats Directive and/or protected. Among the European Union countries, France hosts a high odonatological diversity (98 species), including the Splendid Cruiser *Macromia splendens* (Pictet, 1843), the Pronged Clubtail *Gomphus graslinii* (Rambur, 1842) and the Orange-spotted Emerald *Oxygastra curtisii* (Dale, 1834). As recommended by the French National Action Plan for dragonflies, we tested a standardized protocol to monitor those three species and other riverine Anisoptera in South-Western France. We used "exhaustive" exuviae collection to monitor those species in mid-sized rivers. First, we studied the impact of transect size and number of visits on species detection, Anisoptera species richness and abundance during summer 2015, on the river banks of three rivers (Aveyron, Vère, Dourdou de Camarès). Second, we monitored "sentinel populations" of *M. splendens*, *G. graslinii*, *O. curtisii* on the river Aveyron, Vère, Lot and Viaur, within Natura 2000 sites, respectively for four, four, three and three years. Our results reveal spatial and temporal variability for these three species of community interest and different hypotheses are discussed. The development of such standardised protocols on a larger scale, in randomized localization and/or focusing on "sentinel population", is highly desirable to increase our knowledge of those species' population trends at short- and mid-term.

Students' knowledge and attitude towards dragonflies

Maja BAHOR

Slovene Dragonfly Society, Verovškova 56, 1000 Ljubljana, SLOVENIA. EMAIL: mj.bahor@gmail.com;

KEYWORDS: Odonata, attitude, knowledge, misconceptions, students

Attitude is a feeling and behaviour in relation to objects or situations and it is reflected in our actions. Better knowledge usually results in a more positive attitude towards living organisms and consequently towards protection of their environment, which is particularly important for endangered species protection.

We used a survey questionnaire that collected demographic data, a test of knowledge and a 7-point Likert scale to rate student's attitude towards dragonflies and their willingness to protect them. The survey involved 288 Slovenian high school students, from year 1 to year 3 (aged 15 to 17). The results showed poor knowledge of dragonflies and very poor recognition of their larvae. Students have better general knowledge of dragonflies and weaker knowledge of evolution, ecology and anatomy. We confirmed that direct experience with dragonflies enables a more positive attitude, therefore it would be necessary to provide students in biology lessons with a more direct experience with living organisms, especially in their environment.

Misconception is usually a negative attitude towards an object that develops owing to poor knowledge and impact of the environment (especially family and media). We found that as many as 63.3% students have misconceptions about dragonflies.

Although insects often have a negative connotation, dragonflies are attractive because of their colours and ability to fly. They are flagship species to promote conservation of wetlands. Students with better knowledge have a more positive attitude and a greater interest in learning. They are also more willing and prepared to protect dragonflies, and are also more aware of their important role in ecosystems.

New data and knowledge, but conservation concerns remain – IUCN Red List assessment of Sri Lanka's endemic Odonata

Matjaž BEDJANIČ[1], Amila P. SUMANAPALA[2] & Rory A. DOW[3,4]

[1] National Institute of Biology, Večna pot 111, 1000 Ljubljana, SLOVENIA. Email: matjaz.bedjanic@nib.si; [2] Department of Zoology & Environment Sciences, University of Colombo, SRI LANKA. Email: apsumanapala@gmail.com; [3] Naturalis Biodiversity Centre, P.O. Box 9517, 2300 RA Leiden, THE NETHERLANDS. [4] Institute of Biodiversity and Environmental Conservation, University Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, MALAYSIA. Email: rory.dow230@yahoo.co.uk;

KEYWORDS: Sri Lanka, dragonflies, damselflies, endemicity, island biogeography, threat status

According to published data, 131 dragonfly species from 12 families are currently known from Sri Lanka. The proportion of endemics is 51.1%, with as many as 59 species and 8 subspecies endemic to the island. This extraordinary level of endemicity makes the dragonflies of Sri Lanka an exceptionally interesting group for studies in biodiversity, zoogeography, phylogeny and ecology.

The results of more than two decades of odonatological research on the island are briefly presented. In a monograph *Dragonfly Fauna of Sri Lanka: distribution and biology, with threat status of its endemics*, published in 2014, the odonate fauna of the island was comprehensively presented and analysed. Since then, 10 new species have been described. In recent years, Sri Lankan colleagues have contributed important new insights into the taxonomy, distribution and biology of some new, rare, and critically endangered species.

A global assessment of the threat status of 66 endemic dragonfly species and subspecies from Sri Lanka, described until 2020, was conducted by the authors in 2021, using IUCN Red List criteria. Compared to 2014, the number of new faunistic data available for the assessments, mainly contributed by the second author, has almost doubled. However, despite new data and knowledge, the results remain very concerning – 52 endemics or 78.8% of the Sri Lanka's endemic odonate fauna were classified as globally threatened, among them 12 spp. as critically endangered (IUCN: CR), 23 spp. as endangered (IUCN: EN) and 17 spp. as vulnerable (IUCN: VU). The ranges of many endemics are very limited and for endangered species, the Extent of Occurrence (EOO) calculation averages only about 5,560 km2.

Two enigmatic critically endangered endemics, viz. *Anisogomphus ceylonicus* and *Macromia flinti*, for which there had been no observations for several decades, were surprisingly found by the second author and his colleagues, and new records, together with valuable new data on their natural history, were published only recently in 2022. Unfortunately, conservation concerns remain, as habitat destruction and fragmentation in densely populated southwestern and central Sri Lanka is an ongoing saga, coupled with worrisome impacts from economic crises and climate change.

In conclusion, the need for further odonatological research in Sri Lanka is highlighted. Raising awareness and promoting interest in odonatology among wide community of researchers, conservationists, and students in Sri Lanka remains one of most important goals for the future.

Dragonflies in Iceland

Magnus BILLQVIST

Swedish Dragonfly Society; Idrottsvägen 2, 243 72 Tjörnarp, SWEDEN; Email: magnus.billqvist@gmail.com;

KEYWORDS: insect migration, Odonata, Iceland, Aeshnidae

Iceland lies in the North Atlantic Ocean, on the cusp of the Arctic, between the latitudes 63°N and 68°N, and the longitudes 25°W and 13°W. Most of the island consists of tundra with a subpolar arctic climate. Smaller parts, mainly along the coast, are considered subarctic. Iceland is rather isolated, with the closest land mass being Greenland (ca 300 km) and in Europe the Faroe Islands (420 km). None of these, including Iceland, harbour any native dragonflies.

The closest land mass with an existing Odonate fauna is Norway, almost 1,000 km from Iceland. Nonetheless, three species of dragonflies, viz. *Aeshna affinis*, *A. grandis* and *Anax ephippiger*, have been found in Iceland, all considered to be European, or even African, migrants.

During this presentation I will give an overview of the observations of these three species and how they came to be found in Iceland. The data consists of literature references, databases, and Icelandic, personal, contacts.

KennArt – A nationwide initiative for the education of taxonomic experts in Germany and its part for the dragonflies

Klaus-Jürgen CONZE[1], Christian GÖCKING[2], Norbert MENKE[3] & Mathias LOHR[4]

[1] c/o GdO – Society of Germanspeaking Odonatologists, Hamburger Str. 92, D-45145 Essen, GERMANY. Email: kjc@loekplan.de; [2, 3] NABU-Naturschutzstation Münsterland e.V., Westfalenstraße 490, D-48165 Münster, GERMANY. [2] Email: c.goecking@nabu-station.de; [3] Email: n.menke@nabu-station.de; [4] Technische Hochschule Ostwestfalen-Lippe, Fachgebiete Landschaftsökologie und Tierökologie, An der Wilhelmshöhe 44, 37671 Höxter, GERMANY. Email: mathias.lohr@th-owl.de;

KEYWORDS: curriculum, three-level course-system, certification

Within the framework of the project "KennArt – a nationwide initiative for the education and training of Taxonomic experts" - NABU-Naturschutzstation Münsterland e.V. and the Centre for Biodiversity Monitoring and Conservation Research at the Zoological Research Museum Alexander Koenig are developing species knowledge courses for selected taxonomical groups. This is a joint project within the Federal Program Biodiversity in Germany. In addition to Hymenoptera, beetles, mosses and grasses, dragonflies are also included. The courses for the dragonfly-experts are developed in cooperation with the GdO – the society of the German speaking Odonatologists.

In addition to the course implementation with the provision of appropriate materials, a previously developed curriculum as well as the examination requirements and modalities derived from it are also developed and tested. An important additional aim hereby is the certification for the advanced participants useful as standardized professional qualification.

The courses are based on a multi-level system with basic, advanced and in-depth courses and can be attended independently of each other depending on prior knowledge. Certifications can also be obtained independently of attendance.

The course scope or time commitment for the participants (workload) is about 60 hours per course, divided into lectures, identification exercises, excursions and self-study phases. The courses are to be held in presence as far as possible and supplemented by digital learning formats.

Further Information at „*www.artenkenntnis.de*".

Female colour polymorphism in *Ischnura elegans* from Menorca Island, with the description of a putative new morph

Adolfo CORDERO-RIVERA & Anais RIVAS-TORRES

Universidade de Vigo, ECOEVO Lab, E.E. Forestal, Campus Universitario A Xunqueira, 36005 Pontevedra, SPAIN. Email: adolfo.cordero@uvigo.gal;

KEYWORDS: colour morphs, damselfly, behaviour, Coenagrionidae

The colour polymorphism of the females of Ischnura elegans has been known since the early twentieth century, and has been studied by numerous authors in different regions, showing enormous variability in the frequency of androchromes. Island populations are especially interesting to understand the dynamics of this phenomenon, since the founder effect and possible stochastic extinctions can due to small population sizes lead to population frequencies very differently from those recorded on the continent. Populations on the East coast of Spain are characterized by having a slight predominance of the *aurantiaca* morph (45–50%), the rest being distributed in a similar way between androchromes and *infuscans*. This communication presents the first estimates of polymorphism in three populations of the island of Menorca. In the population of La Vall, 19 mature females were found in September 2020, the most common morph being *infuscans* (60%), followed by *aurantiaca* (21%) and androchromes (16%). In June 2021, this population had hardly any individuals (N=9 mature females), 8 of them being *infuscans* (89%) and one androchrome. In September 2021, only 13 females were found, 63% *infuscans*, 30% *aurantiaca* and 7% androchromes. The frequencies in Cala Tirant and Son Bou obtained in June 2021 (N=28–30 females) also show a preponderance of the *infuscans* morph (60–89%), followed by *aurantiaca* (11–33%), androchromes being extremely rare (0–7%). In September 2021, these populations showed 60–67% *infuscans*, 12–20% *aurantiaca* and 20–21% androchromes, based on a sample of 30–42 females. Finally, the three localities were re-sampled in May–June 2022, with a lower density due to the dry year (N=6–37 mature females), but similar female morph frequencies, with the *infuscans* morph being again dominant (57–81%), over androchromes (0.6–33%) and *aurantiaca* (0–16%). Furthermore, in 2022 we were able to sample a large number of mating pairs (N=88) in Cala Tirant and found that 80% of females involved in copulation were *infuscans*, almost the same frequency as alone females in this population (81%). This implies that the frequencies on the island clearly diverge from those known on the East coast of Spain. In addition, in Son Bou some females similar to *aurantiaca* morph were found, but with immature violet colouration, which to date had only been recorded in immature androchromes and *infuscans*. This suggests the presence of a new allele, exclusive to the Balearic Islands, which may represent a new morph.

The Odonata of the northeast Roman Countryside

Pierangelo CRUCITTI[1] & Davide BROCCHIERI[2]

[1,2] Società Romana di Scienze Naturali, Via Fratelli Maristi 43, 00137 Roma, ITALY. [1] Email: info@srsn.it; [2] Email: davidebrocchieri@hotmail.com;

KEYWORDS: biodiversity, monitoring, distribution, conservation

The Società Romana di Scienze Naturali carried out field surveys from 1997 to 2018 on the Odonata of the Roman Countryside in the northeast of the urban ecosystem of Rome delimited by the GRA highway ring. This "mosaic" lowland area includes some natural reserves, woody patches surrounded by a cultivated and urbanized matrix, rich in canals and ditches with variable hydroperiod (secondary tributaries of the Tiber and Aniene rivers), pools and ponds, artificial reservoirs used for irrigation and fishing, and artificial troughs. Our research allowed establishing the presence of 36 species. A total of 17 Zygoptera and 19 Anisoptera were found; among them, 20 (8 Zygoptera and 12 Anisoptera species) breeding and present with numerous and apparently stable populations, while 16 (9 Zygoptera and 7 Anisoptera species) were localized. Approximately 61% of the species (i.e., 22) were widely distributed in the study area, while 39% (14) were restricted to a single site, with very few sampled individuals, except for *Erythromma viridulum* and *Anax parthenope*. The highest number of species was found in two artificial basins recently realized, with 15 and 19 species. The 36 species found in the study area correspond to 85.7% of the 42 species cited for the city of Rome delimited by the GRA (reasonably, an exceeded value dating back to 1997), 62% of the 58 species known for the Lazio Region and to 37.5% of the 96 species known for Italy. The analysis of chorotypes showed the predominance of species widely distributed in the Palearctic (25 species, 69.5%); the European and Mediterranean components count 4 species each (11.1%), while 3 species are Afrotropical (8.3%). Conservation status of 35 species is of Least Concern, LT; *Coenagrion mercuriale* is considered Near Threatened, NT, and included in the Annex II of EU Habitats Directive.

Towards a new European Red List of Odonata: challenges and first results *

Geert DE KNIJF[1,2], Magnus BILLQVIST[3], Roy VAN GRUNSVEN[2,4] Florent PRUNIER[5] & Damjan VINKO[6]

[1] Research Institute for Nature and Forest (INBO), BELGIUM. Email: geert.deknijf@inbo.be; [2] IUCN Dragonfly Specialist Group; [3] Swedish Society for Conservation of Nature in Scania, SWEDEN. Email: magnus.billqvist@gmail.com; [4] Dutch Butterfly Conservation, THE NETHERLANDS. Email: roy.vangrunsven@vlinderstichting.nl; [5] Red de Observadores de Libélulas en Andalucía (ROLA), SPAIN. Email: aeaelbosqueanimado.info@gmail.com; [6] Slovene Dragonfly Society, Verovškova 56, 1000 Ljubljana, SLOVENIA. Email: damjan.vinko@gmail.com;

KEYWORDS: dragonflies, damselflies, conservation, threats, IUCN Red List

The IUCN Red List criteria are intended to be an easily and widely understood system for classifying species at high risk of extinction. One of the recommendations is that a Red List must be updated every 10 years. Since the Red List of the dragonflies and damselflies of Europe was published in 2010, the European Commission wished to update the old Red List.

The first European Red List of Odonata was published in 2010 and was mostly based on expert opinion rather than on trend analysis. The main reason was the absence of an extended database from Europe. Since then, the European Atlas has been published in 2015, and so a database was compiled. Later a lot of new data of Odonata in Europe became available and some rather under-surveyed regions have received necessary attention, such as Iberia and the Balkans. Some new species have also been discovered in Europe (e.g. *Onychogomphus cazuma*), increasing the total number of species to 147 to assess instead of 138 species of the previous assessment.

It will not be possible to present the final results as the assessments are underway. Here we present the challenges we encountered while compiling the data from several countries. We also give an overview of the different IUCN criteria for assessing a species and will go deeper into the methodology of how a trend was calculated for each species. For some species we present their Red List-status and discuss the reasons for change.

* *Keynote lecture, presented at the 6th European Congress on Odonatology – ECOO 2022, Kamnik, Slovenia*

Atlas of the dragonflies and damselflies of West and Central Asia

Geert DE KNIJF[1,2], Jean-Pierre BOUDOT[2], Sergey BORISOV[3], Roy VAN GRUNSVEN[2,4], Asmus SCHRÖTER[5] & Vincent J. KALKMAN[2,6]

[1] Research Institute for Nature and Forest (INBO), BELGIUM. Email: geert.deknijf@inbo.be; [2] IUCN Dragonfly Specialist Group. [3] Institute of Systematics and Ecology of Anumals, Novosibirsk, RUSSIA; Email: borisov-s-n@yandex.ru; [4] Dutch Butterfly Conservation, Wageningen, THE NETHERLANDS; Email: roy.vangrunsven@vlinderstichting.nl; [5] Notulae odonatologicae, Editorial Office, Tbilisi, GEORGIA; Email: asmustim@gmx.de; [6] Naturalis Biodiversity Center, Leiden, THE NETHERLANDS; Email: vincent.kalkman@naturalis.nl;

KEYWORDS: Odonata, Middle East, distribution, endemism

We present a detailed overview of the distribution of the damselflies and dragonflies (Odonata) of West and Central Asia, an area covering nearly 8 million km². The region is characterized not only by the presence of several vast arid deserts such as the Arabian desert, Syrian desert and the Karakum, but also harbours extensive mountain chains rich in streams, rivers, marshes and lakes including the Caucasus, Zagros and Hindu Kush. These strong geographic differences in combination with its position between the Afrotropical, Oriental and Palearctic realm result in an interesting and diverse odonate fauna.

This Atlas deals with no less than 175 (sub)species, many of which are endemic to the region or occur just marginally outside the region. For each species, a distribution map is presented showing its occurrence in the region and adjacent areas. Although this atlas is not an identification guide, it will definitely help to identify most of the species in the region as it contains images of nearly all species, many of which have seldom been depicted in books before.

In West and Central Asia, the combination of climate change and an ever increasing demand for freshwater for drinking and agriculture will result in increased desertification and habitat degradation. The future of some of the species occurring in the area is therefore gloomy and some might not make it to the end of the century. We hope that this book will help raise local awareness about this group of freshwater species and will contribute to a better protection and management of freshwater ecosystems.

Mitochondrial phylogeography of the Iberian endemic gomphid *Onychogomphus cazuma*

Cecilia DÍAZ-MARTÍNEZ[1], Karen E. LÓPEZ-ESTRADA[2], Natalia ROSAS-RAMOS[1,3] & Mario GARCÍA-PARÍS[1]

[1] Museo Nacional de Ciencias Naturales, MNCN-CSIC, José Gutiérrez Abascal, 2, 28006 Madrid, SPAIN. Email: cdiaz.cuenca@gmail.com. [2] Real Jardín Botánico RJB-CSIC, Plaza de Murillo, 2. 28014 Madrid, SPAIN. [3] Departamento de Biología Animal, Facultad de Biología, Universidad de Salamanca, Campus Miguel de Unamuno s/n, 37007 Salamanca, SPAIN.

