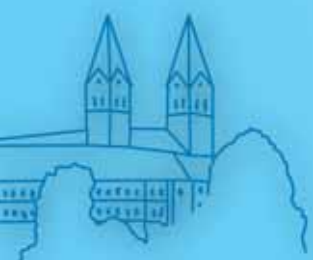

International Congress of Odonatology
2013
FREiSiNG

ICO 2013 Book of Abstracts

2013 International Congress of Odonatology

Freising, Bavaria, Germany
17th to 21st June 2013



2013 International Congress of Odonatology

Freising, Bavaria, Germany
17th to 21st June 2013

Person responsible for the organization

Dr Florian Weihrauch
Jägerstraße 21 A
85283 Wolnzach
Germany

on behalf of the
Gesellschaft deutschsprachiger Odonatologen
(GdO e.V.), Bremen, Germany

ICO 2013 is organized and conducted by the Society of German-speaking Odonatologists (GdO) together with the Bavarian Academy for Nature Conservation and Landscape Management (ANL) and in consensus with the International Odonatological Foundation, Societas Internationalis Odonatologica (S.I.O.), for the Worldwide Dragonfly Association (WDA).

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ICO 2013 Organizing Committee

Florian Weihrauch	*General organization, registration, correspondence, Congress programme*
Wolfram Adelmann	*General organization, Post-Congress Tour*
Christian Stettmer	*General organization, Post-Congress Tour*
Klaus Burbach	*General organization, Mid-Congress Tour*
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Peter Peitzner	*Conference equipment*
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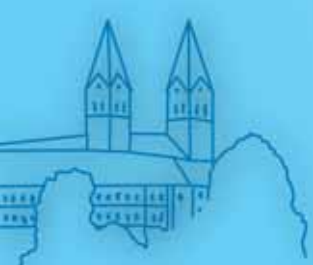


General information

Congress venue
Bildungszentrum Kardinal-Döpfner-Haus, Domberg 27, 85354 Freising, Germany

Congress office

Room 407, 4th floor; phone +49 (0)160 951 842 07 (F. Weihrauch)

Registration and opening hours:

Sunday, 16 June 2013: 14:00 – 20:00

Monday, 17 June 2013: 07:30 – 18:00

Tuesday, 18 June 2013: 08:30 – 18:00

Wednesday, 19 June 2013: 08:30 – 09:30

Thursday, 20 June 2013: 08:30 – 12:30

Friday, 21 June 2013: 08:30 – 09:30

and upon request.

Meals and drinks
Lunches, coffee during the breaks (morning, afternoon), and table water in the assembly hall are included in all congress packages. For attendees with accommodations in the congress venue, breakfast and dinner are also included. All meals are served in the dining-hall on the 2nd floor. Coffee is served during the breaks in front of the chapel on the 3rd floor. Drinks during lunches and dinners have to be paid separately.

Congress Dinner
The official Congress Dinner has to be paid separately and will be held on Thursday, 20 June 2013, in a country inn outside Freising. The price includes the transfers and table water, table wine, beers, soft drinks and coffee. Transport will be arranged by two buses, leaving from the city bus stop, where the downhill footway from the 'Domberg' (clerical hill) reaches the 'Bahnhofstraße'. Please note that our buses will leave from there absolutely on time (in the true German sense), because they are only allowed to stay at the bus stop for boarding. Make sure to be there on time!

ICO 2013 Grants

In order to promote preferably young researchers from developing countries without their own funding possibilities, who however should attend ICO 2013 from a scientific point of view, ICO 2013 has offered five grants for free participation in the congress. Out of a list of 13 applicants, the Scientific Committee chose five awardees by anonymous election.

The ICO 2013 Grants have been awarded to:

Cornelio Andrés Bota-Sierra, Colombia;

Rhainer Guillermo-Ferreira, Brazil;

Tabita Termiati Makitan, Indonesia;

Ângelo Parise Pinto, Brazil;

Monica Torres-Pachón, México.

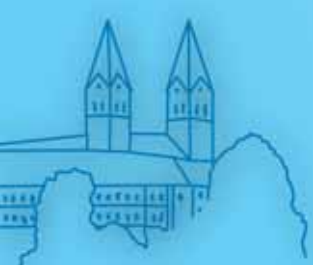
ICO 2013 explicitly thanks all other applicants for their efforts and apologises that, unfortunately, it was impossible to consider everyone who would have deserved the grant as well.

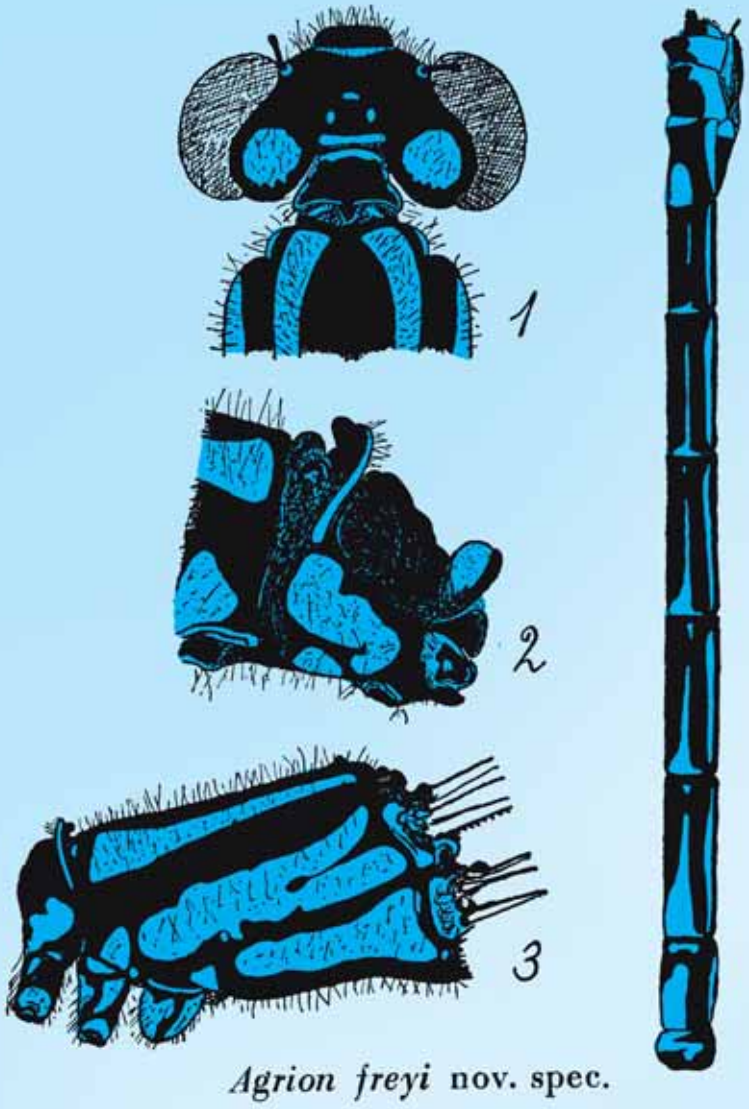
ICO 2013 Awards

The best three oral presentations by young researchers (aged 30 years or younger, *i.e.*, born after the 21 June 1983; please apply for the award in the Congress Office if you give a presentation and are born after that date!) and the best three poster presentations will receive the ICO 2013 Awards during the Farewell Session at the end of the congress. The former will be chosen by an international jury of five persons; the latter will be elected by an anonymous vote of all attendees. The ICO 2013 Awards comprise a cash prize and a fine dragonfly book, respectively. Special thanks to Kiyoshi Inoue, President of the S.I.O., for his generous sponsoring, which made the ICO 2013 Awards possible!

ICO 2013 Portraits

We have the ambition to photograph each attendee of ICO 2013 during the congress as a documentation of portraits. Therefore, we would highly appreciate if attendees will agree that a picture of them can be taken.
The photo sessions will take place on enquiry in the poster hall.



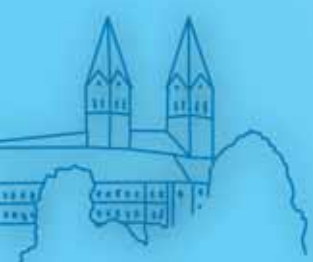


Details of "*Agrion freyi* Bilek".

Taken from:
Bilek A. 1954. Eine neue Agrionide aus Bayern (Odonata).
Nachrichtenblatt der bayerischen Entomologen 3: 97-99 (modified with colour)

Sunday, 16th June 2013

14:00	Registration
18:30	Dinner
20:00	Public lecture in the assembly hall:
	Film by Dagmar Hilfert-Rüppell and Georg Rüppell (in German language)



Monday, 17th June 2013

07:30 Registration

09:00 Opening and welcome words
Melanie Huml (State Secretary, Bavarian State Ministry of the Environment and Public Health)

09:30 **Session 1. The home match: Alpine odonatology.**
Chair: Christian Stettmer

09:30 1.1 Alois Bilek and the tale of the congress logo
Florian Weihrauch

09:45 1.2 Siberia in the Alps: Recent status, habitat requirements, and conservation of *Coenagrion hylas* in Central Europe
Armin Landmann

10:00 1.3 Restoration of peat bogs and protection of *Nehalennia speciosa* in Bavaria: A conflict in targets?
Michael Winterholler, Gerhard Suttner

10:15 1.4 *Somatochlora alpestris* – a dragonfly at its ecological limits
Hansruedi Wildermuth

10:30 **Coffee break**

11:00 **Session 2. Morphology and physiology**
Chair: Sönke Hardersen

11:00 Plenary talk:
2.1 To attach, to protect, to advertise: micro- and nanostructures of dragonflies as possible basis for biomimetics
Stanislav N. Gorb

11:45 2.2 Functional morphology aspects of the mating behavior of Odonata
Jana Willkommen, Jan Michels, Markus Heneka, Stanislav N. Gorb

12:00 2.3 Dragonfly wing veins: a composite structure supplemented by resilin
Esther Appel, Chung-Ping Lin, Stanislav N. Gorb

12:15 Commemorating Anatoly Haritonov and Gordon Pritchard: A minute's silence
Henri J. Dumont

12:30 **Lunch**

Monday, 17th June 2013

14:00 **Session 2. Morphology and physiology**
Chair: Stanislav N. Gorb

14:00 2.4 The sensory systems of Odonata: perceiving the world through the eyes and more…
Manuela Rebora, Silvana Piersanti, Elda Gaino

14:15 2.5 A new insight in the chemical ecology of insects: the role of chemical cues in 'visual dependent insects'
Silvana Piersanti, Francesca Frati, Manuela Rebora, Eric Conti, Elda Gaino, Gianandrea Salerno

14:30 2.6 Wing length allometry in Odonata – differences between families and in relation to migratory behavior
Sönke Hardersen, Roberto Sacchi

14:45 2.7 The thorax musculature of Odonata and the homology with Neoptera
Sebastian Büsse, Thomas Hörnschemeyer

15:00 **Session 3. Phylogeny of dragonflies: is the final battle about to begin?**
Convenors: Klaas-Douwe B Dijkstra, Vincent J. Kalkman
Chair: Klaas-Douwe B. Dijkstra

15:00 3.1 General introduction; progress on dragonfly phylogeny in the last decade
Michael L. May

15:15 3.2 Phylogeny of the Calopterygidae
Henri J. Dumont

15:30 3.3 Phylogeny and biogeography of the Platystictidae
Jan van Tol, Matjaž Bedjanič, Klaas-Douwe B. Dijkstra, Vincent J. Kalkman, Frank R. Stokvis