KEYWORDS: Odonata, biodiversity, evolutionary biology

Onychogomphus cazuma is endemic to the Iberian Peninsula. To date, it has been reported in only 13 localities distributed in an area of 10,000 km^2 in Eastern Spain. These 13 localities are clustered into three geographic groups: northern (three sites), central (eight sites), and southern (two sites), that are 50 and 100 km apart, respectively. *Onychogomphus cazuma* breeds in small permanent streams and springs with hypothermal waters (17–25 ^{0}C).

Species of Anisoptera are known to have a high dispersal capacity. In addition, given the possible existence of genetic bottlenecks, as a result of the small number of populations and relictual distribution, one might expect reduced mitochondrial diversity and a homogeneous phylogeographic pattern for *O. cazuma*. To test for this hypothesis, we analyzed the phylogeographic structure of *O. cazuma* using a 668 bp sequence of mitochondrial DNA (COII) of 35 specimens from nine populations. Contrary to expected, seven haplotypes were identified. There is a predominant haplotype that is present in both northern and central populations. The central group has the lowest diversity, with only two different haplotypes in one population. The southern population presents two exclusive haplotypes but not the predominant one.

This genetic structure leads us to reject the null hypothesis of homogeneity, showing that there are two apparently isolated population groups: north-central, and southern. The low genetic diversity within the north-central group suggests that other haplotypes have been extirpated, and likely current populations are the result of recolonization by a single population in source-sink dynamics.

The birdwatcher's insects? Spreading the message of dragonflies, freshwater and conservation *

Klaas-Douwe B. DIJKSTRA

Naturalis Biodiversity Center, Leiden, THE NETHERLANDS. Email: kddijkstra@gmail.com;

KEYWORDS: Odonata, diversity, popularization, common names, awareness rising

Dragonflies are often called the birder's insects. But while much of their growing audience consists of people who first became interested in nature through groups like birds, our relationship with insects is historically not even nearly as close. A rich vocabulary has evolved organically across centuries for birds and plants, for example. Emulating such everyday language may also speed up the familiarization of species groups where no tradition exists, like Odonata. Indeed, much of the challenge (and sometimes discord) in popularizing dragonflies and damselflies lies there. For example, books and websites already provide 4,000 English names for almost 3,000 of the world's 6,300 known species, of which about 85% were introduced in the last 25 years. On this occasion I reflect on my 'conversion' from ornithology to odonatology as a child, my experiences as a dragonfly explorer and author, and how this continues to shape my thoughts on how we might further increase the interest for dragonflies.

* *Plenary lecture, presented at the 6th European Congress on Odonatology – ECOO 2022, Kamnik, Slovenia*

Cordulegaster species under the pressure of climate change (Insecta: Odonata)

Judit FEKETE[1,2], Marco DINIS[3,4,5], Judit PADISÁK[1], Pál BODA[2], Edvárd MIZSEI[6,7] & Gábor VÁRBÍRÓ[2]

[1] University of Pannonia, Centre of Natural Science, Research Group of Limnology, H-8200 Veszprém, Egyetem u. 10, HUNGARY. Email: juditfekete0307@gmail.com; [2] Centre for Ecological Research, Institute of Aquatic Ecology, Department of Tisza Research, 18/c Bem square, H-4026 Debrecen, HUNGARY. [3] CIBIO/InBIO, Centro de Investigação em Biodiversidade e Recursos Genéticos da Universidade do Porto, Instituto de Ciências Agrárias de Vairão, R. Padre Armando Quintas nº 7, 4485-661 Vairão, PORTUGAL. [4] Departamento de Biologia, Faculdade de Ciências, Universidade do Porto, 4099-002 Porto, PORTUGAL. [5] BIOPOLIS Program in Genomics, Biodiversity and Land Planning, CIBIO, Campus de Vairão, 4485-661 Vairão, PORTUGAL. [6] Kiskunság National Park Directorate, H-6000 Kecskemét, Liszt F. u. 19., HUNGARY. [7] Department of Ecology, University of Debrecen, PO Box 71 H-4010 Debrecen, HUNGARY.

KEYWORDS: modelling, future distribution, shift pattern

Climate change and its effects can be a main threat to every living organism on Earth, especially in the mountainous regions, where the cold adopted and water related species could be the most vulnerable parts of the ecosystem. In our study we aimed to model the future distribution changes of two dragonfly species, the Balkan Goldenring (*Cordulegaster heros*) and the Two-toothed Goldenring (*C. bidentata*), which are both classified as "Near Threatened" according to the IUCN Red List. By modelling the potential occurrence conditions of both species we obtained, with the help of Species Distribution Modelling, a more accurate picture of the most suitable areas for the species, thus facilitating the planning of monitoring and conservation projects. The use of occurrence models is an increasingly common method in conservation biology. In this study a European-wide scale dataset with a total of 2,167 occurrence data were collected for the two species which formed the basis of our models. For the modelling of future predictions, 3 circular models with GCM CompareR tool and 2 different scenarios (RCP 4.5 and 8) were selected. We revealed how and which climatic and abiotic background variables affect these species most and which areas are the most suitable for the species. We calculated how the future climatic changes affect the range of suitable areas of the two species. We suggest that these Cordulegaster species are strongly influenced by climatic variables that have a major impact on the occurrence of these species in the future. We found that the distribution of *C. bidentata* shifts northwards. The forecasts for suitable areas of *C. heros* showed an upward shift towards high elevations and the models predict a more than 90% loss of suitable areas.

A video series on behaviour and habitat selection of dragonfly and damselfly species in the southern part of Finland: *Coenagrion armatum*

Miikka FRIMAN

Jokitörmäntie 7, 01750, Vantaa, FINLAND. Email: miikkafriman@gmail.com:

KEYWORDS: Coenagrionidae, nature documentary, niche

Kiven ja veden korennot (The Dragonflies of Water and Rock) is a working title for a series of short films focusing on the link between dragonflies and their habitats. The mission of the project is to organize the visual footage into species-specific episodes and to visualize the behaviour of adult Odonata species and the key features of their habitats, especially in the context of the microhabitat.

Coenagrion armatum (Charpentier, 1840) (Odonata, Coenagrionidae) is a damselfly species facing the risk of habitat degradation in large parts of its distributional range in Europe, where the distribution is mostly confined to the northern half of the continent. The species is relatively local but not very uncommon in Finland, where *C. armatum* is regionally assessed as Least Concern (LC). Adult males and females of the species were shot on video in the Helsinki metropolitan area at four principal localities with reproductive populations. The footage shot in UHD and 4K resolution had been collected as a by-product of several field visits at the localities since 2015. The field visits were primarily carried out to monitor the phenology and abundance of different Odonata species at the localities. The conditions of the localities during the emerging of the first individuals of *C. armatum*, as well as the morphological variation of the species, and behaviour from foraging to ovipositing, were shot on video in the field.

The behaviour of the species is largely typical for coenagrionids in general, and much of it takes place at the superficially dense and mosaic-like shoreline vegetation of lakes or at shallow wetlands with comparable features. The behaviour of *C. armatum* had probably rarely been shot on video before due to its relatively limited distribution, as well as the short peak of the flight period, of this rather small-sized and therefore perhaps easily overlooked odonate species.

Using European specimen collections during research on South American dragonflies

Floris VAN GEEST[1] & Wouter VAN DER VOORT[2]

[1,2] Dutch Dragonfly Society & Leiden University, THE NETHERLANDS. [1] Email: fwvg@live.nl; [2] Email: woutervandervoort@protonmail.com;

KEYWORDS: *Micrathyria*, Libellulidae, Guiana region, distribution, variation

In a research conducted by two students from PRE-University College of Leiden University, undescribed variation within a selection of the American dragonfly genus *Micrathyria* has been studied. The study was limited to larger *Micrathyria* specimens from the Guiana Region in South America. We made use of an extensive photo collection and specimen collections of Denis Gaschignard and Naturalis Biodiversity Centre. Several corrections of determinations have been made and undescribed variation has been found, most evident in *M. spinifera* and *M. hippolyte*. Also, the known distribution of *M. venezuelae* has been expanded and this species has been discovered within some collections in which it was previously unknown.

The aforementioned research has been carried out without travelling to the Guiana Region. Instead, photo collections and specimen collections have been used. It is not common that such extensive collections from a Neotropical Region are present on another continent. For our study, they were crucial to carry out an in-depth research on such a specific dragonfly genus as *Micrathyria*. Specimen collections like the ones used in our research project are of immense importance and should be preserved and protected for future studies.

Dragonfly conservation in urban environments – a multi-scale perspective

Diana GOERTZEN

TU Braunschweig, Institute of Geoecology, Landscape Ecology and Environmental Systems Analysis, Langer Kamp 19c, D-38106 Braunschweig, GERMANY. Email: d.goertzen@tu-braunschweig.de;

KEYWORDS: diversity patterns, urbanisation, Central Europe, heterogeneity

Freshwater ecosystems face severe biodiversity declines, and habitat loss and degradation caused by urbanisation is one of the major threats. However, urban freshwaters can harbour high biodiversity. In order to assess the potential of urban areas for dragonfly conservation, I investigated patterns of species richness and composition in Central European urban environments. Therefore, I compiled data from field surveys, databases and a literature review and considered different spatial scales: the habitat, city and landscape scale.

The main findings were that dragonfly species richness could be high and urban assemblages could contain a wide array of regional species at all scales, including species of conservation concern. Dragonfly diversity was determined by structural and spatial heterogeneity of single ponds, the city's pondscape and the surrounding landscape. However, with increasing urbanisation the degree of dragonfly richness and the proportion of specialists declined at all scales.

In conclusion, urban environments in Central Europe have good potential for high dragonfly diversity and dragonfly conservation. But this potential is limited in areas of high urbanisation degree and for some species urban areas cannot substitute natural landscapes. Thus, conservation requires a multi-faceted and multi-scaled view integrating good habitat quality, a diverse bluescape and high landscape heterogeneity. To mitigate negative impacts of increased urbanisation degree conservation measures should aim at promoting high structural and spatial heterogeneity at all scales. In addition, the preservation of pristine habitat remnants is crucial to promote regionally characteristic specialists.

Flight styles of *Cordulegaster bidentata* during daily flight activity

Otakar HOLUŠA

Moravian Forestry Institute, r.i., Uhřice 295, CZ-69634, CZECH REPUBLIC. Email: holusao@email.cz;

KEYWORDS: Odonata, Cordulegastridae, dragonflies, behaviour, flight, Czech Republic

Two-toothed Goldenring *Cordulegaster bidentata* is a European species occurring in forest spring areas and very small streamlets. In the Czech Republic, the centre of the species occurrence is in the Western Carpathian Mts. Our study was conducted in a small spring area in the Moravskoslezské Beskydy Mts. (Ostravice village – valley of Mazák, altitude 680 m a.s.l.) and Ždánický les Hills (Lovčice village – valley of Jordánek stream, altitude 378 m a.s.l.) in the eastern part of the Czech Republic. The spring area and contiguous streamlet (with a total length of 70 m) are in a small valley in large complex of forests (stemwoods).

Daily flight activities were studied from mid-June till mid-August in 2013, 2015 and 2020, during the day from 6:00 to 21:00 CET. Flight level, airspeed (semiquantitative only - very slow, slow, fast), and how the actual flight was completed with turns, stops, and loops were monitored. Approximately 10 flight styles were recognized. Within the flights, the ability to underfly obstacles (lying logs) was monitored, the critical value that the imago will not fly is less than 25 cm when the diameter of the obstacle is more than 17 cm.

Atlas of the Odonata of Austria 2.0

Werner E. HOLZINGER[1], Brigitte KOMPOSCH[2] & Andreas CHOVANEC[3]

[1,2] Oekoteam-Institute for Animal Ecology and Landscape Planning, Bergmanngasse 22, 8010 Graz, AUSTRIA. [1] Email: holzinger@oekoteam.at, [2] Email: b.komposch@oekoteam.at; [3] Federal Ministry of Agriculture, Regions and Tourism, Marxergasse 2, 1030 Vienna, AUSTRIA. Email: andreas.chovanec@bmlrt.gv.at;

KEYWORDS: dragonflies, damselflies, species distribution, Red List

The distribution Atlas of the Odonata of Austria published in 2006 is already advancing in years. Therefore, a new edition of the Atlas including the Red List will be compiled in the next few years.

The database on the dragonfly fauna of Austria currently comprises about 90,000 records. Both the spatial distribution of the records and the state of knowledge on the 78 recorded species are very heterogeneous.

Significant changes compared to 20 years ago can be seen in the distribution data of some species: both real range expansions (e.g. *Erythromma lindenii*, *Gomphus pulchellus*) and losses (e.g. *Sympetrum flaveolum*) as well as increases in knowledge (e.g. *Coenagrion ornatum*, *Cordulegaster heros*) can be documented. Still, we expect new species records for Austria in the near future (e.g. *Pantala flavescens*, *Boyeria irene*).

We are grateful for submission of current (and also older) dragonfly records from Austria (by email to: holzinger@oekoteam.at).

First insights and future prospects for the French dragonfly monitoring scheme

Martin JEANMOUGIN[1], Mathilde VIMONT[2], Amélie RUSU-STIÉVENARD[3], Mathieu DE FLORES[4] & Cédric VANAPPELGHEM[5]

[1] Vigie-Nature, Center of Ecology and Conservation Sciences (UMR 7204) - MNHN-CNRS-SU, Muséum national d'Histoire naturelle, 43 rue Cuvier 75005 Paris, FRANCE. Email: martin.jeanmougin@mnhn.fr; [2] Vigie-Nature, Center of Ecology and Conservation Sciences (UMR 7204) - MNHN-CNRS-SU, Muséum national d'Histoire naturelle, 43 rue Cuvier 75005 Paris, FRANCE. Email: mathilde.vimont@mnhn.fr; [3] Office pour les insectes et leur environnement (Opie) – Chemin rural numéro 7 de la Minière, 78280 Guyancourt, FRANCE. Email: amelie.rusu-stievenard@insectes.org; [4] Office pour les insectes et leur environnement (Opie) – Chemin rural numéro 7 de la Minière, 78280 Guyancourt, FRANCE. Email: mathieu.deflores@insectes.org; [5] Conservatoire d'Espaces naturels des Hauts-de-France, 160 rue Achille Fanien, ZA de la Haye, 62190 Lillers, FRANCE. Email: c.vanappelghem@cen-hautsdefrance.org;

KEYWORDS: Odonata, population trends, temporal monitoring, occupancy modelling, opportunistic data, indicator

Temporal biodiversity monitoring scheme is currently one of the main tools to alert on the current decline of biodiversity. Historically focused on birds, there are more and more available long-term initiatives on insects, especially butterflies but also on dragonflies that inform us of population trends on this usually under-studied taxonomic group. In this context, a project for a French dragonfly temporal monitoring scheme (called STELI) was launched in 2011 involving the national citizen sciences program "Vigie-Nature" from the Museum of Natural History of Paris and the former national NGO "Société française d'Odonatologie" (SfO, nowadays Opie-odonates). From previous discussions with European partners, the monitoring protocol retained was based on an occupancy modelling approach. This methodology implies mandatory repeated observation sessions that allow estimating the species detectability and site occupancy on which trends could be ultimately derived. In comparison, more classical modelling approaches use standardized abundance monitoring to estimate population trends or opportunistic data to infer species trends at large spatial scale.

In this study, we analyzed the evolution of the STELI program and its potential in providing relevant temporal trends of dragonflies' populations in France. We envision comparing the STELI modelling approach to more classical ones using in particular standardized abundance data derived from the program itself using recent analyses tools developed in our team.

Results showed that the STELI suffered from a lack of animation and coordination few years after it was launched. It implied an important decrease in volunteer participation that was also induced by the complexity in applying the protocol due to the mandatory repeated sessions. However, as most of the volunteer are professional odonatologists and apart from this difficulty in applying the repeated sessions, there was a strong commitment in following the protocol, e.g. by reporting standardized abundance data. Seizing this opportunity and applying the classical modelling approach on these abundance data, preliminary results showed that we were able to obtain population trends for some common species across France. We wish to consolidate these results in comparison with some selected regions where the occupancy modelling approach could be applied on the current dataset. Ultimately, these results should help initiate thoughts on the future of the program and foster its dynamic through new facilitation and coordination.

Dragonflies of Belarus: the comparison between actual data and generalizing aggregators

Denis KITEL

Neseniuka str., 1-12, Malaryta, 225903, BELARUS. Email: kitelden@gmail.com;

KEYWORDS: Odonata, Belarus, distribution, species ranges

The odonates are poorly studied in Belarus. Not a single publication was issued in the 21st century that would cover the species distribution in the whole country. We should admit that all surrounded countries have at least one such generalized data source, paper or virtual version on the Internet. The data from Belarus is fragmental, concentrated usually in internal resources of local scientific magazines or conference papers in Russian language, which makes it nearly impossible to cope with.

A crucial contribution in investigation of the Odonata fauna of Belarus was made mainly by Polish and Dutch researchers. Since the interest for dragonflies has risen among local naturalists in Belarus in 2014 three new species were officially added to the national list. *Crocothemis erythraea* and *Sympetrum fonscolombii* were discovered in 2015, and *Orthetrum coerulescens* in 2021. By the beginning of 2022 the official number of dragonfly species recorded in Belarus reached 68. The status of *Sympetrum striolatum* is still not clear even though there are two publications where the species is mentioned although with no clear evidence. In the 2014–2021 period we collected data on the presence of 66 species of dragonflies confirming the records with high resolution photos of imagoes or exuviae; only *Aeshna caerulea* and *Coenagrion ornatum* were not found.

Eight species of dragonflies are included in the national Red Data Book from 2006. It may seem that the protected species have been studied better recently but in fact it is not occurring. The status, categories and distribution did not undergo major changes in the next edition from 2015. It should be also noted that it is difficult to explain why these 8 species were chosen. For example, *Anax imperator* and *Brachytron pratense* are widespread species confined to eutrophic lakes with rich vegetation but are on the list, while *Leucorrhinia caudalis*, a local species, found only at some specific sites, is not included.

After the 2nd edition of the "Field guide to the dragonflies of Britain and Europe" by K.-D. B. Dijkstra, A. Schroter and R. Lewington was published we analyzed the maps given in the book and concluded that the authors did not use all available data concerning Belarus. In particular, the ranges were usually extrapolated on the base of the data from neighbouring countries.