15:45 3.4 Megapods to smithereens
Vincent J. Kalkman, Klaas-Douwe B. Dijkstra, Rory A. Dow, Frank R. Stokvis, Jan van Tol

16:00 **Coffee break**

Monday, 17th June 2013

16:30	**Session 3. Phylogeny of dragonflies: is the final battle about to begin?** **Chair: Vincent J. Kalkman**
16:30	3.5 Phylogeny of Coenagrionoidea **Klaas-Douwe B. Dijkstra,** Vincent J. Kalkman, Rory A. Dow, Frank R. Stokvis, Jan van Tol
16:45	3.6 Extraordinary level of species diversity in Vietnamese Chlorogomphidae and Cordulegastridae and recent developments in their taxonomy **Haruki Karube**
17:00	3.7 An insight into the phylogeny of basal Anisoptera families **Günther Fleck**
17:15	3.8 Phylogeny of Libelluloidea: Why so many? **Jessica L. Ware**
17:30	3.9 The relevance of palaeontological data for understanding the age and origin of extant odonates **Günter Bechly**
17:45	3.10 Towards the final tree **Seth M. Bybee**
18:00	Discussion
19:00	**Dinner**
20:00	International Journal of Odonatology, Editorial Board meeting

Tuesday, 18th June 2013

08:30	Registration
09:00	**Session 4. Ethology** **Chair: Yoshitaki Tsubaki**
09:00	**Plenary talk:** 4.1 Why migrate? Frost, flood, fish, and food. **Michael L. May**
09:50	4.2 Riding on floatsam: odonate larvae in the drift **Andreas Martens**
10:10	4.3 Colouration and presentation: wing clapping in the Calopterygoidea **André Günther**
10:30	**Coffee break**
11:00	**Session 4. Ethology** **Chair: Sónia Ferreira**
11:00	4.4 Film: Female refusal behaviour **Dagmar Hilfert-Rüppell**, Georg Rüppell
11:25	4.5 The contributions of male mate choice to the maintenance of female polymorphism in damselflies **Jennette Fox**, Arne Iserbyt, Stefan Van Dongen, Tom Sherratt, Christopher Hassall
11:40	4.6 Pre- and postmating prezygotic barriers in heterospecific interactions between closely related damselflies **Iago Sanmartín-Villar**, Adolfo Cordero-Rivera, Rosa Ana Sánchez-Guillén
11:55	4.7 Damselfly females prefer hot males: higher courtship success of males in sun spots **Yoshitaka Tsubaki**, Yuka Samejima, Michael T. Siva-Jothy
12:10	Discussion
12:20	Congress group photograph in the inner courtyard
12:30	**Lunch**

Tuesday, 18th June 2013

14:00 **Session 5. Odonomics**
Convenors: M. Olalla Lorenzo-Carballa, Phillip C. Watts
Chair: M. Olalla Lorenzo-Carballa, Phillip C. Watts

14:00 5.1 Transcriptomic response to extreme genetic erosion in a threatened damselfly
Phillip C. Watts, M. Olalla Lorenzo-Carballa, David J. Thompson

14:15 5.2 Genomics of the polymorphic damselfly *Ischnura elegans*
Maren Wellenreuther

14:30 5.3 DNA and morphology to disentangle species boundaries in Antillean damselflies of the genus *Hypolestes* (Megapodagrionidae)
Yusdiel Torres Cambas, **M. Olalla Lorenzo-Carballa**, Sónia Ferreira, Phillip C. Watts, Adolfo Cordero-Rivera

14:45 5.4 Thinking forward: defining, approaching, and solving the current problems in odonate higher level phylogeny using next generation techniques
Seth M. Bybee

15:00 Discussion

15:10 **Brief poster presentations I**
Chair: Florian Weihrauch

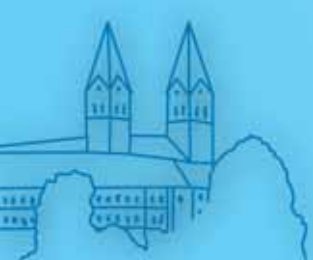
Sequence: 13.1, Andrew; 13.4, Bakare; 13.8, Dhamani; 13.23, Steinhoff; 13.11, Gołąb; 13.18, Lorenzo-Carballa; 13.17, Watts; 13.19, Salerno; 13.21, Sánchez-Herrera; 13.5, Bota-Sierra; 13.7, Carvalho; 13.2, Andrew

16:00 **Coffee break**

Tuesday, 18th June 2013

16:30	**Session 6. Neotropics** **Chair: Joachim Hoffmann**
16:30	6.1 Evolution and behavioral ecology of Neotropical damselflies **Rhainer Guillermo-Ferreira**, Pitágoras C. Bispo
16:45	6.2 A preliminary phylogenetic analysis of some *Argia* Rambur 1842 (Odonata: Coenagrionidae) species based on larval morphology **Mónica Torres-Pachón**, Rodolfo Novelo-Gutiérrez
17:00	6.3 A cladistics analysis of Sympetrinae Tillyard, 1917, with an emphasis in the group of specialized femoral armature: the genera of 'Erythemismorpha' (Odonata: Libellulidae) **Ângelo Parise Pinto**, Alcimar do Lago Carvalho, Carlos José Einicker Lamas
17:15	6.4 The genus *Mesamphiagrion* Kennedy, 1920, in Colombia (Odonata: Coenagrionidae), with the description of four new species **Cornelio Andrés Bota-Sierra**, Martha Isabel Wolff Echeverri
17:30	6.5 Rubyspots: an interesting disparity between morphology and molecules **Melissa Sánchez-Herrera**, Mayra Saenz, Emilio Realpe, Jessica L. Ware
17:45	6.6 Radiation despite niche conservatism in the Neotropical damselfly genus *Megaloprepus*? **Wiebke Feindt**, Tina Baake, Ola M. Fincke, Heike Hadrys
18:00	6.7 Cuatro Ciénegas, Coahuila: An oasis of dragonfly diversity in a Mexican desert **Enrique González-Soriano**, Héctor Ortega-Salas, Marysol Trujano-Ortega
18:15	Discussion
19:00	**Dinner**

20:00	IUCN Dragonfly Specialist Group meeting



Wednesday, 19th June 2013

08:30	Registration
09:00	**Session 7. Mixed bag** **Chair: Enrique González-Soriano**
09:00	**Plenary talk:** 7.1 Biotic interactions with Odonata: a review on parasitism and commensalism **Andreas Martens**
10:10	**Departure to the Mid-Congress Tour**

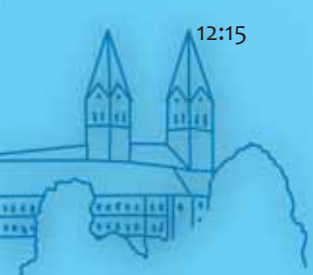
Buses will leave at the city bus stop, where the downhill footway from the 'Domberg' (clerical hill) reaches the 'Bahnhofstraße'. Please note that our buses will leave from there absolutely on time (in the well-known German sense of punctuality!) because they are only allowed to stay at the bus stop for boarding. Make sure to be there on time!

Route of the Mid-Congress Tour from Freising with the three stops 'Vorflutgraben Nord' (drainage ditch of Munich Airport), Kieswerk Gutbrod (gravel pit ponds), and an oxbow lake near Thonstetten, indicated by red dots.

***ca* 12:30**	**Lunch in the field; lunch packs will be provided**
ca 17:30	Return from the Mid-Congress Tour to the Domberg
18:00	WDA Board of Trustees meeting
18:30	**Dinner**
20:00	8th Biennial General Meeting of the Worldwide Dragonfly Association

Thursday, 20th June 2013

08:30	Registration
09:00	**Session 7. Mixed bag** **Chair: Jessica L. Ware**
09:00	7.2 Film: Dragonfly reactions to frog attacks **Georg Rüppell**, Dagmar Hilfert-Rüppell
09:30	7.3 Edmond de Selys Longchamps, founder of Odonatology **Marcel Wasscher**
09:45	7.4 Demons or angels: dragonfly symbolism in the early 17th century still lifes in the Low Countries **Alcimar do Lago Carvalho**
10:00	7.5 An automated system for identifying dragonflies from wings **William R. Kuhn**, Nidhi Dharithreesan, Gareth Russell
10:15	7.6 Dragonflies and cities – species occurrence and diversity in urban habitats **Diana Goertzen**
10:30	**Coffee break**
11:00	**Session 8. Conservation and management** **Convenors: Christian Stettmer, Hansruedi Wildermuth** **Chair: Hansruedi Wildermuth**
11:00	8.1 A conservation program in the Mediterranean for *Lestes macrostigma* **Philippe Lambret**
11:15	8.2 Conservation of *Coenagrion mercuriale* in Switzerland: research and management **Daniela Keller**
11:30	8.3 Distribution and threats to the populations of *Caliaeschna microstigma* (Schneider, 1845) at the western edge of its range **Marina Vilenica**, Dejan Kuljer, Despina Kitanova
11:45	8.4 Habitat conservation for *Cordulegaster heros* in the Czech Republic (Odonata: Cordulegastridae) **Kateřina Holušová**, Otakar Holuša
12:00	8.5 Distribution and protection of dragonflies of European conservation concern in Bosnia and Herzegovina **Dejan Kulijer**, Geert de Knijf, Matija Franković
12:15	8.6 The Dragonfly Association Index – a new tool for the type-specific assessment of lowland rivers **Andreas Chovanec**, Johann Waringer



Thursday, 20th June 2013

12:30	**Lunch**
14:00	**Session 8. Conservation and management** **Chair: Michael J. Samways**
14:00	8.7 An overview on the protection of dragonflies (Odonata) in Europe **Geert De Knijf**
14:15	8.8 Dragonflies – guardians of the rice fields **Jürgen Ott**
14:30	8.9 How are Australia's listed dragonflies doing? **Günther Theischinger**
14:45	Discussion
15:00	**Session 9. Biodiversity** **Chair: Michael J. Samways**
15:00	9.1 Molecular phylogenetic analysis of the Libellulidae of Mizoram, north-eastern India, using mitochondrial Cytochrome Oxidase I gene marker **Laltanpuii**, Manu Thomas Mathai, N. Senthil Kumar
15:15	9.2 Contrasting the diversity of odonates in the five islands within the Straits of Malacca **Farizawati Sabri**, A.G. Idris, Y. Norma-Rashid, Y.F. Ng
15:30	9.3 Population, distribution, and habitat characteristics of *Zyxomma obtusum* in the City and Regency of Malang, East Java (Odonata: Libellulidae) Bernadeta Putri Irma Dalia, Magdalena Putri Nugrahani, **Tabita T. Makitan**
15:45	9.4 Characteristics of the odonate assemblages of African biomes **Frank Suhling**
16:00	**Coffee break**
16:30	**Brief poster presentations II** **Chair: Florian Weihrauch**
	Sequence: 13.6, Bota-Sierra; 13.3, Sánchez-Herrera; 13.20, Salerno; 13.13, Hartung; 13.15, Holuša; 13.9, Fliedner; 13.10, Hardersen; 13.12, Golfieri; 13.16, Kulijer; 13.22, Schloemer
17:00	**Poster session**