Summing up the written above we see the existence of a gap between enthusiastic researchers and institutions that take responsibility to generalize the knowledge and transmit it to the public.

Wings in stone: on Slovenian first and only fossil dragonfly

Matija KRIŽNAR

Slovenian Museum of Natural History – Prirodoslovni muzej Slovenije, Prešernova 20, 1000 Ljubljana, SLOVENIA. Email: mkriznar@pms-lj.si;

KEYWORDS: fossil Odonata, *Sloveniatrum robici*, Simon Robič, Slovenia

Dragonflies are one of the oldest groups of insects in the geological history. First stem group representatives of dragonflies and damselflies (Protodonata) arose more that 320 million years ago (Upper Carboniferous). At this time, the well-known group comprised giant protodonates of the order Meganisoptera, characterized by large wingspans and dense wing venation. First ancestors of modern Odonata appeared in the Triassic, with Anisoptera having originated at least in the Jurassic (Middle Jurassic) and diversified in the Cretaceous.

Fossil dragonflies and damselflies are known from some classical (Konservat-Lagerstätten) paleontological sites like: around Solnhofen and Eichstätt in Germany from the Upper Jurassic age sites, from the Early Cretaceous beds in Brazil (Crato Formation) and from the Cretaceous Burmese amber. Tertiary odonata are well documented, but fossil remains are more scattered and rare, although present at some classical fossil sites, e.g. in the Eocene beds of Bolca (Italy), Green River Formation beds (USA) and the Eocene age Baltic amber. The Miocene beds from Radoboj (Croatia) are one of the nearest insects-fossil sites. From Radoboj some dragonflies remains were described, among them *Croatocordulia platyptera*, a new genus defined by late Slovene odontologist Boštjan Kiauta (1937–2022).

In Slovenia, there are few paleontological localities with fossil insects. The oldest insect remains are scarcely present in the Eocene (Socka) and the Oligocene (Trbovlje Formation) beds from Zasavje (Trbovlje) and Gorenjska (Plaznica Creek) area (Gornji Grad Formation). One of the richest fossil sites is located near Kamnik in Tunjice Hills. Diverse groups of the Middle Miocene - Sarmatian insects (Diptera, Coleoptera and others), molluscs, plant and vertebrate remains (mostly fishes) were discovered here. Most famous are remains of the oldest fossil seahorses in the world, with two species *Hippocampus sarmaticus* and *Hippocampus slovenicus*. In the fossil collection from Tunjice Hills only one dragonfly fossil exists, parts of fore and hindwing, which was described by W. Zessin, J. Žalohar and T. Hitij in 2008 as a new genus and species *Sloveniatrum robici*. It is representative of the family Libellulidae and its age was estimated at around 11.6 and 12.7 Myr before present. Species name is dedicated to Simon Robič (1824–1897), Slovenian amateur naturalist and local fossil collector. Robič was one of the most active collectors in the second part of the 19th century. *Sloveniatrum robici* is still the only fossil representative of Slovenian Odonata.

A functional trait space of European Odonata

Xavier MAYNOU[1], Cinta GOLORONS[2], Ricard MARTÍN[1] & Cesc MÚRRIA[2,3]

[1] Institució Catalana d'Història Natural, SPAIN. Email: xavier.maynou@gmail.com; [2] Departament de Biologia Evolutiva, Ecologia i Ciències Ambientals, Facultat de Biologia, Universitat de Barcelona, SPAIN. [3] Institut de Recerca de la Biodiversitat (IRBio), Facultat de Biologia, Universitat de Barcelona, SPAIN.

KEYWORDS: functional traits, overarching functional space, phylogenetic trait conservatism, functional diversity

Understanding the biogeography and geographical distributions of functional traits and species and their contribution to global patterns of biodiversity is still challenging ecology and evolutionary biology. The responses of species to environmental conditions and biotic interactions are determined by their functional traits, which are defined as those that affect the individual's fitness and performance and its contribution to ecosystem properties. To capture intra and interspecific trait variation, the functional trait space (FS) concept was introduced as an n-dimensional hypervolume in which each point represents the combination of trait values for each species. Analysis of species positions within the FS is essential to understand the species ecological requirements and constraints (i.e., functional niche) and to predict species responses to environmental change.

We built a functional trait space for the odonates inhabiting the 25 Pan-European ecoregions as defined in the Water Framework Directive. As raw data for the construction of the FS we used information for 15 traits including biology, morphology, behaviour and ecology, captured in 51 categories that included intraspecific trait variability, the values for which were obtained from bibliographic sources. To determine phylogenetic trait conservatism, i.e., to what extent species traits and the FS are shaped or constrained by phylogenetic relatedness, we built a well-supported phylogenetic tree based on publicly available molecular data for 11 genetic markers and tested separately the correlations between (1) species positions in the FS and (2) individual trait values on the tree topology.

The traits that best explained the functional differences among species were body size, flight behaviour (flyer/percher), dispersal behaviour, voltinism, adaptation to artificial biotopes, and oviposition type. In general, species within a family were located in close proximity in the FS, which indicates similar functionality, and segregated from other families. An exception were Aeshnidae and Libellulidae, which revealed high variability in trait values and, consequently, filled a large space in the FS that partially overlapped with those of Calopterygidae, Lestidae, and Gomphidae. The functional space of Platycnemididae fully overlapped with that of Coenagrionidae. Phylogenetic trait conservatism was found for body size, short-range dispersive behaviour, oviposition over water and for the species positions in the FS. Overall, our results indicate that current functional niches have been shaped by the interactions of multiple traits related to morphology, life history, behaviour and ecology, and their combination is conserved throughout the phylogeny. This overarching FS, including a comprehensive range of trait values and species, provides a suitable framework to address fundamental research questions in community ecology, macroecology and evolutionary ecology that can be used in estimations of functional diversity of Odonata communities and predictions of species responses to climate change.

Macroecological patterns of taxonomic, functional and phylogenetic diversity of odonates across Europe

Cesc MÚRRIA[1,2], Cinta GOLORONS[1], Ricard MARTÍN[3] & Xavier MAYNOU[3]

[1] Departament de Biologia Evolutiva, Ecologia i Ciències Ambientals, Facultat de Biologia, Universitat de Barcelona, SPAIN. Email: cmurria@ub.edu; [2] Institut de Recerca de la Biodiversitat (IRBio), Facultat de Biologia, Universitat de Barcelona, SPAIN. [3] Institució Catalana d'Història Natural, SPAIN.

KEYWORDS: latitudinal gradient, phylogenetic community structure, community ecology, biogeography

Biodiversity is not evenly distributed on Earth, some regions or taxonomic groups are more diverse than others. Understanding patterns of diversity, the evolutionary processes that drive these patterns and how communities are assembled is critical, for instance, to predict the impact of global change on species distribution and community composition. Traditionally, community ecologists have focused on taxonomic patterns ignoring that species are functionally different or have evolved in distant lineages. The environmental filtering across gradients has favoured certain functional strategies over others, which results in differences in traits composition across communities. If factors associated to functional divergence act over long timescales, this can progressively lead to species proliferation and evolutionary differentiation at all taxonomic levels. Here, we assessed alpha- (local), beta- (similarity among communities) and gamma- (regional) diversities of the taxonomic, functional and phylogenetic composition of odonate communities across Europe to determine the role of ecological and evolutionary processes in generating macroecological patterns. From GBIF we compiled the taxonomic composition of 741 communities across 15 ecoregions defined by aquatic mass typology and biogeography. Functional space was defined using 15 traits including biology, morphology, behaviour and ecology, captured in 51 categories generated from bibliography. We built a phylogenetic tree using 11 genes downloaded from GenBank. All diversity metrics were assessed within (local-scale) and among (regional-scale) ecoregions. We expected a decrease of all diversity metrics from Mediterranean regions to poles. At local scale, the communities analyzed were characterized by high specialization in habitat preference (e.g., rivers, wetlands, temporary ponds), which together with the high environmental heterogeneity captured within each region, resulted in constant values of diversities regardless of latitude. Within each ecoregion, the turnover component of taxonomic beta-diversity was higher than that of functional and phylogenetic beta-diversities. Among regions, the latitudinal decrease in taxonomic richness was not significant despite the fact that values in Central Europe and the Iberian Peninsula were higher than in northern latitudes. In contrast, functional and phylogenetic gamma-diversities decreased significantly in latitude with a higher contribution of the turnover than the nestedness component on beta-diversity. Moreover, northern regions were characterized by phylogenetic clustering (i.e., species were more related than expected by chance), which suggest lineage-specific adaptation to cold conditions. Overall, large-scale environmental filtering rather than local ecological conditions constraints species distribution and shapes the regional species pools, which results in a latitudinal decrease of both the functional space covered and the phylogenetic diversity accumulated in each region.

The Aegean corridor for (Afro)tropical Odonata species in Europe *

Andreas MARTENS

Institute of Biology, University of Education Karlsruhe, Bismarckstraße 10, 76133 Karlsruhe, GERMANY. Email: martens@ph-karlsruhe.de;

KEYWORDS: climate change, range expansion, Crete, Karpathos, Rhodes

There are three main routes/pathways for Afrotropical Odonates to expand their range northwards and to establish themselves in Europe. Very relevant is the Street of Gibraltar as the western corridor. The central corridor includes stepstones as Panteleria, the Pelagie Islands, the Maltese Islands and Sicily (and Sardinia). An eastern corridor for Afrotropical and other tropical Odonata form the islands of the Aegean.

During our stays in eastern Crete (2016, 2017, 2019), Karpathos (2017, 2018), Cyprus (2019) and Rhodes (2021), special attention was drawn on the presence of tropical species. The field data on odonates as well as on the situation of freshwater habitats offered the opportunity for this review.

The eastern part of Crete is marked by a hot and dry climate. However, the only tropical species were *Trithemis annulata* and *Anax ephippiger*. In Crete, there is an overuse of freshwater especially for agriculture (mainly olives) and tourism; therefore, surface waters are becoming very rare. Karpathos is karstic and therefore very poor in permanent surface waters naturally. The only tropical species were *T. annulata*, *A. ephippiger* and *A. immaculifrons*. So far, Rhodes holds the highest number of tropical species: *A. ephippiger*, *A. immaculifrons*, *Diplacodes levebvrii*, *Orthetrum chrysostigma*, *O. sabina*, *Pantala flavescens*, *T. annulata*, *T. arteriosa* and *T. festiva*. So far, candidates as *Ischnura senegalensis*, *Brachythemis impartita*, *O. trinacria*, *T. kirbyi* and *Zygonyx torridus* have not reached the Aegean Islands.

In total, the number of tropical Odonata species in the Aegean is small. It is suggested that the main reason for that is the natural and mainly man-made deficit in inland waters on the islands of Crete and Karpathos.

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Gynandromorphism and intersexuality in Odonata: a review

Andreas MARTENS[1] & Hansruedi WILDERMUTH[2]

[1] Institute of Biology, University of Education Karlsruhe, Bismarckstraße 10, 76133 Karlsruhe, GERMANY. Email: martens@ph-karlsruhe.de; [2] Haltbergstrasse 43, CH-8630 Rüti, SWITZERLAND. Email: hansruedi@wildermuth.ch;

KEYWORDS: phenotypic mosaics, andromorphic females, gynomorphic males, intersex, hermaphroditism

Gynandromorphism is a rare phenomenon among insects, and as measured by the number of publications, particularly so in Odonata. The first case of gynandromorphism in the order was reported in 1866, the second in 1917. To date, 56 chimeric individuals have been described in 45 papers. Bilateral gynandromorphs account for about a third of all cases, the remainder consisting of phenotypical mosaics of male and female characters exhibited in wing patterns, genitalia, or other body parts. There are no patterns of gynandromorphism exclusive to Odonata. Here, as a basis for future work, we provide an overview as complete as possible of the known cases in the order of gynandromorphism in a broad sense, including intersexuality. This is the third review on this topic: the first dates from 1929 and the second from 1971, supplemented in 1975. In the last ten years, all new records have been based on photographic evidence rather than collected specimens, a practice which has its limitations and may skew the data by recording only the most obvious cases. For future research it is recommended that specimens should not only be photographed in the field but also collected and preserved for detailed description and analysis in the laboratory. In addition, researchers should be aware of the possibility of finding gynandromorphs in final instar larvae and exuviae.

Dragonfly Ireland 2019–2024

Damian MCFERRAN

Centre for Environmental Data and Recording (CEDaR), National Museums NI (NMNI), NORTHERN IRELAND. Email: damian.mcferran@nmni.com;

KEYWORDS: Odonata, atlas, citizen science, conservation, research

Dragonfly Ireland 2019–2024 is a partnership project between Ireland's two biological data Centres, CEDaR and National Biodiversity Data Centre (NBDC). Resources made available by Northern Ireland Environment Agency and the Environmental Protection Agency have permitted a comprehensive study of Irish Odonata. This study builds upon previous all-Ireland Dragonfly studies.

In Ireland, the study of Dragonflies has migrated from square-bashing, through the investigation of previously known sites, towards a comprehensive understanding of species assemblages from various habitats. Funding has also permitted investigation of the two Northern Ireland Priority Species (NIPS), the Scarce blue-tailed Damselfly *Ischnura pumilio* and the Irish Damselfly *Coenagrion lunulatum*. Our knowledge of their status and distribution has been greatly enhanced. Wider fieldwork has been carried out to investigate the spread of migrant species, and several training courses have facilitated an increase in records submitted by Citizen Scientists.

In addition, a NERC-Funded CASE PhD (in partnership with Queens University, Belfast) to determine the population genetics of the Irish Damselfly has been secured. This research involves the collection of material across Ireland and Continental Europe. The study will also develop processes to determine species presence via eDNA sampling.

To summarise, funding has increased knowledge transfer and the capacity of Citizen Scientist to assist. Efforts are being made to establish monitoring and surveillance strategies to determine change in species and their presence/absence within key habitats. Ultimately, the outputs from the project will, for example, include an updated Atlas and Red List and numerous research papers. In the interim, records are received from a greater base of recorders and the data set is widely available for policy- and decision-makers.

How to improve the accuracy of automatic identification of dragonflies and damselflies?

Stanislav OŽANA[1,3], Petr DVOŘÁČEK[2], Michal BURDA[3], Marek MALINA[2,3], Veronika KORNOVÁ[1], Eva BÍLKOVÁ[1]

[1] Department of Biology and Ecology, Faculty of Science, University of Ostrava, CZECH REPUBLIC. Email: ozanastanislav@gmail.com; [2] Department of Informatics and Computers, Faculty of Science, University of Ostrava, CZECH REPUBLIC. [3] Centre of Excellence IT4Innovations, division of University of Ostrava, Institute for Research and Applications of Fuzzy Modelling, University of Ostrava, CZECH REPUBLIC.

KEYWORDS: species identification, neural network, citizen science, Odonata

Dragonflies and damselflies are suitable animals for bioindication, also aided by their easy recognition based on a detailed description or photograph. Thus, it is beneficial to involve the public through citizen science to obtain data on their occurrence. However, to identify the species or even the sex of individuals correctly, amateurs need help and automatic identification proves to be a promising mechanism.

The Dragonfly Hunter CZ application helps with species identification using an algorithm based on environmental and expert data. However, this algorithm needs to be improved with additional knowledge of specialist odonatologists. Therefore, we attempted to enhance the algorithm with typical characteristics of individual species or groups of species that would improve the identification of the species and their sex.

Using a testing dataset containing 50,000+ records, subjects were classified into 148 classes (74 Odonata species in Czechia), based on features such as colour etc. The basic model orders all classes for each subject by relevance, with the correct class being on average at 12.27th place. To further improve the accuracy, a model for dynamic questions was developed that selects 5 additional questions (from 17 available) by their influence on results after a basic classification is made, which yields an average correct class place to be 7.62.

Even more promising improvement in the identification can be achieved by image recognition. Based on 22,000+ photographs of individual Czech species, we were able to increase the accuracy of species recognition to the sex level substantially, using a neural network with the SEResnet-50 architecture. The probability of correct identification in the first position of the resulting "species identification list" was 84%, within the first three positions we reached 95% and within the first five positions we even reached an accuracy of 99.89%.

However, despite these very promising results, many challenges still remain, especially related to the use of these results in practice. Moreover, when considering how these results individually contribute to the refinement of the application, their combination seems to be an ideal option for a reliable, automatic identification of odonates in the future.