Thursday, 20th June 2013

18:20 **Departure to the Congress Dinner**

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19:00 **Congress Dinner**

The Congress Dinner will take place in a Bavarian country inn. Table water, soft drinks, beers, table wine, and coffee are included in the price. The dinner is supposed to be a cheerful and festive event. Since Bavarians prefer to be more informal, there is no dress code, and casual clothing is perfectly acceptable. Everyone should feel comfortable!

ca 22:30 **Departure of the first bus to Freising,** arrival at the Domberg *ca* 23:00

ca 23:30 **Departure of the second bus to Freising,** arrival at the Domberg *ca* 24:00

Friday, 21st June 2013

08:30 Registration

09:00 **Session 10. Life histories**
Chair: Frank Suhling

09:00 **Plenary talk:**
10.1 Life history patterns revisited: Seasonal regulation and cohort splitting in temperate-zone Odonata
Ulf Norling

09:50 10.2 Larval development of six European *Lestes* species
Franz-Josef Schiel

10:10 10.3 Photoperiod and variation in developmental rates in core and peripheral populations of the damselfly *Lestes sponsa*
Szymon Śniegula, Frank Johansson

10:30 Coffee break

11:00 **Session 10. Life histories**
Chair: Andreas Martens

11:00 10.4 A model for simulating dragonfly life cycles: application for studying latitudinal compensation hypotheses
Frank Suhling, Otto Richter, Juliane Kellner, Ida Suhling

11:20 **Session 11. Ecology**
Chair: Andreas Martens

11:20 11.1 Predation and pollution in a warming world: what can we learn from latitudinal gradients?
Robby Stoks

11:40 11.2 Farmland versus forest: comparing changes in Odonata species composition in western and eastern Sweden
Kamilla Koch, Göran Sahlén

12:00 11.3 Habitat selection of larval *Macromia clio* and *M. daimoji* in Taiwan (Odonata: Macromiidae)
Klaus Guido Leipelt

12:15 11.4 Sex-ratios, survivorship, and phenology in a sexual population of *Ischnura hastata* from Cuba (Odonata: Coenagrionidae)
M. Olalla Lorenzo-Carballa, Yusdiel Torres Cambas, Adolfo Cordero-Rivera

12:30 Lunch

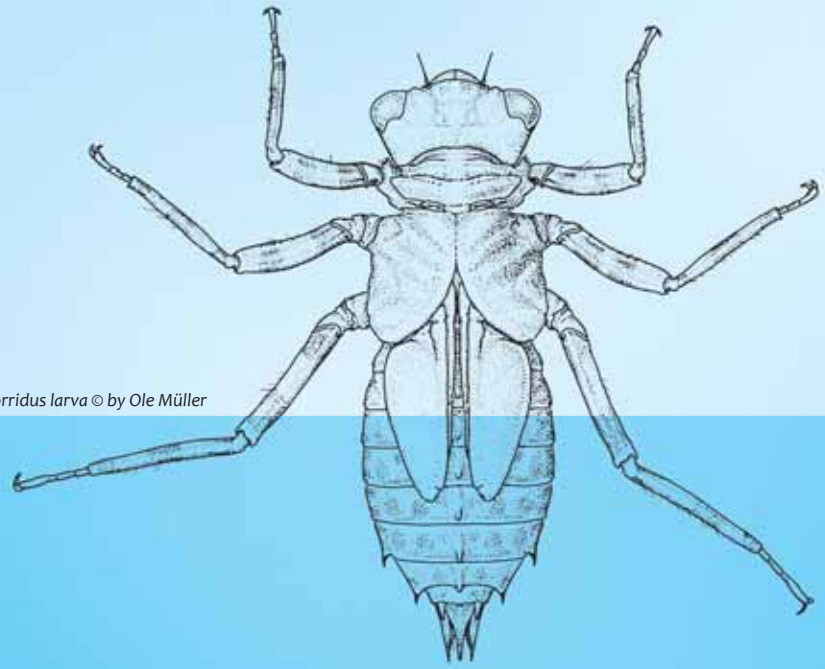
13:30 WDA Board of Trustees meeting

Friday, 21st June 2013

14:00	**Session 11. Ecology** **Chair: John Hawking**
14:00	11.5 Field notes on the oviposition of *Ceriagrion coromandelianum* (Fabricius) in central India (Odonata: Coenagrionidae) **Raymond J. Andrew**
14:15	11.6 Embryonic development and inter-specific predation in three species of the genus *Sympetrum* **Hiroshi Jinguji**
14:30	11.7 The impact on domestic dragonflies by invasive alien species: examples from Japan with the recent expansion of an alien damselfly **Haruki Karube**, Fukui Motoharu
14:45	Discussion
15:00	**Session 12. Watch the dragon, see the change:** **Odonates as indicators of ecological integrity and climate change** **Convenors: Jürgen Ott, John P. Simaika** **Chair: John Hawking**
15:00	12.1 Watch the dragon, see the change **John P. Simaika**
15:20	12.2 How to monitor the unknown **Jürgen Ott**
15:40	12.3 Placing the Odonata in the context of the biological response to environmental change: a case study using UK records **Christopher Hassall**
16:00	**Coffee break**
16:30	**Session 12. Watch the dragon, see the change** **Chair: Jürgen Ott, John P. Simaika**
16:30	12.4 Getting the measure of freshwaters using dragonflies in a changing world **Michael J. Samways**, John P. Simaika
16:45	12.5 Use of DBI in southern South America: first steps in Argentina Javier Muzón, **Federico Lozano**
17:00	12.6 Dragonfly monitoring in the Netherlands: abundance trends versus distribution trends **Tim Termaat**, Arco J. van Strien, Vincent J. Kalkman

Friday, 21st June 2013

17:15	12.7 Can post-mining areas be considered 'secondary biodiversity hotspots'? Dragonflies already know the answer **Filip Harabiš**, Aleš Dolný
17:30	12.8 First results of dragonfly monitoring via an 'Ecological Area Sample' in North Rhine-Westphalia, Germany **Klaus-Jürgen Conze**
17:45	Discussion
18:15	ICO 2013 Awards
18:30	Closing and farewell words
19:00	**Dinner**



Zygonyx torridus larva © by Ole Müller

Post-Congress Tour in Laufen a.d. Salzach

Saturday, 22nd June 2013

»Pre-Alpine highlights of Upper Bavaria«

1st stop: Fens and bogs in former peat production area near Bad Aibling, guided by Klaus Burbach and Florian Weihrauch – expected highlight species: *Nehalennia speciosa*. 2nd stop: Fish ponds »Wasserwiesen«, guided by Klaus Burbach and Florian Weihrauch – expected highlight species: *Orthetrum albistylum* and other typical pond species. Field trip to the »Schönramer Filz« fen, guided by Christian Stettmer and Florian Weihrauch – expected highlight species: *Leucorrhinia dubia*.

Welcome meeting – Congress room of the Kapuzinerhof: Introducing the Bavarian Academy for Nature Conservation and Landscape Management (ANL; Dr. Christian Stettmer and Dr. Wolfram Adelmann); Welcome by the director of the Academy, Dr. Christoph Goppel.

Sunday, 23rd June 2013

»King Ludwig II tour«

Field trip to lakes and fens of the »Seeoner Seenplatte« (Seeon lake region), guided by Klaus Burbach and Florian Weihrauch – Expected highlight species: *Aeshna isoceles*, *Leucorrhinia caudalis*, *L. pectoralis* and *Libellula fulva*. Prien harbour on lake Chiemsee. Boat trip to the »Herrenchiemsee« island. Guided tour to the palace of King Ludwig II on Herrenchiemsee. Boat trip to the »Frauenchiemsee« island, enjoying the flair of a `Biergarten´ on lake Chiemsee; option to have dinner (self-service). Boat trip to Gstadt harbour.

Monday, 24th June 2013

»Watzmann tour«

Berchtesgaden National Park– guided tour with Dr. Michael Vogel (Head of the National Park). Boat trip on the lake »Königssee« to St. Bartholomä – Tasting at the `Fischerwirt´ (Specialty: smoked char or trout). Walk to the alp »Fischunkel«, lunch (alpine specialty). Depature to Schönram with short field trip to creeks and lakes in the pre-alpine region around Berchtesgaden. Visit to the brewery »Landbrauerei Schönram«; guided tour by master brewer Eric Toft and tasting of very special Bavarian beers.

Tuesday, 25th June 2013

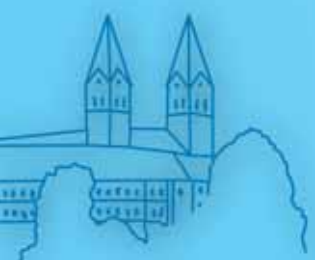
»Salzach tour«

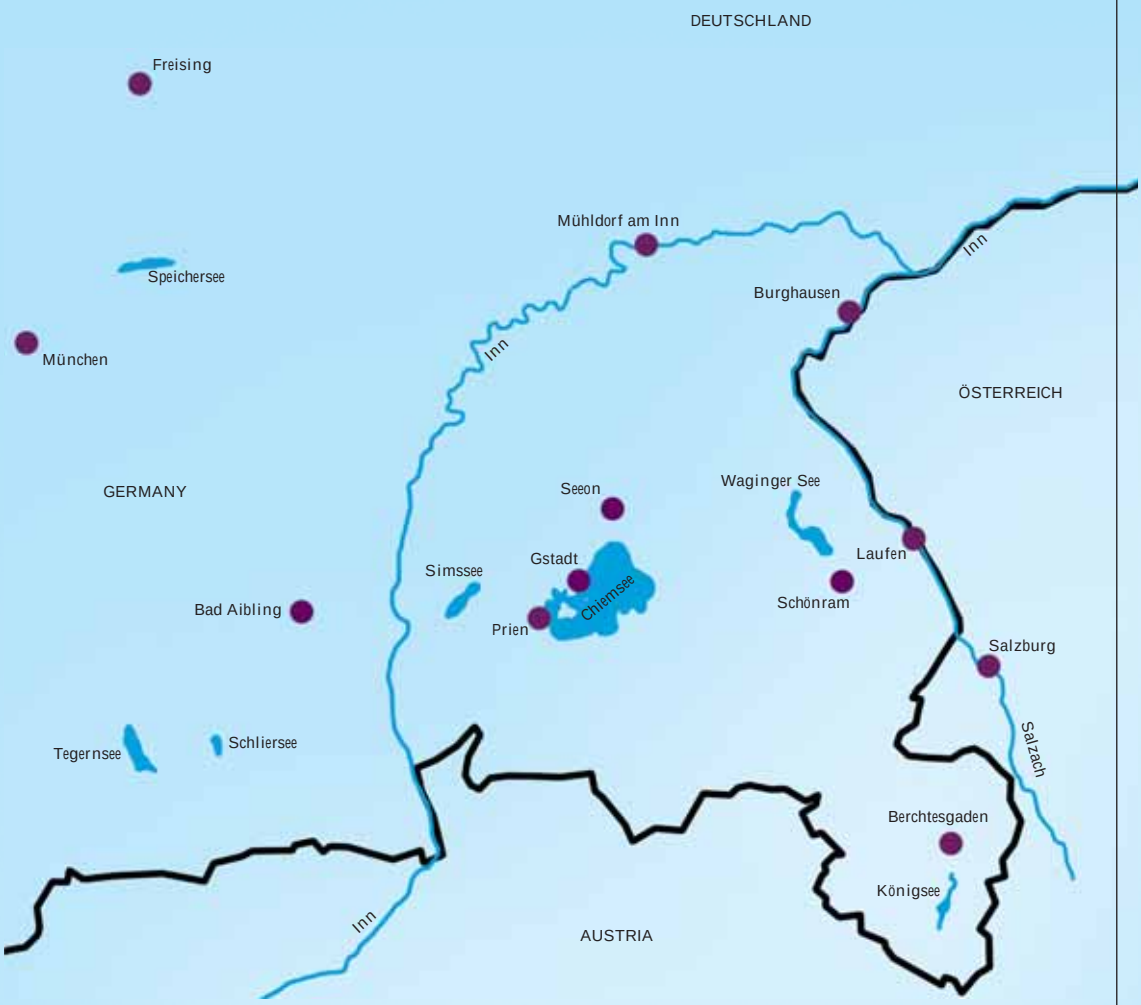
Field trip to the survey and research station »Straß« of the Bavarian Academy for Nature Conservation and Landscape Management (guided by Christian Stettmer) – Expected highlight: mass occurrence of *Calopteryx splendens*. Field trip to river Salzach in Austria (Visa!) – Riverine and alluvial ecosystems. Salzburg: Unguided sightseeing of Salzburg city and free time; open end and self-organised return to Laufen (Germany) or Oberndorf (Austria) by local train.

Wednesday, 26th June 2013

»Good bye«

Good bye – typical Bavarian breakfast with »Weißwürste and Weißbier« at the Kapuzinerhof – Review of the Post-Congress Tour and plans for the future.





Congress		Mid-Congress Tour		Congress		Post- Congress Tour				
monday	*tuesday*	*wednesday*	*thursday*	*friday*	*saturday*	*sunday*	*monday*	*tuesday*	*wednesday*
17th June	18th June	19th June	20th June	21st June	22nd June	23rd June	24th June	25th June	26th June

International Congress of Odonatology
2013
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17-26 JUNE 2013

Book of Abstracts

2013 International Congress of Odonatology

Freising, Bavaria, Germany
17th to 21st June 2013

01 The home match: Alpine odonatology

1.1 Alois Bilek and the tale of the congress logo

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The logo of the 2013 International Congress of Odonatology depicts part of illustrations from the original description of the only species that has ever been described in Bavaria, namely *Coenagrion freyi*, by the Bavarian musician and entomologist Alois Bilek. The first record of this species, seemingly new to science, was a female collected in south-eastern Bavaria, at Lake Zwingsee near Bad Reichenhall, on 28th July 1952. The completely unknown specimen was subsequently sent to the British Museum in London (NHM) and examined by Cynthia Longfield and Douglas E. Kimmins, who commented that this species was not present in the NHM collection and therefore was most likely still nameless. The description (Bilek 1954) then was based on this specimen plus a series of five other females taken at the same site during 1953. The species was named in honour of Georg Frey, a wealthy industrialist from Munich, who was also a renowned coleopterist and odonatologist and an important patron of entomology. Frey had contributed to this series personally with the collection of two females. The first males were collected on 25th June 1955 and immediately described (Bilek 1955). However, in this paper Bilek already noted that *C. freyi* was »most closely related to the Asian *Agrion hylas* Trybom (1899)«. This assessment was soon exceeded by Schmidt (1956), who supposed that the Bavarian specimens of *C. freyi* were in fact conspecific to this Asian species, and one decade after its first discovery in the Alps, the true identity of this taxon as a postglacial relict population of *Coenagrion hylas* was widely acknowledged (Lieftinck 1964). The population at Lake Zwingsee became extinct in 1967.

However, the impact of Alois Bilek (1st March 1909 – 26th September 1974) on the odonatology of Bavaria and all of Europe goes far beyond this contribution; for a detailed appraisal see the obituary by Harz (1978). Although Bilek was a professional classical musician and a celebrated pianist and organist – at the age of nine, he had already publicly performed Mozart's Piano Concerto No. 26 ("Coronation") by heart, and was praised by the critics as a wunderkind – he had also been an enthusiastic naturalist since he was a small boy. Especially his skills as an insect breeder, a taxidermist, and generally an extremely accurate observer of nature were tremendous. In addition, since his early years he restlessly made innumerable field trips in Bavaria, the Alpine and Pre-Alpine region, and later, throughout Europe. For example, when in 1960 the news reached him that Gerhard Jurzitza had found *Aeshna subarctica* – a species unknown from Bavaria at that time, in the Black Forest, the next day he made the 350 km trip to the recording site on his motorcycle to see the species personally. He observed almost each European dragonfly species in its natural environment, including species such as *Macromia splendens* and *Lindenia tetraphylla*, for

Figure 1. Alois Bilek in the late 1960's. Photo by courtesy of G. Jurzitza

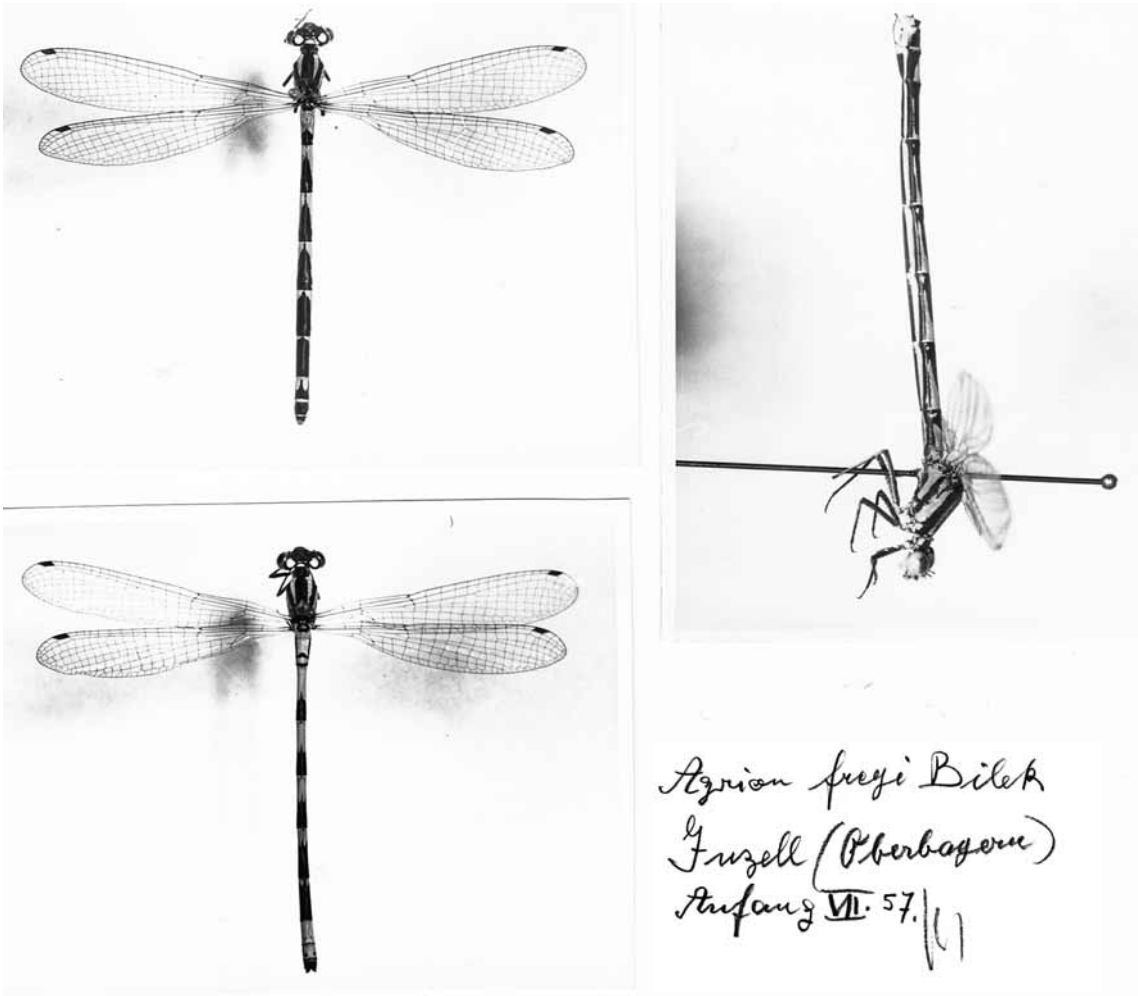


Figure 2: Specimens of „*Agrion freyi* Bilek“ from its locus typicus, the Lake Zwingsee in Bavaria, collected early July 1957, and Bilek's original script on the backside. Photos: A. Bilek

which extremely little general knowledge was available at the time. In 1956, he finally made a profession out of his passion and took on a position at the Zoological State Collection in Munich. Until his retirement in 1974, shortly before his sudden and unexpected death, he published several 'classical' papers on recording trips to the Balkans and southern France. However, with regard to his activities and his capabilities, Bilek's publication record with 40 papers (27 on the Odonata; Harz 1978) was only small and does by no means reflect the significance of his impact on European dragonfly research.

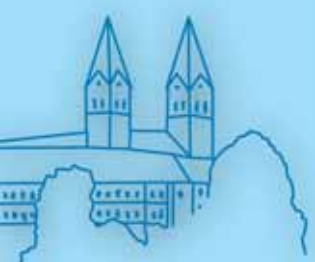
Bilek A. 1954. Eine neue Agrionide aus Bayern (Odonata). Nachrichtenblatt der bayerischen Entomologen 3: 97-99

Bilek A. 1955. Das bisher unbekannte Männchen von Agrion (= Coenagrion) freyi Bilek 1955 (Odon.). Nachrichtenblatt der bayerischen Entomologen 4: 89-91

Harz K. 1978. In Memoriam Alois Bilek, 1909-1974. Articulata 1: 35-46

Lieftinck MA. 1964. Aantekeningen over Coenagrion hylas (Trybom) in Midden-Europa (Odonata, Coenagrionidae). Tijdschrift voor Entomologie 107: 159-166, pls 18, 19

Schmidt E. 1956. Über das neue Agrion aus Bayern (Odonata). Entomologische Zeitschrift 66: 233-234



1.2 Siberia in the Alps: Recent status, habitat requirements, and conservation of *Coenagrion hylas* in Central Europe

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The Siberian damselfly *Coenagrion hylas* is a postglacial relict in Europe, a representative of a cold-stenothermal fauna that probably inhabited the continent during the late Pleistocene and early Holocene (Bernard & Daraż 2010). Although a few records of *C. hylas* exist in Russia west of the Urals, this East Asian species has only an extremely limited distribution in Central Europe. After its extirpation at its first European recording site, Lake Zwingsee in southern Bavaria in 1967, the species was rediscovered 1973 in the Northern Calcareous Alps of Tyrol, Austria, by Heidemann (1974). This region is still the sole stronghold of this endangered damselfly in Europe. However, only three sites with occurrence had been known there until the late 1990s. In the meantime, about 15 different sites of *C. hylas* have been discovered in North Tyrol, including one in the Central Alps (Landmann et al. 2005). These new findings have also broadened our knowledge and understanding of the ecology of *C. hylas* in general, and specifically of its niche characteristics and habitat demands (Müller 2001; Landmann et al. 2005).