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Odonata fauna across European ponds – a case study from the EUROPONDS project

Biljana RIMCHESKA[1], Lena FEHLINGER[2,3], Benjamin MISTELI[4], Ana BALIBREA[5], Vojtěch KOLÁŘ[6,7], Martin SOUTO[5], Veronica NAVA[8], Liam NASH[9], Pietro TIROZZI[8], Dariusz HALABOWSKI[10,11], Luca BONACINA[12], Alberto SCOTTI[13], Ellinor JAKOBSSON[14], Fernando CHAGUACEDA[14], Daniel MORANT[15], Julie C. FAHY[16], David CUNILLERA-MONTCUSI[17], Jose Manuel ZAMORA MARÍN[18], Marina TOMÁS MARTÍN[19], Juan RUBIO-RÍOS[20,21], Katarzyna KUCZYŃSKA[22], Pablo SOTO GARCÍA[19], Aleksandra HABA[22], Francesca VALLEFUOCO[23,24], Olivera STAMENKOVIĆ[25], Judit FEKETE[26], Ena L. SUAREZ[27], Magdalena VANEK[28], Teofana CHONOVA[29], Noel JUVIGNY-KHENAFOU[30], Pablo TIMONER[27], Rhiannon MONDAV[14], Emma DROHAN[31], Lucie VEBROVÁ[6], Tamás BOZÓKI[32], Dawid DĄBROWSKI[33], Alba CAMACHO SANTAMANS[15], Encarnación FENOY[20,21,34], Marta ZAWADZKA[33], Jorge GARCÍA-GIRÓN[35], Mercedes Guerrero BROTONS[36], Joana MARTELO[37,38], Alfredo LLORENTE[39,40], Margaux MATHIEU-RESUGE[2,41], Pierre MARLE[27], Simone MORAS[14], Karla MÜNZNER[14], Jorge HENRIQUES[42], Martin SARKEZI[43], Agnieszka SOWA[44], Maria CALDERÓ PASCUAL[31], Anna CAMACHO-SANTAMANS[15], Zeus FREIXINOS CAMPILLO[36], Remi GERBER[4], Maria Iasmina MOZA[45], Constanze ENGLISCH[43], Stephen ESOSA OSAKPOLOR[30], Darmina NITA[45], Valentin DINU[46], Adriana OLENICI[46] & Frederic LABAT[4]

[1] Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel Blvd., 1000 Sofia, BULGARIA. Email: rimceska@gmail.com; [2] WasserCluster Lunz - Biologische Station GmbH; Dr Carl Kupelwieser Promenade 5, A-3293 Lunz am See, AUSTRIA. Email: lena.fehlinger@gmail.com; [3] Danube University Krems; Dr.-Karl-Dorrek-Straße 30, 3500 Krems an der Donau, AUSTRIA. [4] Université Rennes 1 - UMR 6553 CNRS ECOBIO; Campus de Beaulieu, 263 avenue du Général Leclerc, 35042 Rennes Cedex, FRANCE. Emails: benjamin.misteli@univ-rennes1.fr; remi.gerber@univ-rennes1.fr; frederic.labat@aquabio-conseil.com; [5] CIBIO, Research Center in Biodiversity and Genetic Resources, InBIO Associate Laboratory, Faculty of Sciences and Technology, University of the Azores; Rua da Mãe de Deus, 9500-321 Ponta Delgada, Açores, PORTUGAL. Emails: abalibreaescobar@gmail.com; martin.s.souto@uac.pt; [6] Faculty of Science, University of South Bohemia; Branisovska 1760, Ceske Budejovice, CZ-37005, CZECH REPUBLIC. Emails: kolarvojta@seznam.cz; lucka.veb@seznam.cz; [7] Institute of Entomology, Biology Centre, Czech Academy of Sciences; Branisovska 31/1160, Ceske Budejovice, CZ-370052, CZECH REPUBLIC; [8] Department of Earth and Environmental Sciences, University of Milano-Bicocca; Piazza della Scienza 1, 20126, Milano, ITALY. Emails: v.nava15@campus.unimib.it; p.tirozzi@campus.unimib.it; [9] School of Biological and Chemical Sciences, Queen Mary University of London; Mile End Rd, Bethnal Green, London E1 4NS, UNITED KINGDOM. Email: l.n.nash@qmul.ac.uk; [10] University of Lodz, Faculty of Biology and Environmental Protection, Department of Ecology and Vertebrate Zoology; Banacha 12/16, 90-237 Lodz, POLAND. Email: dariusz.halabowski@gmail.com; [11] University of Silesia in Katowice, Faculty of Natural Sciences, Institute of Biology, Biotechnology and Environmental Protection; Bankowa 9, 40-007 Katowice, POLAND. [12] Department of Earth and Environmental Sciences, University of Milano-Bicocca; Piazza della Scienza 1, 20126, Milano, ITALY. Email: l.bonacina9@campus.unimib.it; [13] Institute for Alpine Environment, EURAC Research; Viale Druso 1, 391000 Bolzano, ITALY. Email: Alberto.Scotti@eurac.edu; [14] Department of Ecology and Genetics, Uppsala University; Norbyvägen 18 D, 752 36, Uppsala, SWEDEN. Emails: ellinor.jakobsson@ebc.uu.se; chagua1932@gmail.com; rhiannon.mondav@gmail.com; simone.moras@ebc.uu.se; karla.munzner@ebc.uu.se; [15] Cavanilles Institute for Biodiversity and Evolutionary Biology; Parque científico- Entrada lateral Calle del Catedrático José Beltrán Martínez, 2, 46980, Paterna, Valencia, SPAIN. Email: daniel.morant@uv.es; albacamachosantamans@gmail.com; annasantamans@gmail.com; [16] EISA, University of Applied Sciences and Arts Western Switzerland; HEPIA, Route de Presinge 150, CH-1254 Jussy, SWITZERLAND. Email: Julie.Fahy@hesge.ch; [17] FEHM-Lab. Section of Ecology, Department of Evolutionary Biology, Ecology and Environmental Sciences. University of Barcelona, Diagonal, 643 (08028) Barcelona, Catalonia, SPAIN. Email: david.cunillera@dcm.cat; [18] Department of Zoology and Physical Anthropology, Faculty of Biology, Campus de Espinardo, University of Murcia, SPAIN. Email: josemanuel.zamora@um.es; [19] Department of Ecology, Universidad Autonoma de Madrid; Calle Darwin, 2, 28049

Madrid, SPAIN. Emails: marina.tomas@estudiante.uam.es; pablo.soto@uam.es; [20] Department of Biology and Geology, University of Almeria; Ctra. Sacramento s/n. La Cañada de San Urbano, 04120 Almería, SPAIN. Email: jrr812@ual.es; encarnafenoy@ual.es; [21] Andalusian Centre for the Evaluation and Monitoring of Global Change (CAESCG), SPAIN; [22] Institute of Biology, Department of Hydrobiology, University of Szczecin; Wąska 13, 71-415 Szczecin, POLAND. Emails: katkucz-07@o2.pl; olahaba1@onet.pl; [23] Research and Innovation Centre, Fondazione Edmund Mach, Via E. Mach 1, I-38098 San Michele all'Adige, ITALY. Email: francesca.vallefuoco@unitn.it; [24] Department of Civil, Environmental and Mechanical Engineering, University of Trento, I-38123 Trento, ITALY; [25] Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš; Višegradska 33, 18000 Niš, SERBIA. Email: olivera.stamenkovic89@gmail.com; [26] University of Pannonia, Centre of Natural Science, Research Group of Limnology and Centre for Ecological Research, Institute of Aquatic Ecology, Department of Tisza Research, Egyetem u. 10, 8200 Veszprém, HUNGARY . Email: juditfekete0307@gmail.com; [27] Department F.-A. Forel for environmental and aquatic sciences, University of Geneva; Uni Carl Vogt - 66, Boulevard Carl-Vogt, CH-1211 Genève 4, SWITZERLAND. Email: ena.suarez@unige.ch; pablo.timoner@unige.ch; pierre.marle@unige.ch; [28] Institute for Alpine Environment, EURAC Research; Viale Druso 1, 391000 Bolzano, ITALY. Email: magdalena.vanek@eurac.edu; [29] Department Environmental Chemistry, Eawag: Swiss Federal Institute of Aquatic Science and Technology, Überlandstr. 133, CH-8600 Dübendorf, SWITZERLAND. Email: teofana.chonova@gmail.com; [30] iES - Institute for Environmental Sciences, University Koblenz-Landau, Fortstraße 7, 76829 Landau i. d. Pfalz, GERMANY. Emails: noel.khenafou@gmail.com; osakpolor@uni-landau.de; [31] Dundalk Institute of Technology, Centre for Freshwater and Environmental Studies, Marshes Upper, Dundalk, Co. Louth, A91 K584, IRELAND. Emails: emma.drohan@dkit.ie; maria.calderopascual@dkit.ie; [32] Institute of Biology, University of Pécs; H-7624 Pécs, Ifjúság útja 6, HUNGARY. Email: bozokitamas18@gmail.com; [33] University of Warmia and Mazury in Olsztyn; Michała Oczapowskiego 2 10-719 Olsztyn, POLAND. Emails: dawid.dabrowski@uwm.edu.pl; marta.zawadzka@uwm.edu.pl; [34] Department of Functional and Evolutionary Ecology, Experimental Station of Arid Zones (EEZA-CSIC), Ctra. Sacramento s/n. La Cañada de San Urbano, 04120 Almería, SPAIN. [35] Finnish Environment Institute, Freshwater Centre, P.O. Box 413, FI-90014 Oulu, FINLAND. Email: jogarg@unileon.es; [36] Department of Ecology and Hydrology, Faculty of Biology, Campus de Espinardo, University of Murcia, SPAIN. Email: mariamercedes.guerrero@um.es; zfreixinos@gmail.com; [37] Marine and Environmental Sciences Centre, Faculty of Sciences, University of Lisbon, 1749-016 Lisbon, PORTUGAL. Email: joanamartelo@gmail.com; [38] Centre for Ecology, Evolution and Environmental Changes, Faculty of Sciences, University of Lisbon; Bloco C2, Campo Grande, 1749-016 Lisbon, PORTUGAL. [39] Anbiotek s.l., Ribera de Axpe, 11 B-201, 48950 Erandio, Bizkaia, SPAIN. Email: alfredo@anbiotek.com; [40] Department of Plant Biology and Ecology, University of Basque Country, SPAIN. [41] Univ Brest, CNRS, IRD, Ifremer, LEMAR, F-29280, Plouzane, FRANCE. Email: m.mathieuresuge@gmail.com; [42] Departamento de Biologia & CESAM, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, PORTUGAL. Email: henriquesjfp@gmail.com; [43] Functional and Evolutionary Ecology, Faculty of Life Sciences, University of Vienna, 1090 Vienna, AUSTRIA. Emails: a01447909@unet.univie.ac.at; constanze.englisch@gmx.at; [44] University of Lodz, Faculty of Biology and Environmental Protection, Department of Invertebrate Zoology and Hydrobiology; Banacha 12/16, 90-237 Lodz, POLAND. Email: agnieszka.sowa@biol.uni.lodz.pl; [45] Research Center for Ecological Services, University of Bucharest, Splaiul Independentei 91-95, 050089, Bucharest, ROMANIA. Email: iasmina_moza@yahoo.com; [46] Research Center in Systems Ecology and Sustainability, University of Bucharest, Independentei 91-95, 050095, Bucharest, ROMANIA. Emails: valentindinu23@yahoo.com; darminanita@yahoo.com; adriana.olenici@gmail.com;

KEYWORDS: permanent ponds, dragonfly and damselfly biodiversity, endemic species

Permanent ponds represent important habitats for aquatic biodiversity and provide vital ecosystem services as key elements for blue landscape connectivity. Although mostly neglected in management programmes, protection schemes and biodiversity studies in general, ponds constitute habitats with high α- and spatial β-diversity, providing unique habitat conditions for many rare and endemic species. The main focus of our contribution is to describe Odonata (including both dragonflies and damselflies) diversity patterns from 46 ponds distributed across Europe. Our data set summarises all Odonate occurrences (i.e., Odonata captured in emerging traps, adults recorded in the surrounding environment and

larvae from benthic samples) from the EUROPONDS project - an Early Career Researchers (ECR) project focusing on emerging insects from ponds. Field sampling was conducted during a whole year sampling campaign throughout 2020/21 in 18 European countries. Our preliminary results suggest a clear latitudinal gradient in Odonata diversity across Europe, i.e., the highest α- and β-diversity levels were found in southernmost ponds (Spain) and the lowest diversity in northernmost ponds (Ireland). Odonata that belonged to the four families of Aeshnidae, Libellulidae, Coenagrionidae and Platycnemididae were captured in the emergence traps in only nine out of the total 46 sampled ponds. The most diverse family was Coenagrionidae, which also represented the most abundant odonate family in benthic samples, especially noted in Polish ponds. Among the observed adult specimens of Odonata (42 different taxa), the commonest species across Europe were *Sympetrum striolatum*, *Aeshna cyanea*, *Anax imperator*, *Libellula quadrimaculata*, *Crocothemis erythraea* and *Enallagma cyathigerum*. Additionally, the endemic species *Ischnura graellsii* and the newly immigrant *Trithemis kirbyi* were reported from Spanish ponds. These locations constitute their northernmost distributional ranges in Europe. Overall, our findings should contribute to the knowledge on spatial distributions of odonates across European ponds.

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Sex wars: a female sexual weapon forces male damselflies to shorten copulation duration

Anais RIVAS-TORRES, Viviana DI PIETRO & Adolfo CORDERO-RIVERA

Universidade de Vigo, ECOEVO Lab, E.E. Forestal, Campus Universitario A Xunqueira, 36005 Pontevedra, SPAIN. Email: adolfo.cordero@uvigo.gal;

KEYWORDS: sexual conflict, copulatory wounding, damselfly, vulvar spine, Coenagrionidae

In some species, males make use of weapons to harm females, increasing their short-term fitness. For the first time, we provide evidence of females using mating weapons against males, a phenomenon never observed so far. Females of the damselfly *Enallagma cyathigerum* have a conspicuous vulvar spine on the 8th abdominal segment. We tested three hypotheses for the function of this structure: (i) it inflicts damage to the male during copulation; (ii) it facilitates endophytic oviposition; and (iii) it stimulates males during copulation to increase their investment. We found that males mated on average for 54 min with control females (i.e. those with the spine intact), but increased copulation to 99 min with females deprived of the spine. The male's ventral tegument of the seminal vesicle shows 8–18 fold-shaped structures, where the spine contacts during copulation, but its number was similar in unmated males and males mated to control and spineless females. Females with and without spine laid eggs at the same rate and showed similar fecundity and fertility. Longevity was also similar in males mated to control and spineless females. We conclude that the spine acts as a sexual weapon, evolved due to a sexual conflict over copulation duration, and hypothesize that the folds in the male's seminal vesicle may have evolved as a counter-adaptation to the copulatory wounding infringed by females.

Conservation of threatened dragonflies, continuation of the French National Action Plan

Amélie RUSU-STIEVENARD[1], Bastien LOUBOUTIN[2], Samuel JOLIVET[3] & Xavier HOUARD[4]

[1,2,3,4] Office pour les insectes et leur environnement (Opie), BP 30, F-78041 Guyancourt Cedex, FRANCE. [1] Email: amelie.rusu-stievenard@insectes.org; [2] Email: bastien.louboutin@insectes.org; [3] Email: samuel.jolivet@insectes.org; [4] Email: xavier.houard@insectes.org;

KEYWORDS: Odonata, monitoring, restoration, knowledge, network

To contribute to the European conservation network for threatened Odonata, the first National Action Plan (NAP) for Odonata was deployed in France from 2011 to 2015. This program aimed to improve consideration on Odonata in government policies, and to increase knowledge on species distribution and conservation status. Taking advantage of the momentum from the first NAP, which structured a network of French odonatologists, a second Plan was launched in 2021.

The IUCN National Red List, published in 2016, shows that 30% of Odonata species are near threatened, threatened or already extinct in France. Accordingly, new species were added to the second NAP, which now targets 33 species, compared to 18 in the previous plan.

Thanks to the increase of knowledge, the second NAP for Odonata can be oriented towards operationality. Its aim is to promote favourable management actions to the conservation of Odonata and their habitats, but also to study the effects of these actions, and to enhance them. To achieve these actions, the second NAP will be deployed for 10 years. It will involve a large panel of actors working in coherence: naturalists, conservation managers, researchers, but also farmers or forestry agents.

As during the first NAP, the major axes defined at the national level will be adapted in each of the 13 French administrative regions, to consider local issues related to different habitats, urbanizations, climates, human resources, etc. Thus, regions can add the species threatened in their territory to the national priority species targeted by the actions of the NAP. The Occitania region, south of France, is located at the heart of the European Odonata biodiversity and is an endemism hot spot. It is the only French region to overlap the four major bioclimatic zones: Atlantic, Mediterranean, Continental, and Alpine. Seventeen of its 78 species were rated as threatened in 2018 by the Regional Red List. However, not all of these were targeted by the NAP, and therefore 5 regionally threatened species were added to the Occitanian declination of the Plan.

To be more consistent with the ecology and distribution of the species, the second NAP supports and promotes interregional projects. SOGAP project is a good example of a program that goes beyond administrative boundaries. It is an extension of a river standardized monitoring protocol which focuses on *Stylurus flavipes* and *Ophiogomphus cecilia*, implemented in the Loire watershed area since 2015. Today this project extends to the whole distribution area of these species in France, and aims to provide indicators for national population trends.

Somatochlora alpestris in the northwestern Black Forest

Franz-Josef SCHIEL

Institut für Naturschutz und Landschaftsanalyse – INULA, GERMANY. Email: franz-josef.schiel@inula.de;

KEYWORDS: distribution, climate change, population trend, Baden-Württemberg

Somatochlora alpestris is a boreoalpine species. In Central Europe, the species occurs exclusively in mountainous areas above 600 m a.s.l. In the German state of Baden-Württemberg, its distribution is restricted to the Black Forest above 880 m a.s.l., where records concentrate in the Middle and Southern Black Forests with a focus in the Feldberg area. In the northern Black Forest, *S. alpestris* has been reported for the raised bogs around Kaltenbronn and for forest bogs in the Calw district. From the central Black Forest and the mentioned localities in the northern Black Forest, the last records date back more than 20 years. However, *S. alpestris* was newly discovered in 2004 in the northwestern part of the Black Forest at elevations from 1,005 m to 1,150 m a.s.l. This area called "Grinden Black Forest" is characterized by nutrition poor sandstone ridges that had been used as pastures since the Middle Ages. Here, *S. alpestris* is currently known from ten sites, where it reproduces in several, very small water bodies.

In 2021, the species was confirmed at eight of nine monitored sites and in a total of 25 water bodies on the basis of 100 exuviae as well as larvae and imagines. The results are shortly discussed regarding the regional climate data in the very dry years 2018–2020.

Suitability of beaver-induced water structures as habitats for the larvae of *Cordulegaster boltonii*

Sara SCHLOEMER[1] & Ulrich MEßLINGER[2]

[1] University Duisburg-Essen, Faculty of Biology, Department of Aquatic Ecology, Universitätsstraße 5, D-45414 Essen, GERMANY. Email: sara.schloemer@uni-due.de; [2] Office for nature conservation planning and ecological studies; Flachslanden, GERMANY. Email: u.messlinger@t-online.de;

KEYWORDS: Odonata, Cordulegastridae, structural diversity, small streams

The recolonization of small streams by beavers (*Castor canadensis*, *C. fiber*) often results in extensive alterations of the influenced stream segments. Numerous studies have shown that beaver activity in streams leads to a significantly increased number of dragonfly and damselfly species. But how do the already established and stenotopic running water species react to these changes? Investigations in the northern Eifel (Germany) revealed an increase in the density of *Cordulegaster boltonii* imagines in water stretches influenced by beavers. In addition to territorial behaviour, oviposition into beaver dams was regularly observed. Exuviae findings suggest that certain structures, such as dams, secondary streams, and fast-flowing areas located directly below dams, are suitable larval habitats for *C. boltonii*. In order to determine the extent to which beaver-induced aquatic structures are colonized by *C. boltonii* larvae and whether they alter larval settlement densities, we carried out a joint project in Bavaria and the northern Eifel (Germany). The survey took place during the summer months, quantifying sediment patches suitable for the development of *C. boltonii* larvae in stream sections with and without beaver activities. These sediment patches were subsequently searched for larvae using a kitchen sieve or kick sampler. In six out of seven investigated streams with *C. boltonii* occurrence, larvae were detected within beaver colonies. In one otherwise structurally impoverished stream, the number of larvae within the beaver colony was even increased by four times. In conclusion, the influence of beaver activities leads to an increase in habitat diversity, especially in small streams, which is beneficial to both stillwater and flowing water Odonata species.