This presentation, on the one hand, summarizes the hitherto known patterns of altitudinal and horizontal distribution of *C. hylas* in the Alps, gives a pictured overview of the range of habitats inhabited, and outlines the Odonata communities accompanying this species.
On the other hand, the presentation informs about on-going conservation efforts for *C. hylas* in Tyrol. It should be kept in mind that this species is one of the very few damselflies listed in Annex II of the EU habitats directive and is therefore regarded to deserve special protection on an international scale. Accordingly, conservation programs and habitat management measures have been put forward for one part of the range of *C. hylas* during the last decade in the course of an EU LIFE project (2001-2007). A new conservation program in this area is on the way. In another part of the Tyrolean range, careful habitat alterations took place in 2012 at an isolated, but important reproduction habitat of *C. hylas*. Overall, there are at present no indications of severe population declines, and this Siberian damselfly seems to be safe in the Tyrolean Alps for now. However, as only few sites with healthy reproductive populations exist, and as there is strong human pressure on all aquatic habitats in this touristically overexploited part of the Alps, future precautions are imperative.

Bernard R, & Daraż B. 2010. Relict occurrence of East Palaearctic dragonflies in northern European Russia, with first records of Coenagrion glaciale in Europe (Odonata: Coenagrionidae). International Journal of Odonatology 13: 39-62, pl. I

Heidemann H. 1974. Ein neuer europäischer Fund von Coenagrion hylas (Trybom) (Zygoptera: Coenagrionidae). Odonatologica 3: 181-185

Landmann A, Lehmann G, Mungenast F, Sonntag H. 2005. Die Libellen Tirols. Berenkamp, Innsbruck

Müller JM. 2001. Neue Erkenntnisse zu Ökologie und Verbreitung der Sibirischen Azurjungfer (Coenagrion hylas). Mercuriale 1: 9-12

1.3 Restoration of peat bogs and protection of *Nehalennia speciosa* in Bavaria: A conflict in targets?

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In Bavaria, *Nehalennia speciosa* (Odonata: Coenagrionidae) is almost exclusively restricted to natural bogs in the Alpine foothills as its primary habitat. At very few places, *N. speciosa* has also colonized secondary habitats. These water bodies are the results of revitalisation of the water balance in formerly damaged peat bogs. The greatest known population in a secondary habitat in Bavaria, with an estimated size of more than 3,000 individuals, exists in the "Koller- und Hochrunstfilze" southwest of Rosenheim, an area of former industrial peat mining, which was restored from 2005 onwards. In contrast to natural mires, common rush Juncus effusus standing in the water there takes the role of sedges (*Carex* spp.) as the essential habitat structure for this damselfly.
The measuring of trace gases proves that natural and restored mires accumulate organic substances continuously and act as carbon sinks, which helps to mitigate climate change. In 2008 the Bavarian State Ministry of the Environment and Public Health established a programme for bog restoration in order to enhance the role of mires in climate protection and for the conservation of biodiversity.
To optimize the function of the peat bog area "Koller- and Hochrunstfilze", further measures for raising the water level were planned between 2010 and 2011 to be implemented in late 2012. The goal of an accompaning study on the Odonata, with emphasis on *N. speciosa*, during June and July 2012 was to provide proposals on how to exclude damage to the central odonate habitats.
The presentation explains how the interdisciplinary group managed to deal with the synergistic goals and the potential conflict of different conservation targets in the peat bog area "Koller- and Hochrunstfilze". It also gives other examples from the Bavarian species protection programme for *N. speciosa*.

1.4 *Somatochlora alpestris* – a dragonfly at its ecological limits

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For ecologically specialized dragonflies, comprehensive knowledge on their habitat requirements is a prerequisite to their successful conservation. This applies also to the Alpine Emerald *Somatochlora alpestris*, a species that is considered a glacial relict in Central Europe. It is strictly confined to isolated mountain regions, most important of which is the Alps, where the species exists at its ecological limits. The altitudinal occurrence ranges mainly from localities at 1,600 to 2,200 m above sea level with mean annual temperatures of 0–4°C and mean summer temperatures of 3.5–8°C. Below the tree line, the species is confined to subalpine mires whereas in higher altitudes it mainly breeds in waters that are situated in alpine meadows and pastures. The spectrum of larval habitats varies from tiny puddles to small vegetated lakes. Optimal sites for larval development are shallow water bodies with dark bottom surfaces, the latter consisting of plant debris and fine organic matter, apt to warm up rapidly during sunny summer days and that are also suitable for hibernation.

The larvae live buried in muddy ground or among submerged bryophytes and are able to survive temporary desiccation as well as complete freezing of the water body. They forage in the sit-and-wait manner and recognize their prey by tactile sense rather than visually. Food is usually limited and comprises mainly chironomids, water mites, small crustaceans, oligochaetes, and small freshwater clams. In densely populated pools, cannibalism may occur. Main predators of *S. alpestris* larvae are those of *Aeshna juncea*. The latter prefer larger ponds and densely vegetated lake shores where *S. alpestris*, however, is rarely found. On the other hand, *S. alpestris* larvae live mainly in very shallow water bodies, such as runnels in spring mires on turf ground where *A. juncea* is rare. Hence, *S. alpestris* seems to avoid *A. juncea*.

In Central Europe, *S. alpestris* is endangered mainly because of two different factors. Below the altitudinal tree line, especially in the mid-range mountains, climate change is the most important impact. According to numerical modelling based on a temperature increase of 3°C for the Romanian Carpathians, an altitudinal range shift of 600 m upwards and, consequently, a loss of 90 % of the habitats is expected. Above the tree line, especially in the Alps, the local populations are currently endangered by touristic exploitation, road construction, and habitat change due to intensified cattle grazing. The negative impact of cattle trampling in breeding sites can be effectively avoided by simple fencing. However, this proves rather costly as annual renewals of the fences and hard negotiations with the farmers are required.

02 Morphology and physiology

Plenary talk:

2.1 To attach, to protect, to advertise: micro- and nanostructures of dragonflies as possible basis for biomimetics

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Dragonflies bear surfaces with specific structures and different properties on various parts of the body. Some of these surfaces are used to attach different body parts together (head arresting system) or to protect the dragonfly body against water and predators (crystalline wax coverage), while some others provide visual cues involved in territorial and courtship behaviours (thin cuticle layers, spherical vesicles in epidermal cells). The functionality of many of these surfaces is based on structures at the micro- and naometer scale and their mechanical/optical properties. It is demonstrated how electron microscopy data, together with physical characterisation methods, can provide important information about the relationships between structure and function of these surfaces. These data are not only interesting for a better understanding of the biology of dragonflies, but they may stimulate the development of technical materials and surfaces with novel, dragonfly-inspired properties.

2.2 Functional morphology aspects of the mating behavior of Odonata

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As one of the most ancient extant lineages of winged insects, the Odonata are of special interest for phylogenetic studies. Their copulatory apparatus and mating behaviour have an apomorphic state and are unique among insects and, therefore, of special interest for phylogenetic reconstructions. Males have complex genitalia, consisting of primary genitalia and a secondary copulatory apparatus for sperm transfer located on the second and third abdominal segments. Their caudal appendages, located on the last abdominal segment, are used to clasp the female's head/prothorax during both copulation and egg-laying processes. The data on the functional morphology of these appendages are important for understanding the evolution of these structures in Odonata and res- pective organs of the remaining insects. To date, the question of how male claspers exactly function has not been answered satisfactorily. In the present study, detailed information on the functional morphology of odonate caudal appendages is obtained from video-analyses, various microscopy techniques, and micro-computed tomography.

2.3 Dragonfly wing veins: a composite structure supplemented by resilin

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Wings of the Odonata are rather stiff, but during flight, they are able to undergo passive deformations adapted to the momentary aerodynamic situation, thereby improving the aerodynamic performance. Resilin, a rubber-like protein, is one of the key players in insect wing flexibility. The elastic protein has not only been found in wing vein joints, endowing the wing with chordwise flexibility, but also in internal layers of wing veins of *Sympetrum vulgatum* (Anisoptera, Libellulidae) and *Matrona basilaris basilaris* (Zygoptera, Calopterygidae). In this study, we combined the application of bright-field light microscopy (LM), fluorescence microscopy (FLM), confocal scanning microscopy (CLSM), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and atomic force microscopy (AFM) for elucidating the structure, material composition, and mechanical properties of odonate wing veins. Based on our results, we suggest that wing veins may be considered as composite structures made of typical cuticle and resilin. They consist of up to six different cuticle layers, with the endocuticle being dominated by resilin. In general, wing veins may be considered as hollow tubes, containing hemolymph and tracheae, and showing an asymmetrical construction, with a stiff, tanned, and dehydrated exocuticle and a soft, compliant inner layer, the endocuticle. This design may allow larger deformation before failure, lead to an increased elastic energy storage, and prevent fracture formation. This is especially important for longitudinal veins as they do not have the possibility to yield to bending loads and torsional deformations with the aid of flexible, resilin-bearing joints.

2.4 The sensory systems of Odonata: perceiving the world through the eyes and more…

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»**The face of** the dragonfly is practically nothing but eyes!«, as a Japanese poem states. In fact, in their powers of vision, Odonata are remarkable; no other insects have compound eyes that are larger or contain more ommatidia. For this reason, many studies have focused on Odonata vision, neglecting other sensory abilities. Ultrastructural (scanning and transmission electron microscopy) and electrophysiological investigations conducted by our research group have revealed in Odonata the presence of different sensory structures that make them capable of receiving a wide variety of environmental stimuli. Particular interest has been devoted to the sensilla present on the antennae and on the endophytic ovipositor of Odonata. On the antennae of adult dragonflies and damselflies, thermohygrosensory sensilla and olfactory sensilla have been identified, while on the endophytic ovipositor, gustatory sensilla and peculiar mechanoreceptors able to sense the stretching of the cuticle have been described. On the antennae of some larvae and on adult mouthparts, peculiar mechanoreceptors (filiform hairs) specialized in receiving vibrations of the surrounding medium were identified. Studying the sensory biology of Odonata, which are the oldest winged insects, is particularly useful for: 1) widening the knowledge on the biology of Odonata, 2) clarifying some aspects related to the adaptation of insects to the aquatic environment, 3) outlining evolutionary trends within insect sensory systems.

2.5 A new insight in the chemical ecology of insects: the role of chemical cues in 'visual dependent insects'

Silvana Piersanti[1], Francesca Frati[2], Manuela Rebora[1], Eric Conti[2], Elda Gaino[1], Gianandrea Salerno[2]
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The present research project (financially supported by the Italian Minister of University and Research-FIRB Futuro in Ricerca Program) aims to investigate the role played by olfaction in some aspects of Odonata behavior, such as predation, mating, and oviposition, using both electrophysiology (EAG, GC-EAD, SCR) and behavior (bioassays in the laboratory and in the field). Our results will shed light on the role of chemical ecology in the biology of these 'visual dependent' insects, in which olfactory sensilla have been recently described on the antennae. *Libellula depressa* (Anisoptera) and *Ischnura elegans* (Zygoptera) are used as model species for the research.
In this first year of research we focused on the role of olfaction in prey perception. Wind tunnel bioassays demonstrated that *I. elegans* adults are attracted by live *Drosophila melanogaster*, even when they are not visible. In addition, non-visual stimuli emitted by live prey effectively integrate the visual stimuli, increasing the attractiveness of the prey for the damselfly. Electrophysiological recordings (EAG and SCR) on *L. depressa* and *I. elegans* antennae showed olfactory responses to many odorants related to vertebrate predators, plants, and standing waters. In addition, we obtained olfactory responses to odorants reported to be able to elicit olfactory responses in coeloconic receptors in *Drosophil*a antennae. These sensilla have been recently described as expressing Ionotropic receptors on their sensory dendrites, probably an ancient mechanism for sensing chemical cues. Considering the basal position of the order Odonata, the results of the present research could also contribute to delineate evolutionary trends in the olfaction of arthropods.