Highlights from ten years of dragonfly monitoring on Cyprus

David J. SPARROW[1], Geert DE KNIJF[2] & Rosalyn L. SPARROW[1]

[1] Cyprus Dragonfly Study Group, PO Box 62624; Paphos, CYPRUS. Email: davidrospfo@hotmail.com; [2] Research Institute for Nature and Forest (INBO); Havenlaan 88 bus 73, 1000 Brussels, BELGIUM. Email: geert.deknijf@inbo.be;

KEYWORDS: flight period, checklist, island, Eastern Mediterranean, citizen science

The Cyprus Dragonfly Study Group (CDSG) started year-round monitoring of the island's odonates to bridge the lack of knowledge of their distribution, abundance and phenology, not only on Cyprus but in the Mediterranean in general. Dragonflies are excellent bio-indicators, not only of their aquatic habitat but also of the surrounding terrestrial habitats, and data on trends are of great importance in establishing much-needed conservation methods, particularly on this water-stressed island. Up to the end of 2019, prior to pandemic-related movement restrictions, 7,877 visits were made by the CDSG to 703 sites island-wide, 136 of which were repeatedly surveyed, resulting in 23,899 records and a count of 342,008 adults. From this, we acquired an excellent knowledge of the diversity, phenology and status of the Odonata of Cyprus.

Prior to the CDSG's work, 36 species of odonates were on Cyprus' checklist. Two species new to the island, *Aeshna isoceles* and surprisingly the rare I*schnura intermedia*, were discovered by the group. One species, *Calopteryx virgo*, for which there is only a single record from 1930, we consider to be a misidentification and have removed it from the list, which now stands at 37 species. Typically of an island fauna, this is a rather impoverished number compared to that of the neighbouring mainland. Furthermore, three species on the checklist were only rarely recorded in the past and are considered to be no longer present. Unusually for a faunal order on Cyprus, not one of the species is considered to be endemic, although the island is home to some range-restricted species, of which Ischnura intermedia is the most important, and several charismatic species such as *Anax immaculifrons*, Europe's largest dragonfly, *Epallage fatime* and *Caliaeschna microstigma*.

Flight seasons determined for the 31 species with sufficient data were generally found to be longer than those reported for other countries in the Eastern Mediterranean. This may be due to intensive year-round monitoring but could also result from Cyprus' warmer climate. Very wide annual variations were found in the abundance of all species, showing an almost immediate response to the wide fluctuations in Cyprus' annual rainfall. Although not as thorough as the CDSG programme, results from the 1994 survey and monitoring in 2003–2004 gave us insights into how the status of species has changed and the impact of climate change over this 26-year timeline.

Constructed wetlands as “species islands” for dragonflies in the agricultural landscape – examples from LIFE-Goodstream

John A. STRAND

Hushållningssällskapet Halland (Rural Economy and Agricultural Society), Lilla Böslid 146, 305 96 Eldsberga, SWEDEN. Email: john.strand@hushallningssallskapet.se;

KEYWORDS: species richness, succession, surveys of adults, wildlife cameras

The project LIFE-Goodstream aims at bringing an agricultural stream in South-West Sweden to Good Ecological Status according to the Water Framework Directive (mainly nutrient reduction to combat eutrophication). The environmental measures implemented include constructed wetlands (CWs), amphibian ponds and new stream beds. As one method to monitor the effects of the measures on biodiversity, we used dragonflies as an organism group indicator. The results have been positive with a large increase in dragonfly species and populations.

Surveys of adult dragonflies in 25 CWs resulted in a total of 35 species. The measures have led to new species discovered in the region (e.g. Yellow-spotted Whiteface *Leucorrhinia pectoralis*) and show that in intensively farmed landscapes, relatively small water bodies are of major importance for biodiversity. The monitoring also shows that species thought to prefer more forested streams, e.g. Common Goldenring *Cordulegaster boltonii*, can be quite common in open, agricultural streams. There was also a clear succession pattern in the CWs where early species (e.g. Broad-bodied Chaser *Libellula depressa* and Black-tailed Skimmer *Orthetrum cancellatum*) were replaced with e.g. Large Redeye *Erythromma najas*. Notable is that the late immigrant Blue Emperor *Anax imperator*, first discovered in our region in 2008, now was the 4th commonest species in the surveys in terms of species occurrence. We also discovered that wildlife cameras (to survey mammals) provide film clips of sufficient quality to identify at least larger species (e.g. *Anax*, *Aeshna* and *Cordulegaster*).

A brief history of Slovak odonatological meetings

Dušan ŠÁCHA[1,2]

[1] State Nature Conservancy of the Slovak Republic, Protected Landscape Biele Karpaty Administration, Trenčianska 31, 914 41 Nemšová, SLOVAKIA. Email: dusan.sacha@sopsr.sk; [2] Spoločnosť Aqua vita, Podtatranského 31, 031 01 Lipt. Mikuláš, SLOVAKIA. Email: dusan.sacha@vazky.sk;

KEYWORDS: Slovakia, odonatology, citizen science, partnerships

The idea of holding odonatological meetings in Slovakia (Slovenské vážkarske stretnutie – SVS) is not a new one; nonetheless it is only in the last couple of years that this has been brought to life. The first meeting took place in 2019 in eastern Slovakia and became a proof of concept. Since then, each year a new episode of SVS has been organized in still another part of the country.

Target group of the SVS is quite diverse, ranging from odonatologists by profession, through employees of nature conservation agencies to dragonfly-fans and photographers, including kids of all ages. The program is arranged accordingly, encompassing practical management, field trips, evening lectures, scientific talks and leisure-time activities. Recently a brief workshop on dragonfly larvae identification has been included. This strategy resulted in tripling the number of participants within four years of existence of SVS; since 2021 the meetings have an international dimension, too (participants from the Czech Republic).

SVS is being organized in collaboration with Spoločnosť Aqua vita as the lead organizer (NGO) and a local branch of the State Nature Conservancy or a National Park; other organisations (museums etc.) are invited to co-organise the SVS. This approach provides SVS with the necessary legal and scientific background. In the last years, the meetings are coordinated with the monitoring of the species and habitats of community interest project (carried out by the State Nature Conservancy), with the headquarters of the State Nature Conservancy providing some financial support as well.

The outputs of the SVS include mostly enhancement of partnerships between state and NGO conservationists, scientists and the public (combination of professional and citizen science). Each year, one day is dedicated to conservation management of a specific site, and this provides a benefit for the local nature-conservation body. Regarding scientific outcomes, we visited 47 sites within three years, whilst the studied dragonfly sample amounted to 1,527 individuals and 44 species, including 3 species listed in the Habitats Directive.

The 2022 SVS is taking place just two weeks ahead of the ECOO, with its preliminary results presented in Kamnik.

Status and conservation of *Coenagrion ornatum* at Ljubljansko barje (Ljubljana Moor), Central Slovenia (Coenagrionidae, Odonata)

Ali ŠALAMUN[1,3] & Ana TRATNIK[2,3]

[1] Centre for Cartography of Fauna and Flora, Tacenska cesta 20, 1000 Ljubljana, SLOVENIA. Email: ali.salamun@ckff.si; [2] Javni zavod Krajinski park Ljubljansko barje, Podpeška cesta 380, 1357 Notranje Gorice, SLOVENIA. Email: ana.tratnik@ljubljanskobarje.si; [3] Slovene Dragonfly Society, SLOVENIA.

KEYWORDS: *Coenagrion ornatum*, Ljubljansko barje, conservation measures, monitoring, Habitats Directive

Populations of *Coenagrion ornatum* at Ljubljansko barje (Ljubljana Moors), which measures app. 163 km² and embraces more than 700 km wide network of ditches and channels, have been known as the largest in Slovenia for more than 25 years. Ornate Bluet is an Annex II Habitats Directive species and one of many qualifying species at Ljubljansko barje, which was included in Natura 2000 network in 2004. Nevertheless, the knowledge on the species, and the number of known localities, remained at almost the same level, growing from 18 localities in 1997 to 21 in 2017. During a study made in 2013 on a 500- meters stretch of a single channel, over 2,000 individuals where marked, with estimated population size up to 7,000 individuals.

In 2018, Ljubljansko barje Landscape Park started the project PoLJUBA – Restoration and Conservation of Wetland Habitats at Ljubljansko barje. As the first part of the project, a survey of *C. ornatum* was made in 2018 and 2019 by the Centre for Cartography of Fauna and Flora. Out of 357 surveyed localities, *C. ornatum* was found on 92 localities. Distribution and differences in habitats and other results of the survey are presented.

As part of the project, 20 areas were selected across Ljubljansko barje for the implementation of measures for improvement of the species' habitat and its population's conditions. At Ljubljansko barje, the main problem concerning Ornate Bluet is the habitat's overgrowth, together with increasingly intensive agriculture and inappropriate renewal of ditches and mowing of their banks. Therefore, the suggested measures include cutting of overshadowing trees and bushes, timely adjusted mowing of overgrown vegetation in the ditches and on the banks and, finally, renewal of ditches with removal of vegetation and accumulated mud with excavators. The selected areas included good, poor and bad localities for *C. ornatum* and the measures were adjusted to species' phenology and implemented at a few 100 meters long stretches, with planned "rotation model" of the channels' future management. In winters and autumns of 2020 and 2021, 6 km of ditches were cleaned with excavators and on 9 km overgrowing vegetation was removed.

Monitoring of implemented measures is underway and will be concluded in 2022. First results are presented and future measures proposed. The need of systematic solutions and collaboration between landscape park management, water management and nature conservation authorities are emphasized.

Project Restoration and Conservation of Wetland Habitats at Ljubljansko barje (PoLJUBA) is financed by the EU Regional Development Fund and the Republic of Slovenia.

Highway stormwater ponds enhance odonate diversity in agricultural and semi-natural landscapes

Hana ŠIGUTOVÁ, Aleš DOLNÝ, Petr PYSZKO & Jiří VALUŠÁK

University of Ostrava, Chittussiho 10, 710 00 Ostrava, CZECH REPUBLIC. Email: sigutova.hanka@gmail.com;

KEYWORDS: α- and β-diversity, Dragonfly Biotic Index, highway runoff, reconciliation ecology, stormwater management

Stormwater ponds along highways and in cities are constructed to collect excess runoff and pollutants from traffic. These ponds may enhance freshwater biodiversity in urban areas, but their role in semi-natural and agricultural landscapes remains poorly known. Along the selected sections of the highway in Czechia we compared a set of highway stormwater ponds and control ponds. We used Odonata as a bioindicator to examine the extent to which stormwater ponds act as refuges for freshwater biodiversity. We focused on the differences in environmental parameters, as well as in the richness, compositions, and conservation values of the odonate communities (expressed by the Dragonfly Biotic Index). Moreover, we analyzed the factors responsible for the differences in the communities of stormwater and control ponds. Compared to the control ponds, the stormwater ponds had higher plant diversity, more dense vegetation overgrowth, and higher pH values. Moreover, they were less eutrophicated, smaller, less stocked with fish, less shaded by trees, and had a lower connectivity with other ponds in the area. Stormwater ponds harboured richer odonate communities, and their β-diversity was also higher, but their assemblages were taxonomically more similar. Indicator species identified in stormwater ponds included *Sympetrum striolatum*, *Ischnura pumilio*, and *Enallagma cyathigerum*, whereas no indicator species were detected in control ponds. Moreover, stormwater ponds hosted more species of higher conservation values. The fish stocking intensity, relative tree shading, and trophic state were the correlated factors responsible for the differences between stormwater and control ponds. An increase in these factors was correlated with a decrease of community richness and conservation value. Collectively, our results demonstrate the ability of stormwater ponds to support the odonate diversity in agricultural and semi-natural landscapes. Furthermore, we suggest management practices to maintain the conservation function of these ponds which, at the same time, help to maintain their technological function.

Dragonflies in specific and highly threatened calcareous fens in central-eastern Poland

Adam TARKOWSKI[1] & Paweł BUCZYŃSKI[2]

[1,2] Department of Zoology and Nature Protection, Maria Curie-Skłodowska University, Akademicka 19, 20-033 Lublin, POLAND. [1] Email: tarkowski890@gmail.com; [2] Email: pawbucz@gmail.com;

KEYWORDS: peatlands, environmental factors, anthropogenic impact

Calcareous fens are atypical lowland fens with clearly alkaline pH. They cover large areas of habitats protected under Natura 2000, including priority habitat 7210 (Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*). Calcareous fens are relatively rare and their conservation status is good only in small areas of the EU. In Poland, the largest fen areas are located in central-eastern regions of the country: in Western Polesie and Polesie Wołyńskie, especially in the region of the Poleski National Park and near the city of Chełm. They boast an extremely high floristic and faunistic diversity.

The main aim of the study was to analyse occurrence of dragonflies in specific and highly threatened calcareous fens in central-eastern Poland. In 2015–2018, we studied dragonfly assemblages in fens located near the village of Garbatówka (51°21'N, 23°6'E) and Chelm (51°8'–51°9'N, 23°29'–23°41'E) against selected environmental factors, in habitats with different conservation status and transformation level. We compared these data with faunistic records obtained in the same areas in 2007–2009. Of the 51 study sites, 21 were located within nature reserves. We found 50 species of dragonflies (67.5% of the national fauna): 41 in 2007–2009 and 44 in 2015–2018, among which 9 species were protected by law and/or redlisted: *Sympecma paedisca*, *Coenagrion armatum*, *Aeshna juncea*, *A. viridis*, *Ophiogomphus cecilia*, *Orthetrum coerulescens*, *Sympetrum depressiusculum*, *Leucorrhinia albifrons* and *L. pectoralis*.

Our study revealed that among the most important factors shaping dragonfly assemblages and determining their survival in general, is drying of fens, which is particularly evident when comparing data from the precipitation-poor years 2015–2018 and the clearly precipitation-rich years 2007–2009. The most sensitive to drying were odonatocenoses of peatlands reclaimed and used as hay meadows. Untransformed peatlands, usually located in nature reserves, were found to have more resistant dragonfly assemblages. The role of peat pools, which in many areas were centres of dragonfly biodiversity and also provided refugia for dragonflies at times when the surrounding peatlands dried out, proved surprisingly large.

Our data suggest that: (1) maintaining the continuity of natural habitats is a key factor for dragonfly conservation, (2) it would be beneficial to use anthropogenic waters (especially peat pools) for their protection. The role of peat pools may become more important due to climate change, which results in the drying of natural habitats. Appropriate techniques have already been developed for the protection of selected species, especially *Leucorrhinia pectoralis*.

Results of the first Odonata survey in the Periyar Tiger Reserve, Western Ghats, Kerala (India) – 2017

Brij Kishore TYAGI

Society of Medical Arthropodology & Advisor, SpoRIC, VIT University, Vellore - 632014 (TN), INDIA.
Email: abktyagi@gmail.com;

KEYWORDS: India, Periyar Tiger Reserve, endemic

Dragonflies of India have been studied taxonomically by a large number of odonatologists, most famously by F.C. Fraser in his three-volume monumental work *The Fauna of British India, including Burma and Ceylon* published in 1933, 1934 and 1936. Yet, some protected areas remained outside their reach for decades, and one such habitat was Periyar in the Western Ghats region in Kerala, India. The Western Ghats south of Palghat gap is fragmented into three landscape units viz., Anamalai-Palni, Periyar and the Agasthyamala Hills. The Periyar Wildlife Sanctuary was established in 1934, consisting of a part of the current catchment area of Mullaperiyar Dam on Periyar River. It became a tiger reserve in 1978 and was declared a National Park in 1982. The PTR is situated in the Cardamom Hills and Pandalam Hills of the Southern Western Ghats between latitudes 9°17' 56.04" and 9°37' 10.2" N and longitudes 76°56' 12.12" and 77°25' 5.52" E. The major portion of the reserve forms the catchment of the River Periyar and the rest is that of the River Pamba. Administratively, the PTR falls in Idukki, Kottayam and Pathanamthitta Districts of Kerala. The total extent of PTR is 925 km^2 of which 881 km^2 is notified core or critical tiger habitat and the remaining 44 km^2 is notified buffer.

The present study gives the results of a dragonfly survey in the Periyar Tiger Reserve (PTR) implemented in October 2017. Altogether 15 camps, each comprising 4–5 volunteer-dragonfly conservationists, were formed, viz., Eravangalar, Moozhikkal, Pamba, Sathram, Gavi, Aruviode, 4th Mile, Vallakkadavu, Anjuruli, Pachakkad, Thannikudi, Mavadi, Kokkara, Upper Manalar and Puthusserry. A total number of 80 odonate species were identified during the survey, of which 46 were dragonflies (Anisoptera) and 34 damselflies (Zygoptera). Kerala has 161 reported species. That 50% of the species in Kerala could be observed in the PTR in a short period of two days is a good achievement. Out of the 88 species of Odonata endemic to Western Ghats, five dragonflies and seven damselflies were observed during the survey. The following species endemic to Western Ghats were observed during the survey: Anisoptera – *Hemicordulia asiatica*, *Gomphidia kodaguensis*, *Macrogomphus wynaadicus*, *Merogomphus longistigma tamaracherriensis*, and *Epithemis mariae*; Zygoptera – *Libellago indica*, *Aciagrion approximans krishna*, *Agriocnemis keralensis*, *Pseudagrion indicum*, *Euphaea fraseri*, *Indosticta deccanensis*, and *Protosticta gravelyi*. The substantial number of 80 odonates in this brief and off-seasonal survey indicates the need for extensive and year-round surveys in the future. There is a huge gap of information on odonates not only of the PTR but also of Kerala, which warrants large scale surveys in the state which would elicit much-needed scientific data that would contribute to the understanding of the role of this group as bio-indicators.