2.6 Wing length allometry in Odonata – differences between families and in relation to migratory behavior

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In insects, wing shape and body size are correlated with several aspects of behaviour, and the optimal morphology of wings is a trade-off between a number of functional demands in relation to behaviour (e.g., foraging, migration and sexual display). Dragonflies are spectacularly skilful flyers and present a range of different wing shapes, but no detailed studies have been conducted on wing length allometry in relation to body size in the Odonata. We use published data on body length and wing length in all European and North American dragonflies to investigate differences in wing length allometries among Odonata taxa (suborders and families) and to relate these to behavioural patterns.
We found different wing allometries between Zygoptera and Anisoptera, which are probably related to the flight mode and wing form of the two suborders. Among the Anisoptera, the Libellulidae was the only family for which wing length allometry clearly differed from all other families. This distinction is paralleled by a behavioural trait, as there exists a striking quantitative difference in the proportion of the time spent in flight between typical fliers (Aeshnidae, Cordulegastridae, and Corduliidae) and Libellulidae, which have almost exclusively been classed as perchers. In the Anisoptera we found that migrating species on average have relatively longer wings than non-migrating members of the same family. Finally, wing length allometry differed among all the zygopteran families analysed, and this pattern suggests that each family evolved a particular wing morphology in response to peculiarities in behaviour, habitat, and flight mode.

2.7 The thorax musculature of Odonata and the homology with Neoptera

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Among the winged insects (Pterygota), the dragonflies and damselflies (Odonata) are unique for several reasons. Behaviorally, they are aerial predators that hunt and catch their prey in flight only. Morphologically, the flight apparatus of the Odonata is significantly different from what is found in the remaining Pterygota. However, to understand the phylogenetic relationships of winged insects and the origin and evolution of insect flight in general, it is essential to know how the elements of the odonate flight apparatus relate to those of the other Pterygota. Here, we present a comprehensive, comparative morphological investigation of the thoracic flight musculature of adult damselflies (Zygoptera) as well as dragonfly (Anisoptera) larvae. Based on our new data we propose a homologization scheme for the thoracic musculature throughout the Pterygota. The new homology hypotheses will allow for future comparative work and especially for phylogenetic analyses using characters of the thoracic musculature throughout all winged insects. This will contribute to the understanding of the early evolution of pterygote insects and their basal phylogenetic relationship.

03 Phylogeny of dragonflies: is the final battle about to begin?

Convenors: KD Dijkstra, VJ Kalkman

3.1 General introduction; progress on dragonfly phylogeny in the last decade

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From the mid-20th Century to the early years of the 21st, the phylogeny of Fraser (1957) dominated thinking about Odonata relationships. With the increasing accessibility and sophistication of techniques for molecular analysis and phylogenetic inference, however, many older ideas have been overturned. Especially among Zygoptera, even old concepts of interfamilial and subfamilial relationships and even of family identity have been thoroughly rearranged, while others have survived largely unscathed. Here, I review some of the most important areas of change and stability and will try to suggest why some suites of characters may give less accurate answers than others.

3.2 Phylogeny of the Calopterygidae

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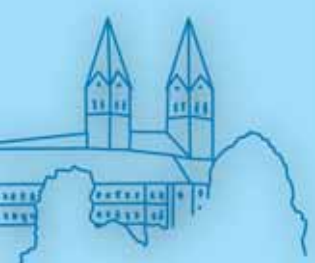
In the phylogeny of the Zygoptera, little is certain, except that the lestomorphs are sister to all other zygopterans, and that the Platystictidae are sister to all Zygoptera minus the lestomorphs.

The calopterygid clade is less easy to define than one would think at first sight. More than three antenodals in all wings used to be one of its signature characters, but it is now likely that this originated more than once. There is, however, consensus over the monophyly of the central clade, to be taxonomically called Calopterygoidea (if one considers Hetaerinidae as a family), or Calopterygidae (if one chooses to rank the hetaerinids at the subfamily level). Also within this clade, there is now a reasonable stable phylogeny, down to genus level. This clade also contains some of the most colourful and spectacular extant damselflies.

Problems arise if one attempts to look at the deeper AND shallower clades. Supra-familiar phylogenies turn out to differ substantially between authors, and within authors, between papers.

But circum-specific descent is also obscure. The best studied species, *Calopteryx splendens*, is a case in point. In spite of numerous efforts, no satisfactory DNA marker for a below-species taxonomy has been found, and various advanced techniques of morphological analysis (e.g., geometric morphometry) have revealed many measurable differences between populations, but no objective criteria (yet) that allow us to use these as taxonomic tools.

Fraser FC. 1957. A reclassification of the order Odonata, based on some new interpretations of the venation of the dragonfly wing. Royal Zoological Society of New South Wales, Sydney, Handbook 12: 1-133



03 Phylogeny of dragonflies: is the final battle about to begin?

3.3 Phylogeny and biogeography of the Platystictidae

Jan van Tol[1], Matjaž Bedjanič, Klaas-Douwe B. Dijkstra,
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We studied the phylogenetic relationships between species of the family Platystictidae using both morphological and molecular characters. Taxon sampling included species assigned to the Palaemnematinae from the New World, the Sinostictinae from China, as well as the Platystictinae from Sri Lanka to New Guinea.
A new classification, based on the results of this analysis, as well as a reconstruction of the historical biogeography of this family, will be presented. Special attention will be paid to the position of the fauna of Sri Lanka and southeastern China.

3.4 Megapods to smithereens

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The greatest systematic challenge in Zygoptera is classifying the over 300 species currently or formerly associated with Megapodagrionidae. Their heterogeneity has long been recognized, and many family-group names have been proposed although most of these have rarely been used. Based on an analysis of larval gills, Kalkman et al. (2010) were able to divide Megapodagrionidae into four groups: (1) species with inflated sack-like gills with a terminal filament; (2) species with flat vertical gills; (3) species in which the outer gills in life form a tube folded around the median gill; (4) species with flat horizontal gills. A molecular analysis based on COI 16S and 28S, which included nearly all recognized genera, showed that the later three groups are indeed monophyletic and are best recognized as distinct families (Megapodagrionidae, Philosinidae, and Argiolestidae, respectively). The genera possessing inflated sack-like gills were, as expected, found to be non-monophyletic and, instead, fall apart into five different clades for which family-group names are available (Heteragrionidae, Hypolestidae, Philogeniidae, Pseudolestidae, Thaumatoneuridae). No family-group names are available for an additional seven clades of, in total, ten genera, and these are left incertae sedis. It is likely that further study will show that these too should be placed in seperate families. This latter group includes such oddballs as Amanipodagrion from Tanzania, Tatocnemis and Protolestes from Madagascar, Mesopodagrion and Priscagrion from China, and Dimeragrion from South-America. Two of the better studied and understood new families, Argiolestidae and Philosinidae, are presented in more detail.

Kalkman VJ, Choong CY, Orr AG, Schütte K. 2010. Remarks on the taxonomy of Megapodagrionidae with emphasis on the larval gills (Odonata). International Journal of Odonatology 13: 119-135

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3.5 Phylogeny of Coenagrionoidea

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Coenagrionoidea include almost 60 % of all damselfly species, but their classification is unsettled. Extensive molecular sampling now allows for a reconfiguration of the superfamily. The status of Isostictidae, which includes less than 3 % of species, is still uncertain, but Platycnemididae (24 %) is clearly the sister-group of the remaining 73 % of Coenagrionoidea. The Old World 'protoneurids' fall within the Platycnemididae and this entire Old World family can now be separated into some well-defined subfamilies, with several distinctive genera moving between it and Coenagrionidae. The latter family encompasses almost 1,300 species, representing the greatest damselfly radiation and odonate family. Two major groups can be distinguished, both of which are cosmopolitan and contain over 600 species. The group including Coenagrion is generally defined by well-developed postocular spots and dominates in the Holarctic and Palaeotropics. The remainder rarely possesses these spots but often have a ridged frons. It is richest in the Neotropics with 70 % of species, including Pseudostigmatidae and true Protoneuridae.

3.6 Extraordinary level of species diversity in Vietnamese Chlorogomphidae and Cordulegastridae and recent developments in their taxonomy

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In the last 20 years, there has been a very active study of Odonata in the Indochina region. Here I introduce some of the results of this work in Vietnam.

First, considering the Chlorogomphidae; before our survey, only two species had been recorded (*Chlorogomphus auratus*, *C. vietnamensis*). In 1993, I started surveying the northern part of Vietnam and discovered several additional species. In 1995, I recorded six species, including four new to science (*Chlorogomphus albomariginatus*, *C. nakamurai*, *C. sachiyoae*, *C. takakuwai*). During the same year, the late Dr. Asahina also studied the Vietnamese fauna and described two new species (*Chloropetalia owadai*, *Watanabeopetalia uenoi*) and one newly recorded species (*Chlorogomphus miyashitai*).

This year, I published a full revisional work on the Vietnamese Chlorogomphidae, in which a total of 15 species and two subspecies were recorded. These include four new species (*caloptera*, *aritai*, *ojisan*, *piaoacensis*) and two newly recorded species (*Watanabeopetalia usignata*, *Sinorogomphus tunti*). Thus, the known Vietnamese chlorogomphid fauna presently numbers 19 species. The total number of species in this family is 51;, hence, about 40 % of them occur in Vietnam. From the very large mainland area of the People's Republic of China, only 18 species have been recorded. The extraordinary level of species diversity in Indochina is peculiar to that region.

A similar phenomenon occurs in the genus *Anotogaster* (Cordulegastridae) from Vietnam. I have so far reported five species (*A. sakaii*, *A. sapaensis*, *A. klossi*, *A. chaoi*, *A. gigantica*). This survey has encompassed only a few mountain areas. Therefore, it is likely that there still are many undescribed species awaiting discovery.

There still remain problems in our understanding of the systematics of these groups. Recently we have studied the molecular phylogeny of the Chlorogomphidae and present an interim report.

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3.7 An insight into the phylogeny of basal Anisoptera families

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The basal phylogeny of the four main clades of Anisoptera, i.e., Gomphoidea, Aeshnoidea, Petaluroidea, and Cavilabiata (= Libelluloidea + Cordulegastroidea), all rooted in the Jurassic, is still disputed from both molecular and morphological approaches. The position of the archaic family Chlorogomphidae within the Cavilabiata is not clear and needs to be clarified. New and revisited adult and larval characters lead to new hypotheses on the relationships of Anisoptera basal clades. Within the Aeshnoidea, the position of the Austropetaliidae as a sister-group of the Aeshnidae is reinforced. The Aeshnoidea and Petaluroidea are gathered in a new clade named Siphonoprocta. Within the Cavilabiata, the remarkable family Neopetaliidae is considered belonging to the Cordulegastroidea, and the family Chlorogomphidae, presenting a unique set of plesiomorphies, is considered to be the sister group of the remaining Cordulegastroidea. Due to their numerous potential plesiomorphies, the phylogenetic position of the Gomphoidea remains a delicate problem, and this archaic taxon could represent the sister group of the remaining recent Anisoptera. Nevertheless, it cannot be ruled out that Gomphoidea represent the sister group of Cavilabiata or that of Siphonoprocta.

3.8 Phylogeny of Libelluloidea: Why so many?

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Libelluloidea is the most speciose group in Anisoptera, but its phylogenetic history has been difficult to interpret. Using the most comprehensive morphological and molecular dataset to date (178 taxa, 100 morphological characters and 9,902 molecular characters), we examine phylogenetic hypotheses of libelluloid relationships using parsimony and doublet-model Bayesian analyses. Homoplasy in dragonfly wing-based morphological datasets has been previously identified as a source of disagreement between molecular and morphological topologies, but our data suggests that other morphological larval, penile, accessory genitalic, and external body datasets are similarly prone to convergence, all of which recover topologies in disagreement with molecular findings. The taxonomy of non-cordulegastrid Libelluloidea is revised to include just four families (Synthemistidae sen. nov., Macromiidae, Corduliidae, and Libellulidae) with Libellulidae further subdivided into at least four subfamilies (Trameinae sen. nov, Sympetrinae sen. nov., Trithemistinae sen. nov., and Libellulinae). We use Garli maximum likelihood results to estimate both divergence times and diversification rates. Libelluloidea diverged approximately 214 million years ago; rates are highest in the Corduliidae and Libellulidae. Phylogenetic hypotheses, diversification and divergence estimates are discussed in relation to the success of Libelluloidea, with a focus on the evolution of exophytic oviposition and burrowing behavior. Apparently, the rapid radiation of "higher Libelluloidea" and the switch to exophytic oviposition occurred during the Cretaceous Period.

3.9 The relevance of palaeontological data for understanding the age and origin of extant odonates

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Paleontological evidence provides direct or indirect minimum ages for the existence of recent lineages and the concerning phylogenetic splitting events, and thus also is of crucial importance as independent evidence for calibrating molecular clock data. Furthermore, fossils provide independent tests for theoretically reconstructed evolutionary scenarios of character transformation and reconstructed ancestral ground plans.

The earliest stem group representatives of odonates belong to the protodonate grade (Erasipteridae and Namurotypidae) and have been found in the lowermost Upper Carboniferous (Namurian B, 319 mya) of Hagen-Vorhalle in Germany. The morphologically more primitive Eugeropteridae from the Upper Carboniferous of Argentina are not reliably dated and probably somewhat younger. Even protodonate larvae are known from the Upper Carboniferous Mazon Creek locality in U.S.A. and already were aquatic with prehensile mask. Adult protodonates did not possess a male secondary genital apparatus and thus could not mate in wheel position, but probably transferred external spermatophores like apterygote insects. The oldest fossil record of odonates with secondary male genitalia is provided by the protozygopteran *Engellestes* from the latest Early Permian of Tshekarda (ca. 278 mya). Typical structures of modern odonate wing venation, like nodus, discoidal cell, and pterostigma, are already known from a few protozygopteran damselflies (*e.g. Bechlya* and *Luiseia*) of the Upper Carboniferous of New Mexico (299 mya) and England (307 mya).

The first fossil record of crown group representatives of Odonata is represented by isophlebioid damsel-dragonflies from the Upper Triassic (Carnian, ca. 232 mya) Schilfsandstein of Bavaria and the Australian Ipswich coal mines (*e.g.*, Mesophlebia), which belong to the stem group of Epiprocta and still had larvae with three caudal gill lamellae like Zygoptera. The earliest true Zygoptera is a still undescribed Hemiphlebiidae from the Upper Jurassic (Tithonian) limestones of Painten (150 mya) and Solnhofen (148 mya) in Bavaria. The oldest known relative of extant Epiophlebiidae is the recently described, small damsel-dragonfly Burmaphlebia from the Lower Cretaceous amber of Myanmar (99 mya). The earliest stem group Anisoptera is an undescribed Liassophlebiidae from the Lower Jurassic (Liassic alpha) of Bavaria (200 mya) and many more are known from the Liassic Posidonia shale (180 mya) of Middle Europe, but the first crown group representatives of Anisoptera (Cymatophlebia) appear in the Upper Jurassic Malm beta (154 mya) of the Swabian Alb. Of many modern families, the oldest representatives (stem group or crown group) can be found in the Lower Cretaceous (*e.g.*, Crato Formation). Fossil damselflies and dragonflies from the Paleogene (*e.g.*, Baltic amber, Middle Eocene, 44 mya) and especially the Neogene often can already be attributed to modern genera, but only Quartenary fossils from the Pleistocene are conspecific with modern species.

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3.10 Towards the final tree

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The first attempts at reconstructing the evolutionary history of Odonata and the relationships between the major clades began in the 1990's. Since that time, there has been a great deal of research focused on odonate phylogeny, both at higher and lower levels. The attention that this group has received and continues to receive is especially interesting in light of the group's relatively small size when compared to other insect groups, particularly other insect orders. There is little surprise that the group has received such focus, as it is unique among insect groups *(e.g.*, evolutionary position among insects, extensive fossil record, unmatched flight ability, almost entirely visually dependent, and exceptional behavior). For these reasons, and many others, the evolution of odonates holds the link to many comparative and evolutionary studies. A brief outline of our current working knowledge of odonate phylogeny will be presented. A brief vision for the future of odonate phylogenetics will also be presented. This will be followed by discussion from participants in attendance regarding the future and direction of odonate phylogentics.

04 Ethology

Plenary talk:
4.1 Why migrate? Frost, flood, fish, and food

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New technologies and a new wave of interest in Odonata have sparked a wave of interest in a long known but little studied phenomenon migration. In North America, Anax junius is known to traverse hundreds to thousands of kilometers from north to south during fall migration. Pantala flavescens apparently fly up to 6,000 km from northern India to East Africa with the Northeast Monsoon, with some 3,500 km spent passing over open ocean. These spectacular movements reflect extreme responses to a suite of environmental hurdles all dragonflies must overcome. In broadest terms, the solutions depend on combinations of trophic interactions and habitat stability that determine the selective balance between the risks of habitat deterioration and of extended flight and delayed reproduction.

4.2 Riding on floatsam: odonate larvae in the drift

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Several odonate larvae inhabiting lotic waters exhibit a strong thigmotactic behaviour. They clasp roots and driftwood and huddle against the substrate. What happens if the substrate drags them away and gets into the drift? How do the larvae behave when they are taken into the current?
Special underwater video recordings were used to study these situations. The main investigations were made with larvae of *Boyeria irene* (Aeshnidae) and *Calopteryx xanthostoma* (Calopterygidae) and offer new insights into the phenomenon 'drift of macroinvertebrates' as well as to the ability of macrozoobenthos organisms to choose a habitat in a turbulent situation.

Boyeria irene larva © by Hansruedi Wildermuth

4.3 Colouration and presentation: wing clapping in the Calopterygoidea

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Wing clapping is a well-known behaviour in the Calopterygoidea. Perched adults open and close their wings abruptly. The functions of this behaviour have been interpreted in different ways. In particular, thermoregulatory or signalling functions have been suggested.
In the present study the wing clapping of several species of Calopterygidae, Chlorocyphidae, and Euphaeidae with differing wing morphology and colouration was filmed at 300 and 600 frames per second (fps). Slow motion analyses showed strong differences in the movement between species with differing wing coloration. Furthermore, at least in studied *Neurobasis* and *Calopteryx* species, there were clear differences between these signals displayed by a single male inside its territory or a guarding male in front of his female. The specialised presentation of coloured ornaments of the wings indicates that this behaviour most probably has a predominantly signalling function.

4.4 Female refusal behaviour

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At dragonfly reproduction sites, males are more present than females. Most of the females that have already mated are trying to avoid harrassing males by a special refusal behaviour. Many different types of refusal behaviour have been described (Corbet 2004). However, some of these patterns are too fast for the human eye. By means of slow motion filming (300-600 fps), we discovered two new types of refusal behaviour: flying loops in *Libellula quadrimaculata* and flying sharp turns by a sudden bending of the abdomen in *Anax imperator*. The analysis of this behaviour is presented and discussed in context with other refusal behaviour that is already known.

Corbet PS. 2004. Dragonflies. Behavior and ecology of Odonata. 2nd, revised edition. Harley, Colchester

4.5 The contributions of male mate choice to the maintenance of female polymorphism in damselflies

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Current theories on the maintenance of female limited polymorphs in Odonates predict differences in male mate choices within individual males, however all studies to date study population level preferences. So the predictions made by these theories have not been tested. This study tested individual males of the species *Nehalennia irene* to determine if male mate choice is occurring by individual males for a morph and for particular females within that morph. Results suggest that there is no evidence of inter-male variability in preference between or within morphs. The implications of these findings for current theories of male mimicry and learned mate recognition will be discussed.

4.6 Pre- and postmating prezygotic barriers in heterospecific interactions between closely related damselflies

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Reproductive isolation is the key characteristic of a biological species, but the origin and evolution of reproductive isolation are still controversial and widely unknown. Sexual conflict is likely to be involved as a driver of speciation in odonates, and a possible outcome of these interactions can be the rapid divergence of male genitalia. Male cerci and the female mesostigmal plates are important characters for interspecific mate recognition. Thus, when a female receives an incorrect stimulation, it could use this information to reject the mating. In this study, we investigate the prezygotic mechanisms behind female avoidance of heterospecific matings. Here, we present a laboratory study where we have measured the intensity of two prezygotic barriers (mechanical incompatibility and copulation duration) and two prezygotic female responses (no mating acceptance and sperm ejection) between two allopatric damselflies (*Ischnura genei* and *I. graellsii*). We found that mechanical barriers impeded 34.3 % of matings between *I. genei* females and *I. graellsii* males, and 63.6 % in the opposite direction. Hybrid copulations in both heterospecific cross directions were intermediate regarding conspecific matings. Additionally, we identified two mechanisms used by the female to avoid hybridization: over a half (58.0 %) of *I. graellsii* females and 37.1 % of *I. genei* females did not accept the heterospecific mating; and 43.5 % of the *I. genei* females ejected the sperm after the heterospecific mating while we did not see any case in *I. graellsii*. Our results suggest that, in *Ischnura* damselflies, two postmating prezygotic barriers mediated by females *i.e.*, no mating acceptance and sperm ejection can prevent hybrid formation.

4.7 Damselfly females prefer hot males: higher courtship success of males in sun spots

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Males of some territorial calopterygid damselflies show an elaborate courtship display that involves high frequency wing-beats directed towards an incoming female. Although it has been suggested that female mate preference is based on some characteristics of the male's courtship display, it is unclear whether the courtship display varies between males or is influenced by environmental conditions. Combining two recent technologies, thermographic imaging and high-speed digital videography, we found that male thorax temperature was associated with solar exposure in his territory and hotter males were more likely to copulate than others. Males might also have greater mate guarding abilities in warmer territories.

05 Odonomics

Convenors: MO Lorenzo-Carballa, PC Watts

5.1 Transcriptomic response to extreme genetic erosion in a threatened damselfly

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Coenagrion mercuriale (Charpentier, 1840), presently listed as »Near Threatened« by the IUCN, exemplifies the population declines experienced by many odonates. Continuous declines have been reported in France and Spain due to shifting agricultural practices and, largely because of loss of suitable habitat, this species has suffered a 30 % reduction in distribution in the UK during the last 100 years. At the extreme northwest edge of this species' range, one isolated population (Anglesey) suffers from extremely low genetic diversity, being almost monomorphic at a panel of microsatellite loci. We examined the transcriptomic consequences of this unprecedented loss of genetic diversity using RNAseq, comparing samples of larvae from the closest large population (Pembrokeshire) with high levels of genetic diversity with samples from the genetically impoverished population. Using 454 sequencing, we generated 1,154,713 high quality reads from the transcriptome of *C. mercuriale*, 861,485 (74.6 %) of which could be assembled to generate 16,623 contigs (leaving 123,916 singletons and 12,196 outliers). 1,244 contigs had a significantly different ($P<0.05$) representation in the two populations, with 806 and 438 contigs under- or over-expressed in Anglesey respectively. Notable differences in terms of greatest fold difference in expression between sites included upregulation of vitellogenin in Pembrokeshire and upregulation of antimicrobial peptides in Anglesey. More generally, variation in transcript expression represented an upregulation of genes associated with assembly of proteins and other macromolecules in Anglesey and a greater expression of genes associated with mitochondrial function in Pembrokeshire. RNAseq thus provide insights into the transcriptomic response to inbreeding stress in wild populations of genetic non-model organisms.