Indian Odonatology: past, present and future

Brij Kishore TYAGI

Society of Medical Arthropodology & Advisor, SpoRIC, VIT University, Vellore - 632014 (TN), INDIA.
Email: abktyagi@gmail.com;

KEYWORDS: Indian fauna, Indian Odonatology, Indian Dragonfly Society (IDS)

Dragonflies (Odonata), probably next only to butterflies (Lepidoptera), are the most elegant and attractive insects as a group that have fascinated imagination of man through the time immemorial. The Indian fauna of dragonflies is highly rich in both species and community populations, representing nearly 10% of the total number of species present in the world. Even though dragonflies had been regularly appearing in the old Indian scriptures and in Sangam literature in Tamil, dragonflies or 'tumbi' find space in folklores aplenty. The first range of scientific investigation was, however, initiated during the 19th century when taxonomy and distributional mappings dominated, culminating almost entirely in the three magnum opuses '*The Fauna of British India, including Burma and Ceylon. Odonata*' by F.C. Fraser, published in 1933, 1934 and 1936. After the World War II, too, Col. F.C. Fraser's writings continue to flourish with Indian dragonflies in the centre. Meanwhile, P.S. Corbet in 1962 came out with his classic '*A biology of dragonflies*' which presented the global knowledge, culminating into his *magnum opus* '*Dragonflies: Behaviour and ecology of Odonata*' in 1998. On Indian front, a similar attention was spearheaded on the biology and ecology particularly to the phenomena of species' voltinism and migration by A. Kumar and M. Prasad in 1981. Indian odonatology was at this point of time evolving to its maximum, covering systematics, functional morphology, physiology of gills and oxygen consumption, reproduction, endocrinology, toxicology, cytogenetics and cytotaxonomy, ethology, trophic biology and eco-energetics, biogeography, potential of dragonflies as biocontrol agents of insects' pests/vectors etc. This evolution was duly facilitated by India's first dragonfly journal, *Indian Odonatology*, the newsletter, *Fraseria*, produced by Indian National Office (established 1981) of the International Odonatological Society (SIO), and a series of biennially organized Indian Symposia of Odonatology (commencing 1984). Dragonflies in India today are studied through several portals such as *DragonflyIndia* which organized its 4th and 5th annual meetings in Goa in 2017 and Nagpur in 2018, in conjunction with the ninth and tenth Indian Symposiums of Odonatology, respectively, under South Asian Council of Odonatology. Independently, and for the first time in the history of Indian odonatology, an indigenous scientific association, the Indian Dragonfly Society (IDS), was established (in 2017) which is producing its open access semiannual newsletter, *Bradinopyga*, in addition to serial biennially held symposia, e.g., 1st Indian Conference of Odonatology (Dehra Dun; 2018). The IDS has been a member (through B.K. Tyagi) to the Dragonfly Specialist Group of the Species Survival Commission (IUCN) since 2021, and has had ties with the World Wildlife Fund, India and the Bombay Natural History Society, Delhi Chapter with which the IDS had participated in a 9-month long awareness programme called, "Dragonfly Festival", on dragonflies throughout the country during 2021–2022.

120 years of dragonfly trends in the Netherlands

Roy H.A. VAN GRUNSVEN

Dutch Butterfly Conservation, De Vlinderstichting, Mennonietenweg 10, Postbus 506, 6700 AM Wageningen, THE NETHERLANDS. Email: roy.vangrunsven@vlinderstichting.nl;

KEYWORDS: Odonata, climate change, long-term monitoring, water quality

Trends in dragonflies are assessed in many countries and regions. Normally, these are restricted to the recent decades as recently started monitoring schemes, and for older periods little data is available. However, in the previous period there had already been substantial shifts in dragonfly faunas, and ignoring this gives a false baseline. In the Netherlands, a database of nearly 4 million records exist, but this is dominated by recent records and also includes old records including museum specimens. We analyzed trends in Dutch dragonflies by aggregating data in periods and using a list-length approach to calculate trends.

The list-length method can be used to calculate trends from data with changing recording efforts. This allows us to assess the changes over 120 years and identify the most important drivers of change for different periods. We compared trends for dragonflies from different habitats and different climatological preferences. The deterioration and recovery of water quality dominated the shifts in the Dutch dragonfly fauna over a large part of the 20th century. Species from running waters had declined in distribution by 66%, when comparing the 1850–1950 period to the 1975–1990 period. They have more than recovered since, partially because of legislation on water quality. Dragonflies with high and low Species Temperature Indices (species preferring high or low temperatures) had similar trends until 1990, but in the last three decades the species with high Species Temperature Indices have had much more positive trends. This indicates that climate change has become the main driver of shifts in dragonfly communities.

Dragonfly fauna of Slovenia: current knowledge and detected changes from a 25-year perspective

Damjan VINKO[1], Ali ŠALAMUN[1,2], Mladen KOTARAC[1,3] & Matjaž BEDJANIČ[1,4]

[1] Slovene Dragonfly Society, Verovškova 56, 1000 Ljubljana, SLOVENIA. Email: damjan.vinko@gmail.com; [2,3] Centre for cartography of fauna and flora, Tacenska cesta 20, 1000 Ljubljana, SLOVENIA. [2] Email: ali.salamun@ckff.si; [3] Email: mladen.kotarac@gmail.com; [4] National Institute of Biology, Večna pot 111, 1000 Ljubljana, SLOVENIA. Email: matjaz.bedjanic@nib.si;

KEYWORDS: Odonata, dragonflies, damselflies, Slovene Dragonfly Society, distribution, database, research, monitoring

As of 2021, the Odonata fauna of Slovenia numbers 73 species. National odonatological database, maintained jointly by the Slovene Dragonfly Society and the Centre for Cartography of Fauna and Flora, currently contains over 61,500 faunistic data and 8,605 georeferenced localities with dragonfly records.

A quarter of a century has passed since the publication of the Slovene odonatological groundwork *Atlas of the Dragonflies (Odonata) of Slovenia*. Despite the lack of systematic monitoring and predominantly volunteer basis of data collection, manifold increase in number of surveyed localities and collected observations, as well as better overall knowledge, allow for at least preliminary analysis of changes and trends possible from a 25-year timespan perspective.

While for some species the apparent range and abundance increase is most likely an effect of better field coverage and increased knowledge (e.g. *Coenagrion ornatum*, *Cordulegaster heros*, *Ophiogomphus cecilia*), there are also species in which real range expansions are probable (e.g. *Erythromma lindenii*, *Aeshna isoceles*, *Crocothemis erythraea*, *Libellula fulva*), either due to climate change as an effect of their regional populations range pulsations, availability of new habitats or combination of many factors. On the other hand, apparent range and abundance losses, despite much more comprehensive general dataset at hand, are easier to interpret. While in some cases habitat destruction and degradation, natural succession or climate change are the reasons behind their decline (e.g. *Lestes dryas*, *Aeshna viridis*, *Leucorrhinia caudalis*, *L. pectoralis*), there are examples of species which would possibly demand special search approach to confirm their supposed marked decline (e.g. *Epitheca bimaculata*). Some northern species, for which Slovenia represents the southern edge of their Central European range, are either getting scarcer (e.g. *Aeshna juncea*) or have not been observed anywhere in Slovenia in the last two decades (e.g. *Coenagrion hastulatum*, *Somatochlora alpestris*, *Sympetrum danae*).

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Abstracts of Posters

Can we apply the Bergmann rule on *Aeshna juncea* (Linnaeus, 1758) (Odonata: Aeshnidae)?

Attila BALÁZS[1], Jan ŠIPOŠ[1] & Christophe BROCHARD[2]

[1] Department of Zoology, Faculty of AgriSciences, Mendel University in Brno, Zemědělská 1, 613 00 Brno, CZECH REPUBLIC. Email: balazsaeko@gmail.com;
[2] Bureau Biota, Groningen, THE NETHERLANDS. Email: c.brochard@bureaubiota.com;

KEYWORDS: morphometrics, body size, exuviae, morphology

Body size changes in aquatic ectotherms, shifted by altitude or latitude is a controversial topic, due to inconsistent reactions in body size changes of the studied groups of organisms. Aquatic ectothermic arthropods at increased temperatures tend to have reduced body size which could be challenging to explain appropriately. Only a few papers studied the effects of latitude or altitude on the body size of Odonata. *Aeshna juncea* is the most widespread dragonfly of its genus with Holarctic occurrence, inhabiting peatbogs and other still waters with well-developed *Sphagnum* vegetation. The species´ range extends considerably further south than other European *Aeshna* species. Altogether 150 exuviae were measured with a stereomicroscope by a single person. Fifty specimens (25 ♂♂, 25 ♀♀) from three different countries (The Netherlands, France and Iran) were examined. We measured 20 morphological features for females and 19 features for males. The least variable body trait was the width of labial palps in all studied populations. We observed that the overall body size, the length of abdominal spines and abdominal appendices were bigger on the specimens originating from Iran. On the contrary, the width of head, the minimal width of prementum, the maximal width of prementum and the length of prementum were bigger in Dutch populations. The bigger body size of Iranian population might be explained due to suitable ecological factors of the habitat provided for *A. juncea*.

The effects of temperature and water aeration on the development and survival of *Sympetrum striolatum* larvae

Eva BÍLKOVÁ[1,2], Veronika KORNOVÁ[1], Veronika GROCHOLOVÁ[1], Petr PYSZKO[1], Aleš DOLNÝ[1] & Stanislav OŽANA[1]

[1] Department of Biology and Ecology, University of Ostrava, CZECH REPUBLIC. [2] Email: eva.bilkova@osu.cz;

KEYWORDS: dragonfly, Odonata, thermal reaction, laboratory breeding, climate warming

Several questions remain unanswered regarding Odonata larval hatching success and survival under different climate change scenarios. Laboratory rearing of larvae is thus an essential tool for studying larval morphology, development, growth, and behaviour. However, no universal method for larval breeding exists.

We developed and tested a laboratory breeding system for *Sympetrum striolatum*, with the examination of the effect of water temperature (24°C, 26°C, 28°C) and dissolved oxygen levels (aeration/no aeration) on egg hatching success as well as development and survival rate of larvae. Our experiment consisted of 150 eggs from 5 females reared in controlled conditions for 60 days in rearing chambers.

We found no effect of water temperature on egg hatching success or rate of egg development, but a significant effect on larval development rates and survival, while the effect of the aeration was unclear. Larvae showed faster development at higher water temperatures. However, prolonged exposure to higher temperatures (26 °C or 28 °C) led to high mortality rates (close to 100%) during the 60 days of experiment. Our results also indicated that the optimal temperature for larval development was 24 °C, which enabled constant development and high survival rates.

The results presented here reaffirms previous findings that temperature is an important factor affecting the development and survival that may change species distribution and population viability. Thorough understanding the effects of temperature on Odonata development and survival, in particular with regard to eggs and larvae, provides much information on specific biochemical, metabolic, and molecular mechanisms that underlie species community structuring. Although many dragonfly species are adapted to survive relatively high temperatures during their larval stages, there is a threshold temperature (as little as 2 °C above optimal temperature) where prolonged exposure can be lethal. This shows how vulnerable dragonflies are in the context of natural habitat degradation mediated through climate change.

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Trithemis annulata and *Trithemis kirbyi*: their recent expansion in the Iberian Peninsula

Martiño CABANA[1], Florent PRUNIER[2], Adolfo CORDERO-RIVERA[3], Cecilia DÍAZ-MARTÍNEZ[4], Adrià MIRALLES-NÚÑEZ[5] & Pere LUQUE[5]

[1] Department of Animal, Plant and Ecological Biology, University of A Coruña, A Coruña, SPAIN. [2] Red de Observadores de Libélulas en Andalucía (ROLA), SPAIN. Email: aeaelbosqueanimado.info@gmail.com; [3] University of Vigo, Department Ecology and Animal Biology, SPAIN. [4] National Museum of Natural Sciences, MNCN-CSIC, José Gutiérrez Abascal, 2, 28006 Madrid, SPAIN. [5] Oxygastra. Grup d'Estudi dels Odonats de Catalunya, SPAIN.

KEYWORDS: Odonata, dragonflies, colonization, distribution

Odonates, most notably Anisoptera, are strong flyers with high capacities of dispersion, enabling them to expand their ranges when favourable conditions arise. A few dragonflies have recently experienced large changes in their distribution range, as illustrated by *Trithemis annulata* and *T. kirbyi*, two African libellulids which have colonized Southern Europe in the last decades.

Trithemis annulata: first Iberian record in 1978, reaching continental France (roughly 1,000 km as the crow flies) in 16 years and the Balearic islands in 31 years. *Trithemis kirbyi*: first Iberian record in 2007, reaching France in 10 years and the Balearic islands in 15 years.

We present the most up-to-date maps of range expansion within the Iberian Peninsula and compare the process of colonization for both species. *T. annulata* was initially detected in Andalusia and southern central Spain and its expansion followed both western (Atlantic) and eastern (Mediterranean) routes. On the contrary, *T. kirbyi* colonized very quickly the Mediterranean coast and its expansion has been faster northward than that of *T. annulata*, but generally slower through the entire Peninsula.

Including data on dragonflies (Odonata) into a common Nature Conservation Information System in Slovenia – challenges and opportunities

Nina ERBIDA

Slovenian Environment Agency, Ljubljana, SLOVENIA. Email: nina.erbida@gov.si;

KEYWORDS: LIFE NarcIS, conservation, information system, dragonflies, data

The overall objective of the LIFE NarcIS project is to build an integrated functional NAtuRe Conservation Information System, combining Slovenian nature conservation data from various sources and providing one entry point to access them. The system will include all public data on 73 species of dragonflies that have been found in Slovenia, and their conservation statuses. The new information system will increase the efficiency of implementing nature conservation and environmental legislation, reduce the administrative burden, and raise awareness among stakeholders and target users about data availability and usability.

A comparative study of larval Odonata data within permanent ponds across Hungary

Lena FEHLINGER[1,2], Biljana RIMCHESKA[3], Judit FEKETE[4*], Tamás BOZÓKI[5], Benjamin MISTELI[6], Ana BALIBREA[7], Vojtěch KOLÁŘ[8,9], Martin SOUTO[7], Veronica NAVA[10], Liam NASH[11], Pietro TIROZZI[10], Dariusz HALABOWSKI[12,13], Luca BONACINA[14], Alberto SCOTTI[15], Ellinor JAKOBSSON[16], Fernando CHAGUACEDA[16], Daniel MORANT[17], Julie C. FAHY[18], David CUNILLERA-MONTCUSI[19], Jose Manuel ZAMORA MARÍN[20], Marina TOMÁS MARTÍN[21], Juan RUBIO-RÍOS[22,23], Katarzyna KUCZYŃSKA[24], Pablo SOTO GARCÍA[21], Aleksandra HABA[24], Francesca VALLEFUOCO[25,26], Olivera STAMENKOVIĆ[27], Ena L. SUAREZ[28], Magdalena VANEK[29], Teofana CHONOVA[30], Noel JUVIGNY-KHENAFOU[31], Pablo TIMONER[28], Rhiannon MONDAV[16], Emma DROHAN[32], Lucie VEBROVÁ[8], Dawid DĄBROWSKI[33], Alba CAMACHO SANTAMANS[17], Encarnación FENOY[22,23,34], Marta ZAWADZKA[33], Jorge GARCÍA-GIRÓN[35], Mercedes GUERRERO BROTONS[36], Joana MARTELO[37,38], Alfredo LLORENTE[39,40], Margaux MATHIEU-RESUGE[1,41], Pierre MARLE[28], Simone MORAS[16], Karla MÜNZNER[16], Jorge HENRIQUES[42], Martin SARKEZI[43], Agnieszka SOWA[44], Maria CALDERÓ PASCUAL[32], Anna CAMACHO-SANTAMANS[17], Zeus FREIXINOS CAMPILLO[36], Remi GERBER[6], Maria IASMINA MOZA[45], Constanze ENGLISCH[43], Stephen ESOSA OSAKPOLOR[31], Darmina NITA[45], Valentin DINU[46], Adriana OLENICI[46],Frederic LABAT[6] & Gábor VÁRBÍRÓ[47]

[1] WasserCluster Lunz - Biologische Station GmbH; Dr Carl Kupelwieser Promenade 5, A-3293 Lunz am See, AUSTRIA. Email: lena.fehlinger@gmail.com; [2] Danube University Krems; Dr.-Karl-Dorrek-Straße 30, 3500 Krems an der Donau, AUSTRIA. [3] Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel Blvd., 1000 Sofia, BULGARIA. Email: rimceska@gmail.com; [4] University of Pannonia, Centre of Natural Science, Research Group of Limnology, Egyetem u. 10, 8200 Veszprém and Centre for Ecological Research, Institute of Aquatic Ecology, Department of Tisza Research, Debrecen, HUNGARY. Email: juditfekete0307@gmail.com; [5] Institute of Biology, University of Pécs; H-7624 Pécs, Ifjúság útja 6. HUNGARY. Email: bozokitamas18@gmail.com; [6] Université Rennes 1 - UMR 6553 CNRS ECOBIO; Campus de Beaulieu, 263 avenue du Général Leclerc, 35042 Rennes Cedex, FRANCE. Emails: Benjamin.misteli@univ-rennes1.fr; remi.gerber@univ-rennes1.fr; frederic.labat@aquabio-conseil.com; [7] CIBIO, Research Center in Biodiversity and Genetic Resources, InBIO Associate Laboratory, Faculty of Sciences and Technology, University of the Azores; Rua da Mãe de Deus, 9500-321 Ponta Delgada, Açores, PORTUGAL. Emails: abalibreaescobar@gmail.com; martin.s.souto@uac.pt; [8] Faculty of Science, University of South Bohemia; Branisovska 1760, Ceske Budejovice, CZ-37005, CZECH REPUBLIC. Emails: kolarvojta@seznam.cz; lucka.veb@seznam.cz; [9] Institute of Entomology, Biology Centre, Czech Academy of Sciences; Branisovska 31/1160, Ceske Budejovice, CZ-370052, CZECH REPUBLIC. [10] Department of Earth and Environmental Sciences, University of Milano-Bicocca; Piazza della Scienza 1, 20126, Milano, ITALY. Emails: v.nava15@campus.unimib.it; p.tirozzi@campus.unimib.it; [11] School of Biological and Chemical Sciences, Queen Mary University of London; Mile End Rd, Bethnal Green, London E1 4NS, UNITED KINGDOM. Email: l.n.nash@qmul.ac.uk; [12] University of Lodz, Faculty of Biology and Environmental Protection, Department of Ecology and Vertebrate Zoology; Banacha 12/16, 90-237 Lodz, POLAND. Email: dariusz.halabowski@gmail.com; [13] University of Silesia in Katowice, Faculty of Natural Sciences, Institute of Biology, Biotechnology and Environmental Protection; Bankowa 9, 40-007 Katowice, POLAND. [14] Department of Earth and Environmental Sciences, University of Milano-Bicocca; Piazza della Scienza 1, 20126, Milano, ITALY. Email: l.bonacina9@campus.unimib.it; [15] Institute for Alpine Environment, EURAC Research; Viale Druso 1, 391000 Bolzano, ITALY. Email: alberto.scotti@eurac.edu; [16] Department of Ecology and Genetics, Uppsala University; Norbyvägen 18 D, 752 36, Uppsala, SWEDEN. Emails: ellinor.jakobsson@ebc.uu.se; chagua1932@gmail.com; rhiannon.mondav@gmail.com; simone.moras@ebc.uu.se; karla.munzner@ebc.uu.se; [17] Cavanilles Institute for Biodiversity and Evolutionary Biology; Parque científico- Entrada lateral Calle del Catedrático José Beltrán Martínez, 2, 46980, Paterna, Valencia, SPAIN. Email: daniel.morant@uv.es; albacamachosantamans@gmail.com; annasantamans@gmail.com; [18] EISA, University of Applied Sciences and Arts Western Switzerland; HEPIA, Route de Presinge 150, CH-1254 Jussy, SWITZERLAND. Email: julie.fahy@hesge.ch; [19] FEHM-Lab. Section of Ecology, Department of Evolutionary Biology, Ecology and Environmental Sciences. University of Barcelona, Diagonal, 643 (08028) Barcelona, Catalonia, SPAIN. Email: david.cunillera@dcm.cat;

[20] Department of Zoology and Physical Anthropology, Faculty of Biology, Campus de Espinardo, University of Murcia, SPAIN. Email: josemanuel.zamora@um.es; [21] Department of Ecology, Universidad Autonoma de Madrid; Calle Darwin, 2, 28049 Madrid, SPAIN. Emails: marina.tomas@estudiante.uam.es; pablo.soto@uam.es; [22] Department of Biology and Geology, University of Almeria; Ctra. Sacramento s/n. La Cañada de San Urbano, 04120 Almería, SPAIN. Email: jrr812@ual.es; encarnafenoy@ual.es; [23] Andalusian Centre for the Evaluation and Monitoring of Global Change (CAESCG), SPAIN; [24] Institute of Biology, Department of Hydrobiology, University of Szczecin; Wąska 13, 71-415 Szczecin, POLAND. Emails: katkucz-07@o2.pl; olahaba1@onet.pl; [25] Research and Innovation Centre, Fondazione Edmund Mach, Via E. Mach 1, I-38098 San Michele all'Adige, ITALY. Email: francesca.vallefuoco@unitn.it; [26] Department of Civil, Environmental and Mechanical Engineering, University of Trento, I-38123 Trento, ITALY. [27] Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Niš; Višegradska 33, 18000 Niš, SERBIA. Email: olivera.stamenkovic89@gmail.com; [28] Department F.-A. Forel for environmental and aquatic sciences, University of Geneva; Uni Carl Vogt - 66, Boulevard Carl-Vogt, CH-1211 Genève 4, SWITZERLAND. Email: ena.suarez@unige.ch; pablo.timoner@unige.ch; pierre.marle@unige.ch; [29] Institute for Alpine Environment, EURAC Research; Viale Druso 1, 391000 Bolzano, ITALY. Email: magdalena.vanek@eurac.edu; [30] Department Environmental Chemistry, Eawag: Swiss Federal Institute of Aquatic Science and Technology, Überlandstr. 133, CH-8600 Dübendorf, SWITZERLAND. Email: teofana.chonova@gmail.com; [31] iES - Institute for Environmental Sciences, University Koblenz-Landau, Fortstraße 7, 76829 Landau i. d. Pfalz, GERMANY. Emails: noel.khenafou@gmail.com; osakpolor@uni-landau.de; [32] Dundalk Institute of Technology, Centre for Freshwater and Environmental Studies, Marshes Upper, Dundalk, Co. Louth, A91 K584, IRELAND. Emails: emma.drohan@dkit.ie; maria.calderopascual@dkit.ie; [33] University of Warmia and Mazury in Olsztyn; Michała Oczapowskiego 2 10-719 Olsztyn, POLAND. Emails: dawid.dabrowski@uwm.edu.pl; marta.zawadzka@uwm.edu.pl; [34] Department of Functional and Evolutionary Ecology, Experimental Station of Arid Zones (EEZA-CSIC), Ctra. Sacramento s/n. La Cañada de San Urbano, 04120 Almería, SPAIN. [35] Finnish Environment Institute, Freshwater Centre, P.O. Box 413, FI-90014 Oulu, FINLAND. Email: jogarg@unileon.es; [36] Department of Ecology and Hydrology, Faculty of Biology, Campus de Espinardo, University of Murcia, SPAIN. Email: mariamercedes.guerrero@um.es; zfreixinos@gmail.com; [37] Marine and Environmental Sciences Centre, Faculty of Sciences, University of Lisbon, 1749-016 Lisbon, PORTUGAL. Email: joanamartelo@gmail.com; [38] Centre for Ecology, Evolution and Environmental Changes, Faculty of Sciences, University of Lisbon; Bloco C2, Campo Grande, 1749-016 Lisbon, PORTUGAL. [39] Anbiotek s.l., Ribera de Axpe, 11 B-201, 48950 Erandio, Bizkaia, SPAIN. Email: alfredo@anbiotek.com; [40] Department of Plant Biology and Ecology, University of Basque Country; SPAIN; [41] Univ Brest, CNRS, IRD, Ifremer, LEMAR, F-29280, Plouzane, FRANCE. Email: m.mathieuresuge@gmail.com; [42] Departamento de Biologia & CESAM, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, PORTUGAL. Email: henriquesjfp@gmail.com; [43] Functional and Evolutionary Ecology, Faculty of Life Sciences, University of Vienna, 1090 Vienna, AUSTRIA. Emails: a01447909@unet.univie.ac.at; constanze.englisch@gmx.at; [44] University of Lodz, Faculty of Biology and Environmental Protection, Department of Invertebrate Zoology and Hydrobiology; Banacha 12/16, 90-237 Lodz, POLAND. Email: agnieszka.sowa@biol.uni.lodz.pl; [45] Research Center for Ecological Services, University of Bucharest, Splaiul Independentei 91-95, 050089, Bucharest, ROMANIA. Email: iasmina_moza@yahoo.com; [46] Research Center in Systems Ecology and Sustainability, University of Bucharest, Independentei 91-95, 050095, Bucharest, ROMANIA. Emails: valentindinu23@yahoo.com; darminanita@yahoo.com; adriana.olenici@gmail.com; [47] Centre for Ecological Research, Institute of Aquatic Ecology, Department of Tisza Research, Debrecen, HUNGARY. Email: varbirog@gmail.com;

KEYWORDS: permanent ponds, Odonata, diversity, larvae, Hungary

Whilst being small and shallow, permanent ponds provide valuable habitats for a multitude of organisms as well as provide habitats for animals like aquatic insects and others, including many rare species. These ponds, which were often neglected in limnological studies, were the core of our joint project, the 3rd freshwater project - EUROPONDS in order to evaluate the often overlooked ecological ecosystem services provided by permanent ponds across Europe. As a part of this project, two Hungarian ponds were surveyed for a full year (2020/21). One of the project aims was to assess the freshwater macroinvertebrate assemblages by dip netting over the four annual seasons. Here, we present preliminary

results examining the data on larval Odonata of two Hungarian ponds in relation to the physicochemical variables measured, as well as compare the results to a previous national survey. Altogether the examination of 24 waterbodies (22 from a national survey and two from the EUROPONDS project) was carried out in this study. All of the involved water bodies were clustered using a Ward analysis including the water physicochemical parameters into three groups, and then the dragonfly fauna was investigated within the groups found. Diversity metrics and the presence or absence of different species were also included and the results were compared between the different clusters. Herein, we aimed to assess differences between the three main clusters, identify key factors driving the presence of the studied species and the relationship between the diversity indexes and the physicochemical parameters influencing the Odonata communities in the studied ponds.

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Ejection, ingestion and fragmentation of mesoplastic fibres to microplastics by *Anax imperator* larvae (Odonata: Aeshnidae)

Isabelle IMMERSCHITT[1] & Andreas MARTENS[2]

[1,2] University of Education Karlsruhe, GERMANY. [1] Email: isabelle.immerschitt@t-online.de; [2] Email: martens@ph-karlsruhe.de;

KEYWORDS: dragonfly, Anisoptera, faeces, gizzard, microplastic fragmentation by freshwater organisms, digestive fragmentation

Exposure to plastic litter in ecosystems is increasing globally. Marine and terrestrial ecosystems, as well as freshwater ecosystems, are affected. Despite this, the impact of increased exposure to plastics on the freshwater fauna is largely unexplored. The present work investigates the reactions of 42 *Anax imperator* larvae to plastics in their habitat. Mesoplastic fibres (ca 8 mm long) were presented with a *Chironomus* sp. larva that was placed behind the fibre. In the majority of the observations, ejection attempts using the labium and the front legs were observed. When ingestion occurred, macerated plastic fibres (0.5–3.5 mm) appeared in the faeces of several individuals. Consequently, Odonata larvae turned mesoplastics into microplastics. It is assumed that the mechanical comminution was achieved by the action of the gizzard, which contains strong chitinous teeth.

Opie-odonates, a new group dedicated to dragonflies in France

Samuel JOLIVET[1,2], Régis KRIEG-JACQUIER[2], Martin JEANMOUGIN[2] & Philippe LAMBRET[2]

[1,2] Opie-odonates – Chemin rural numéro 7 de la Minière, 78280 Guyancourt, FRANCE.
[1] Email: samuel.jolivet@insectes.org; [2] Email: odonates@insectes.org;

KEYWORDS: France, Odonatological NGO, SFO, Opie-odonates

Since 2019, the French Office for insects and their environment (Office pour les insectes et leur environnement – Opie) features a working group dedicated to Dragonflies named Opie-odonates. This working group aims at taking over the projects of the former French society of odonatology (Société française d'odonatologie – SfO) that no longer exists.

Over the 30 years of actions of the SfO, various projects were held and initiated that are now redeployed and supported by a professional team. The activity of Opie-odonates is based on the animation of the network of French odonatologists in relation with other national or regional organizations. This animation aims at fostering synergies between organizations and the realization of national scale actions in favour of Odonata as the diffusion of knowledge.

(1) Implementation and participation in projects. These projects emanate from the confrontation of the network of volunteers and the needs linked to the knowledge, its diffusion and the protection of Odonata. (i) A permanent atlas of Odonata. The project to produce an atlas of the Odonata of France aims to increase knowledge of dragonflies, to synthesize and pass on experiences. It will be available for consultation on an interactive website. (ii) Evaluation of species populations. Opie-odonates is the reference supporting the updates of the threat status of the French dragonflies for the national Red List. (iii) Expert involvement. Opie-odonates is required to participate as an expert in several committees. Through its network, it is involved in the regional versions of the action plans for Odonata, actively participating in the drafting of the recent National Action Plan 2020–2030 for dragonflies. The work group is also the suitable interlocutor for European projects as the revision of European Red List of Odonata. (2) Dissemination of knowledge. Opie-odonates maintains links within its network and disseminates knowledge through digital content via a Facebook account (www.facebook.com/Opie.odonates) and an electronic newsletter. It promotes scientific content through e.g. the journal *Martinia*, an open-access and online journal (martinia.insectes.org), and by editing and accompanying book projects on French odonatology. (3) Network animation. In the continuity of the SfO, Opie-odonates provides a link between odonatologists, national and regional structures. Scientific meetings, informal meetings, field trips will be organized and encouraged in partnership with local structures.

The genus *Cordulegaster* on Plachkovica Mountain (North Macedonia)

Despina KITANOVA

Macedonian Ecological Society, Blvd "Boris Trajkovski" St.7-9a, Skopje, NORTH MACEDONIA: Email: kitanova@mes.org.mk;

KEYWORDS: *Cordulegaster*, distribution, habitat preferences, Plachkovica Mt.

Dragonfly fauna of Plachkovica Mt. was studied during the selection process of Natura 2000 sites in the East Planning Region of North Macedonia. Three species of *Cordulegaster* (viz. *C. heros*, *C. picta* and *C. bidentata*) were recorded often in syntopy in some of the mountain streams. The hydrography of Plachkovica Mt. is well developed with more than 20 small mountain rivers and streams. The distributions and habitat preferences of the three *Cordulegaster* species are presented, based on records of both larvae and adults. Potential localities for Natura 2000 site taking into account the distribution of *C. heros* at Plachkovica Mt. are also identified.

Interspecific mating and potential hybrids in the genus *Sympetrum*

Veronika KORNOVÁ[1,2], Eva BÍLKOVÁ[1], Stanislav OŽANA[1], Petr PYSZKO[1] & Aleš DOLNÝ[1]

[1] Department of Biology and Ecology, University of Ostrava, CZECH REPUBLIC. [2] Email: veronika.kornova@osu.cz;

KEYWORDS: Odonata, dragonfly, interspecific mating, hybridization

Interspecific mating and hybridization in the order Anisoptera is still an insufficiently researched phenomenon. Understanding the interspecific interactions and hybridization is important for studying the evolution and behaviour of species. Global warming and the destruction of natural habitats can cause changes in species ranges, allowing interactions between formerly isolated species. Understanding if hybridization might increase rates or risk of extinction is very important with regard to species conservation and nature protection.

We focused on the genus *Sympetrum*, for which interspecific mating has been reported and described in the literature, and recently even viable hybrid individuals have been described. Field studies were carried out at two localities in the Czech Republic, where three or more species of the genus *Sympetrum* occur together. The field survey was conducted during the main flight activity of the *Sympetrum* genus, when 367 pairs were captured and determined during 16 days of field work in September and October 2021. For each pair, we also recorded environmental conditions such as time of capture, temperature and other weather variables. *Sympetrum sanguineum* (36.7% of the total number of captured pairs) and *S. striolatum* (52.3% of the total number of captured pairs) were the dominant species at the first locality in the studied period. At the second locality, *S. sanguineum* was the dominant species (65% of the total number of captured pairs). The proportion of interspecific pairs in these localities was 6.5%, suggesting that interspecific mating occurs quite commonly. The commonest interspecific pairs were between a male *Sympetrum sanguineum* and a female *Sympetrum striolatum* and also between a male *Sympetrum striolatum* and a female *Sympetrum vulgatum*. Significant factors affecting the number of heterospecific pairs were the species composition of females or males and temperature, with lower temperatures resulting in more heterospecific pairs. When possible, the eggs of the female from the interspecies pairs were taken and the larvae of potential hybrid individuals are currently being reared under controlled conditions in the rearing chambers.

Our research will continue in 2022, with further field observations (extended by monitoring habitat conditions and species behaviour), rearing of potential hybrids and DNA analysis.

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Atlas of the Odonata of Bosnia and Herzegovina

Dejan KULIJER

National Museum of Bosnia and Herzegovina, Zmaja od Bosne 3, 71000 Sarajevo, BOSNIA AND HERZEGOVINA. Email: dejan.kulijer@gmail.com;

KEYWORDS: dragonflies, damselflies, diversity, species distribution, fauna, database

Although the first data on dragonflies in Bosnia and Herzegovina were collected in the 19th and in the beginning of the 20th centuries Bosnia and Herzegovina remained, due to poor research efforts in later years, among the countries with least explored dragonfly fauna in Europe. In recent years, systematic investigations have led to a significant increase of odonatological knowledge for the country, but the species' distribution is still insufficiently known. In our presentation we give an overview on the project *Atlas of Odonata of Bosnia and Herzegovina*.

The main reason for the preparation of the Atlas is to summarize and present the results of surveys of the dragonfly fauna in Bosnia and Herzegovina conducted from 2009 to 2021, as well as all other known dragonfly records for the country currently stored in the national dragonfly database. Although the knowledge on the Odonata of Bosnia and Herzegovina is still largely incomplete, this atlas will serve as a good base for the future research and increasing interest in dragonflies in the country.

The dataset includes app. 12,000 records from literature, field data and museum collections, covering a period of 134 years, from 1888 to 2022. Data are available for more than 80% of 10x10 UTM squares, although for many of them only a single or only few records of species are available.

Besides the distribution maps for each species, the *Atlas of Odonata of Bosnia and Herzegovina* will also contain information on the species, their habitats, ecology, phenology and will also be useful, although this is not its main purpose, in species identification, as it to contain photos of all species. One of important aims of the Atlas is also to help raise public awareness on threats to dragonfly species and their habitats and to contribute to their protection.

An analysis of fluctuating asymmetry of wing size characters in Odonata: A step-by-step guide

Olena KUSHNIRENKO[1,2], Nadia SYDOROVA[1,3], Yaroslav SYDORENKO[1,4], Hlib BURTSEV[1,5], Ruslan NERUSH[1,6], Anna KALAIDA[1,7], Maria PRONINA[1,8], K. GOSHKA[1,9], Volodymyr LIASHENKO[1,10] & Natalia MATUSHKINA[1,11]

[1] Taras Shevchenko National University of Kyiv, UKRAINE. [2] Email: elenakushnirenko500@gmail.com; [3] Email: nadia.sydorova@gmail.com; [4] Email: yaroslav.basilevich@gmail.com; [5] Email: burtsevh@gmail.com; [6] Email: nerush.77@gmail.com; [7] Email: quercoideae@gmail.com; [8] Email: proninamaria2002@gmail.com; [9] Email: 07032003k@gmail.com; [10] Email: volodymyrliashenko1992@gmail.com; [11] Email: odonataly@gmail.com;

KEYWORDS: statistic analysis, wings, methods, insects

Fluctuating asymmetry (FA) is defined as slight random deviations from ideal bilateral symmetry in living organisms. Negative factors, like extreme environmental conditions and limited gene flow, can suppress the ability of the organism to counteract developmental shifts resulting in an increased level of FA. Odonata are important bioindicators of freshwater ecosystem health. Nevertheless, very few odonatologists use FA parameters as a routine analytical tool. Available statistical analysis protocols are too complicated and too varied, which may disappoint the researchers, especially the young ones. Moreover, if applied blindly, i.e. without understanding animal biology, they can cause non-compatible and dubious results. To fill this gap, we developed an easy-to-use guide on how to conduct the FA study of wing size traits in Odonata. We highlight that a row of tests must be performed prior to the comparison of samples, including the test for typos, test for hidden wing deformation, test for measurement error, test for sexual dimorphism, test for directional asymmetry and antisymmetry, and test for allometry. Based on the results of these tests, the study samples should be rearranged over and over again, aiming to exclude some traits and some specimens from the subsequent steps of the analysis.

DNA barcoding of the Slovak dragonfly fauna – preliminary results

Kristína LAŠŠOVÁ[1], Dušan ŠÁCHA[2,3], Zuzana ČIAMPOROVÁ-ZAŤOVIČOVÁ[1,4], Zuzana ŠÍBLOVÁ[5], Stanislav DAVID[6], Ladislav RACKO[7], Kornélia PETROVIČOVÁ[8], Attila BALÁZS[9], Fedor ČIAMPOR Jr[10]

[1,10] Plant Science and Biodiversity Centre, Slovak Academy of Sciences, Dúbravská cesta 9, SK-84523, Bratislava, SLOVAKIA. [1] Email: kristina.lassova@savba.sk; 10 Email: f.ciampor@savba.sk; [2] The State Nature Conservancy of Slovak Republic, Trenčianska 31, SK-91441 Nemšová, Slovakia. Email: dusan.sacha@sopsr.sk; [3] Spoločnosť Aqua vita, Podtatranského 31, SK-03101 Lipt. Mikuláš, SLOVAKIA. Email: dusan.sacha@vazky.sk; [4] Department of Ecology, Faculty of Natural Science, Comenius University, Mlynská dolina B-1, SK-84215 Bratislava, SLOVAKIA. Email: zuzana.zatovicova@savba.sk; [5] Institute of Landscape Ecology, Slovak Academy of Sciences, Jesenná 4, SK-82102, Bratislava, SLOVAKIA. Email: zuzana.siblova@savba.sk; [6] Institute of Landscape Ecology, Slovak Academy of Sciences, Akademická 2, SK-94901 Nitra, Slovakia. Email: stanislav.david@savba.sk; [7] Spoločnosť Aqua vita, Hlinská 2589/20, SK-01001 Žilina, SLOVAKIA. Email: tomsur.lr@gmail.com; [8] Institute of Plant and Environmental Sciences, Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, SK-94976 Nitra, SLOVAKIA. Email: kornelia.petrovicova@gmail.com; [9] Department of Zoology, Faculty of AgriSciences, Mendel University in Brno, Zemědělská 1, CZ-61300 Brno, CZECH REPUBLIC. Email: balazsaeko@gmail.com;

KEYWORDS: Odonata, cytochrome oxidase I, DNA barcoding, molecular identification

Dragonflies and damselflies (Odonata) have been widely used as bioindicators in monitoring of the environment in different ecological studies. The use of molecular data for their accurate and rapid determination is becoming increasingly popular. For hydrobiological, odonatological, monitoring or DNA barcoding purposes it is sometimes a challenge to identify dragonfly larvae, which are frequently present in samples but can be difficult to identify correctly using morphological characters, especially younger instars. Globally, more than 40,000 records of Odonata are available in the Barcode of Life Data System (BOLD, www.boldsystems.org), covering some 3,400 species. Despite the high number of records, data from Slovakia have so far been missing. The aim of this study was to process material collected in Slovakia, contribute to the barcode reference libraries and to discover local genetic diversity of dragonflies.

The samples were collected in 2021 in co-operation with the State Nature Conservancy of the Slovak Republic within its project of monitoring species and habitats as pere Habitats Directive. A total of 126 sampling sites were selected, evenly distributed across the country. Altogether, 373 individuals of 60 species were collected (mostly imagines, some larvae and exuviae), covering most odonate species known for Slovakia.

In this study, we produced DNA barcodes (5' end of the cytochrome c oxidase I gene – COI) for almost the complete Slovak dragonfly fauna and compared these with 1,527 barcodes from BOLD to confirm determination of both adults and larvae based on morphology. The complete analysed dataset from Slovakia included 221 specimens (213 adults and 8 larvae), representing 188 COI barcodes for 57 morphologically identified species (9 families, 24 genera) collected from more than 90 localities in various regions of the country. The DNA determination was highly congruent with morphology and differed only for few larvae of closely related species. Concerning intraspecific genetic variability, some Slovak samples pooled with other European samples, while some barcodes revealed distinct haplotypes suggesting a distinct position of the region in regard to the genetic diversity of some species.

Data on a preliminary evaluation of the local threat status of Odonata species for Albania based on the Red List Categories and Criteria of the IUCN

Anila PAPARISTO[1], Enilda SHKËMBI[2], Eltjon HALIMI[3], Bledar PEPA[4], Xhuljana QIRINXHI[5], Kastriot MISJA[6†]

[1,2,3] Tirana University, Faculty of Natural Sciences, ALBANIA. [1] Email: anila.paparisto@yahoo.com; [2] Email: enilda07@gmail.com; [3] Email: eltjon.halimi@fshn.edu.al; [4] University of Vlora "Ismail Qemali", Faculty of Natural Sciences, ALBANIA. Email: bledarpepa@gmail.com; [5] University of Korça "Fan S. Noli", ALBANIA. Email: xh.qirinxhi@yahoo.com; [6] In memory;

KEYWORDS: Odonata, Red list, Albania, IUCN criteria

The loss of biodiversity that the world faces today is one of the most important and discussed scientific problems. Half of the species on Earth will face difficulties to survive in the upcoming decades. The highest extinction risk is expected to be faced by insects. A recent study showed that in a global assessment about 10% of the world's dragonflies (order Odonata) would probably be regarded as Threatened (CR, EN or VU) and 35% as Data Deficient. Based on the European Red List of Dragonflies 15% or 1 of 7 European dragonflies is assessed as threatened. In this paper we are presenting data collected and analysed during the 2013–2018 period to show the status of a selected list of 25 dragonflies and damselflies (Odonata) from Albania which are part of the European Red List. Species determination still needs a revision, as all published and available data have been included. We used quantitative measures of the IUCN Red List Categories and Criteria to evaluate the local threat status of Odonata species for Albania and to classify Albanian odonata species into categories of extinction risk according to criteria of distribution, population abundance trends, rate of decline, geographic range information, and fragmentation. From the analysis performed, it results that: 8 species of odonates are assigned to the Least Concern category, constituting 11.4% of all species of Odonata for Albania; 3 species or 4.2% are assessed as Near Threatened; 4 species or 5.7% are assessed as Vulnerable; 3 species or 4.2% are assessed as Endangered; and 3 species or 4.2% are classified as Critically Endangered; whereas the other 4 species or 5.7% have been assessed as Data Deficient. As there are around half of the species of European odonata found in Albania, the results of this preliminary study show the need for a deeper assessment of all Albanian odonata status, based on the Red List Categories and Criteria of the IUCN quantitative measures.

Can Odonata promote conservation of intermittent rivers in the Mediterranean?

Marina VILENICA[1], Fran REBRINA[2], Lea RUŽANOVIĆ[2], Vesna GULIN[2] & Andreja BRIGIĆ[2]

[1] University of Zagreb, Faculty of Teacher Education, Petrinja, CROATIA. Email: marina.vilenica@gmail.com;
[2] University of Zagreb, Faculty of Science, Department of Biology, Zagreb, CROATIA.

KEYWORDS: dragonflies, threatened species, land use, diversity indices, conservation indices

Intermittent rivers, lotic habitats that cease to flow during dry periods of the year, make up a large proportion of the world's inland waters, and are an important source of water in dry regions, such as the Mediterranean. Odonata are widely used as a valuable tool for assessing freshwater ecosystems, as the structure and composition of their assemblages indicate the ecological health and integrity of a particular habitat, as well as also environmental change due to anthropogenic impact. With the aim of investigating the bioindicator value of Odonata for intermittent rivers in the Mediterranean and thus the conservation relevance of such habitats based on the assemblages they support, we studied adult Odonata at four intermittent Mediterranean rivers in the Dinaric Western Balkans ecoregion. We analysed various diversity and conservation indices, and recorded significant differences in Odonata species richness and Croatian Conservation Odonatological index between the studied rivers. Although the highest values of these parameters were recorded for a river with lowest land cover heterogeneity, and high share of anthropogenic land use, this river is also characterized by the highest habitat heterogeneity, reflected through well-developed aquatic vegetation, which can support life cycle completion of different Odonata species. Our study confirms the importance of habitat structure and of the presence of aquatic vegetation for Odonata conservation. The results presented could contribute to the development of conservation measures for Mediterranean Odonata and for intermittent freshwater habitats.

ECOO 2022

6th European Congress on Odonatology

27-30th June 2022 • Kamnik, Slovenia

List of participants

Altogether, 74 odonatologist or other nature enthusiasts are to participate at the ECOO 2022. Participants are coming from 25 countries from Europe and around the world – Albania, Australia, Austria, Belarus, Belgium, Bosnia and Herzegovina, Colombia, Croatia, Cyprus, Czech Republic, Finland, France, Germany, Hungary, India, Italy, the Netherlands, North Macedonia, Poland, Slovakia, Spain, Sweden, Ukraine, United Kingdom and Slovenia.

Surname and Name	Country	Email
Amaya-Vallejo Vanessa	COLOMBIA	stolenseason@gmail.com
Arguel Loan	FRANCE	loan.arguel@univ-tlse3.fr
Bahor Maja	SLOVENIA	mj.bahor@gmail.com
Balázs Attila	CZECH REPUBLIC	balazsaeko@gmail.com
Bedjanič Matjaž	SLOVENIA	matjaz.bedjanic@nib.si
Bílková Eva	CZECH REPUBLIC	evbilkova@gmail.com
Billqvist Magnus	SWEDEN	magnus.billqvist@gmail.com
Brochard Christophe	THE NETHERLANDS	c.brochard@bureaubiota.com
Buechner Thomas	GERMANY	tb10999@gmail.com
Burbach Klaus	GERMANY	k-burbach@web.de
Casagrande Luigi	AUSTRALIA	lcasa@bigpond.net.au
Conze Klaus-Jürgen	GERMANY	kjc@loekplan.de
Cordero-Rivera Adolfo	SPAIN	adolfo.cordero@uvigo.gal
Crucitti Pierangelo	ITALY	info@srsn.it
De Knijf Geert	BELGIUM	geert.deknijf@inbo.be
Díaz Cecilia	SPAIN	cdiaz.cuenca@gmail.com
Dijkstra Klaas-Douwe B.	THE NETHERLANDS	kddijkstra@gmail.com
Dinova Kitanova Despina	NORTH MACEDONIA	despinadi@gmail.com
Erbida Nina	SLOVENIA	nina.erbida@gmail.com
Fekete Judit	HUNGARY	juditfekete0307@gmail.com
Franković Matija	CROATIA	svanimir@yahoo.com
Friman Miikka	FINLAND	miikkafriman@gmail.com
Goertzen Diana	GERMANY	d.goertzen@tu-braunschweig.de
van Geest Floris	THE NETHERLANDS	fwvg@live.nl
van Grunsven Roy	THE NETHERLANDS	roy.vangrunsven@vlinderstichting.nl
Holuša Otakar	CZECH REPUBLIC	holusao@email.cz
Holzinger Werner	AUSTRIA	holzinger@oekoteam.at

Surname and Name	Country	Email
Hostnik Maja	SLOVENIA	maja.hostnik93@gmail.com
Immerschitt Isabelle	GERMANY	isabelle.immerschitt@t-online.de
Jeanmougin Martin	FRANCE	martin.jeanmougin@mnhn.fr
Kitel Denis	BELARUS	kitelden@gmail.com
Kogovšek Peter	SLOVENIA	kogovsek.pero@gmail.com
Komposch Brigitte	AUSTRIA	b.komposch@oekoteam.at
Kornová Veronika	CZECH REPUBLIC	ver.kornova@gmail.com
Koselj Klemen	SLOVENIA	klemen@koselj.si
Kotarac Mladen	SLOVENIA	mladen.kotarac@gmail.com
Križnar Matija	SLOVENIA	mkriznar@pms-lj.si
Kulijer Dejan	BOSNIA & HERZEGOVINA	dejan.kulijer@gmail.com
Kushnirenko Olena	UKRAINE	elenakushnirenko500@gmail.com
Louboutin Bastien	FRANCE	bastien.louboutin@insectes.org
Maria Pronina	UKRAINE	proninamaria2002@gmail.com
Martens Andreas	GERMANY	martens@ph-karlsruhe.de
Maruca Maria	AUSTRALIA	mmaruca@bigpond.com
Mayer Katrin	GERMANY	Katrin.Mayer@uni-bayreuth.de
Maynou Xavier	SPAIN	xavier.maynou@gmail.com
McFerran Damian	UNITED KINGDOM	damian.mcferran@nmni.com
Múrria Cesc	CATALONIA	cmurria@ub.edu
Myrenås Jonas	SWEDEN	jonas@myrenas.se
Nüß Ruth Ilka	GERMANY	r.nuess@uebersee-museum.de
Ober Stefan	GERMANY	stefan.ober@entoball.com
Ožana Stanislav	CZECH REPUBLIC	ozanastanislav@gmail.com
Paparisto Anila	ALBANIA	anila.paparisto@yahoo.com
Peitzner Gabi	GERMANY	gabi.peitzner@gmx.de
Peitzner Peter	GERMANY	peter.peitzner@gmx.de
Pirnat Alja	SLOVENIA	alja.pirnat@gmail.com
Prunier Florent	SPAIN	aeaelbosqueanimado.info@gmail.com
Rimcheska Biljana	NORTH MACEDONIA	rimceska@gmail.com
Rusu-Stiévenard Amélie	FRANCE	amelie.rusu-stievenard@insectes.org
Schiel Franz-Josef	GERMANY	franz-josef.schiel@inula.de
Schloemer Sara	GERMANY	sara.schloemer@gmx.net

Surname and Name	Country	Email
Sparrow David	CYPRUS	davidrospfo@hotmail.com
Sparrow Rosalyn	CYPRUS	rosalyn250@gmail.com
Strand John	SWEDEN	john.strand@hushallningssallskapet.se
Sydorova Nadia	UKRAINE	nadia.sydorova@gmail.com
Šácha Dušan	SLOVAKIA	dusan.sacha@vazky.sk
Šalamun Ali	SLOVENIA	ali.salamun@ckff.si
Šigutová Hana	CZECH REPUBLIC	sigutova.hanka@gmail.com
Tarkowski Adam	POLAND	tarkowski890@gmail.com
Tivadar Nika	SLOVENIA	tivadarnika@gmail.com
Tratnik Ana	SLOVENIA	annatratnik@gmail.com
Tyagi Brij Kishore	INDIA	abktyagi@gmail.com
van der Voort Wouter	THE NETHERLANDS	woutervandervoort@protonmail.com
Vilenica Marina	CROATIA	marina.vilenica@gmail.com
Vinko Damjan	SLOVENIA	damjan.vinko@gmail.com
van Wouwen Nick	THE NETHERLANDS	nickvanwouwen@gmail.com

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Notes

ICO2023 Paphos, Cyprus

25–30 June 2023

ICO2023 will be held in the coastal town of Paphos, on Cyprus, an island country in the eastern Mediterranean, which offers great value for money. The congress venue will be Neapolis University, which has modern facilities and onsite accommodation, and is located in a resort area with a variety of restaurants and shops. Budget hostels are also available nearby.

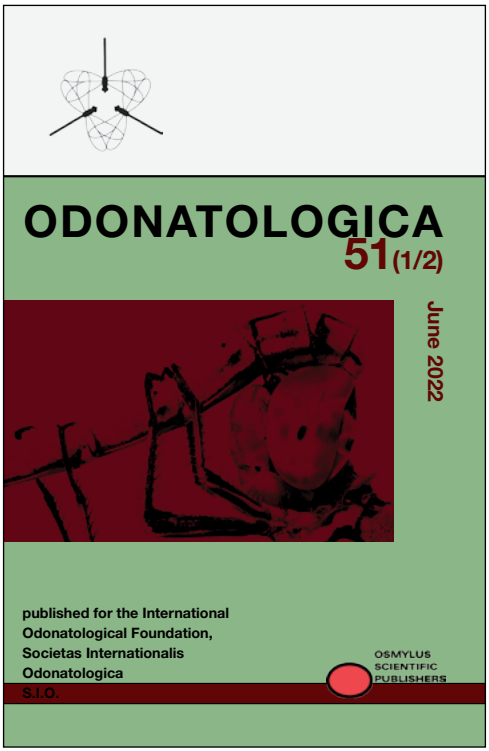
We'll get together at a welcome cocktail reception on the evening of Sunday 25 June 2023. There will be four days of presentations, workshops, poster sessions, discussion forums etc. The mid-congress field trip will explore sites mainly along the Diarizos River, the most species-rich among Cyprus' rivers, ascending into the Troodos Mountain area for a late lunch. The congress will close with our congress dinner on Friday 30 June. There will follow an optional 3-day post-congress field trip.

June is the optimum month for odonatologists to visit Cyprus, when dragonflies are most abundant. Cyprus has a modest 37 species of dragonflies, but a unique mix of European, Asian and African species. It is the only place in Europe where the rare *Ischnura intermedia* (Persian Bluetail) occurs and one of the few places in Europe where the charismatic species *Anax immaculifrons* (Magnificent Emperor), *Epallage fatime* (Odalisque) and *Caliaeschna microstigma* (Eastern Spectre) can be seen. Other species which should be on the wing include *Orthetrum chrysostigma* (Epaulet Skimmer), *Orthetrum sabina* (Slender Skimmer), *Orthetrum taeniolatum* (Small Skimmer), *Trithemis arteriosa* (Red-veined Dropwing) and *Trithemis festiva* (Indigo Dropwing).

Odonatologica

is the world's oldest international journal devoted to the study of dragonflies. Odonatologica publishes original papers in all fields of odonatology. It is a semi-annual journal, still published in an old-fashioned way primarily in print, on 1st June and 1st December, for the International Odonatological Foundation, Societas Internationalis Odonatologica (S.I.O.). It is regularly accompanied by the bulletin *Notulae odonatologicae*. The *Notulae* publishes minor original papers and short notes related to all aspects of odonatology: faunistics, taxonomy, book reviews, ethno-odonatology, etc. As of 2020, all *Odonatologica* and *Notulae* contents can also be accessed via the BioOne Complete database (*https://bioone.org/*). It is general policy that submitted papers will be refereed. Publication language is English.

For further information and subscription details see *https://osmylus.com/* and *https://www.odonatologica.com/*.



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Osmylus Scientific Publishers
Dr Florian Weihrauch
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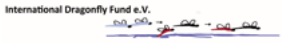
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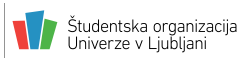
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