5.2 Genomics of the polymorphic damselfly *Ischnura elegans*

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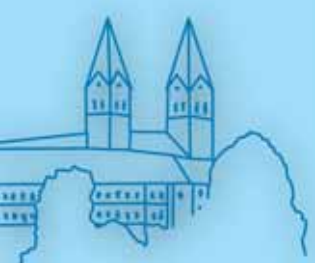
Visually detectable polymorphisms provide simple phenotypic markers that can be easily employed to study evolutionary processes in the wild. Genetic colour polymorphisms are commonly found amongst Odonates, and one of the best studied species is *Ischnura elegans*, which is characterized by a female limited colour polymorphism. Breeding experiments have shown that colour in this species is controlled by a simple Mendelian locus with three alleles in a dominance hierarchy, but other than that, the genotype-phenotype relationship has remained a puzzle. We seek to unravel the molecular basis of this colour polymorphism using microsatellites, genome and transcriptome sequencing, RAD-sequencing, re-sequencing of morph pools and sequences.



5.3 DNA and morphology to disentangle species boundaries in Antillean damselflies of the genus *Hypolestes* (Megapodagrionidae)

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The genus *Hypolestes* includes two morphologically-similar species, *H. trinitatis* from Hispaniola and Cuba and *H. clara* from Jamaica, that are both categorized as »Vulnerable« by the IUCN. A particular problem for conservation of the two species within this genus is a lack of ecological and biological data and, crucially, the unclear species boundaries because their current taxonomic status is based solely on morphological criteria. To redress this deficiency, we collected molecular and morphological data on representative samples of *Hypolestes* from populations on Hispaniola, Jamaica, and Cuba. Fragments of two mitochondrial (COII; 16S) and two nuclear (Pgi; Arg) genes were sequenced and both traditional and geometric morphometric methods were used to compare male genitalia and cerci. Our molecular data indicate three distinct lineages that correspond to each island, with the Jamaican lineage being the most basal. Such genetic divergence is concordant with the sequence of palaeogeographical events that separated the three islands and supports a model of speciation by vicariance. Moreover, the penis and cerci morphology differed between each genetic *(i.e.*, island) lineage. We hypothesize that the genus Hypolestes might be composed of three different species, one found on each of the islands.

5.4 Thinking forward: defining, approaching, and solving the current problems in odonate higher level phylogeny using next generation techniques

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Odonate phylogeny has received a wonderful amount of attention over the last two decades. Each estimate of phylogeny has increased our knowledge of odonate classification and evolution, often in dramatic form. These estimates have helped to solidify major portions of the odonate tree of life and provide evolutionary insight into odonate behavioral, morphology and molecular evolution. A brief synopsis of the past data and their power in resolving a robust phylogeny of the Odonata are presented and reviewed. An outline of current molecular approaches that can help push odonate phylogeny forward are presented along with progress toward implementing each approach. Additionally, a brief outline of some of the central relationships yet to be resolved along with some important goals in odonate phylogeny is presented.

6.1 Evolution and behavioral ecology of Neotropical damselflies

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Although the behavior and ecology of many North American, European, and Asian groups of damselflies are well-known, respective data for Neotropical groups is still scarce. This presentation intends to highlight the importance of knowing these groups, from a phylogenetic point of view, pointing at gaps in the evolution of traits and showing results of recent research on Brazilian damselflies. For example, we show the courtship and territorial behavior of *Mnesarete pudica* and *Chalcopteryx scintillans*, two beautiful damselflies with brightly colored wings. Based on these species, we discuss the role of pigmentation and structural colors on fighting and sexual behavior and the influence of these traits on the evolution of damselfly wings. Finally, we call the attention of odonatologists interested in these groups to engage in behavioral research to help increase the knowledge of the Neotropical odonates.

6.2 A preliminary phylogenetic analysis of some *Argia* Rambur 1842 (Odonata: Coenagrionidae) species based on larval morphology

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The genus *Argia* was described and established by Rambur in 1842. It is the largest and most diverse genus of the family Coenagrionidae with 113 species. Its distribution is exclusively in the New World, and Mexico is the country with the greatest number of species described to date (50 species, corresponding to 44 % of total species).

The systematics and evolutionary relationships of Argia is poorly studied. The only preliminary phylogenetic hypothesis available for this genus was developed using mitochondrial 16S rDNA and limited adult morphological characters of some North American species.

The aim of this study was to explore phylogenetically informative morphological and morphometric larval characters, and to propose an alternative phylogenetic hypothesis. Specimens from three entomological collections (Mexico, Argentina and United States of America) were examined. Amphipteryx agrioides, Hetaerina vulnerata, and Telebasis digiticollis were selected as outgroup species. A series of six individuals of both sexes, from 35 out of the 43 Argia species whose larva is known, were reviewed.

Parsimony analysis will be performed in WinClada ver. 1.00.08 and NONA ver. 2.0. All characters will be treated with the same weight. A heuristic search with TBR branch swapping with multiple TBR + TBR (mult*max*), holding 10,000 trees, will be carried out. A total of 1,000 replicates will be made, starting with 10 trees per replicate. This procedure will be repeated 10 times. Bootstrap (1,000 replicates) will be applied as a measure of support and strength of the branches.

6.3 A cladistics analysis of Sympetrinae Tillyard, 1917, with an emphasis in the group of specialized femoral armature: the genera of 'Erythemismorpha' (Odonata: Libellulidae)

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Libellulidae is the richest Anisoptera family with more than one thousand species and is also the most abundant in the field. Investigations of the phylogenetic relationships among its genera have been shown to be complicated, with widely divergent hypotheses. We undertake a morphological cladistic analysis of Sympetrinae s.l. based on 171 characters from adults, with an emphasis on the 'armed leg group' (Erythemismorpha sensu Pinto & Carvalho, in prep.), which includes the holotropical group of genera *Acisoma*, *Carajathemis*, *Cyanothemis*, *Erythemis*, *Porpax*, *Rhodopygia*, *Rhodothemis*, and *Viridithemis*. Representatives of almost all subfamilies of Libellulidae and genera of Sympetrinae were also included, summing up to a total of 69 taxa. This broad sampling aimed to provide a strong test on the monophyly of Erythemismorpha and to identify monophyletic groups in Sympetrinae s.l. Both Fitch and Sankoff parsimony approaches with distinct weighting schemes were performed. Sankoff parsimony was adopted to minimize the influence of 'gaps' (innaplicable data), and its consequences are discussed. Erythemismorpha was shown to be monophyletic and, in addition to the cited genera, also includes at least *Erythrodiplax castanea*. The genera *Acisoma*, *Rhodo-themis*, and *Rhodopygia* have their hypotheses of monophyly supported by the analyses. Contradicting previous results, Erythemis proved to be paraphyletic in almost all trees. Internal nodes of Eyrthemismorpha are still inconclusive, however, *Cyanothemis* + *Porpax*, as well as *Carajathemis* + *Rhodopygia*, are both highly supported (Fig. 1). The full composition of Erythemismorpha is still open, pending inclusion of other data sources. We also discuss some misconceptions about homoplasy and its implications on venational characters of Anisoptera under the light of cladistic theory.

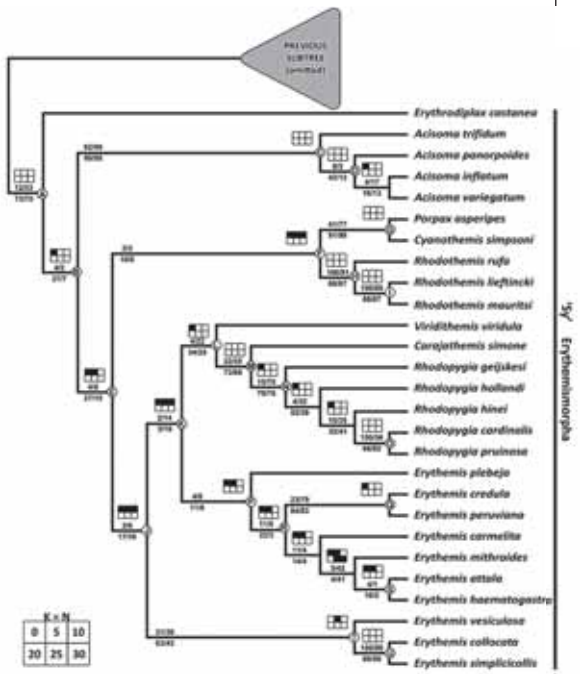

Figure 1. Subtree depicting phylogenetic relationships of the armed leg group (Erythemismorpha) from the unique most-parsimonious tree obtained with the Fitch approach under implied weighting (K = 15, fit = 75.22, CI = 0.23, RI = 0.58). Values above of the branches correspond respectively to the relative Bremer support and resampling Poisson (modified bootstrap p ≈ 37) 'GC' (group present and contradicted) frequency; those below to symmetric resampling (modified jackknife with p = 33) with absolute and GC frequencies. Rectangles above each node (Navajo's rug) depict values of K that support the respective nodes; K = 0 corresponds to the strict consensus under equal weights. 'Sy' = Sympetrinae s.l.

Pinto AP, Carvalho AL. in prep. A morphological cladistic analysis of the Pondhawks dragonflies of the genus Erythemis (Odonata, Libellulidae) and the significance of congruence test of characters for homology statements of wing venation in Anisoptera.

6.4 The genus *Mesamphiagrion* Kennedy, 1920, in Colombia (Odonata: Coenagrionidae), with the description of four new species

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The genus *Mesamphiagrion* Kennedy, 1920, occurs in the Pantepui region and the northern Andes in South America, with its greatest specific richness in Colombia. However, it is precisely in this country where the genus is less known. In this work, we record 11 species of *Mesamphiagrion* from Colombia, including four new species (*Mesamphiagrion gaudimontanum* sp. nov., *M. nataliae* sp. nov., *M. rosseri* sp. nov., and *M. santainense* sp. nov.). We also describe the female of *M. risi* (De Marmels, 1997), *M. ovigerum* (Calvert, 1909), and *M. occultum* (Ris, 1918), which were previously unknown. Descriptions, photographs, illustrations, distribution maps, and natural history notes are provided.

6.5 Rubyspots: an interesting disparity between morphology and molecules

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Riverine damselflies of the family Calopterygidae occur on all continents except Australia and Antarctica. Sixty-seven of the 73 species distributed in the New World are members of the exclusively Neotropical subfamily Hetaerininae. Unique combinations of morphological traits make the subfamily easily to recognize. However the species reso- lution has been challenging due to numerous names in literature, lack of access of type material and overall similarity among species. Garrison (1990, 2006) revised the genera *Hetaerina* and *Mnesarete*; but he discussed the difficulty in species delimitation and in establishing a phylogenetic analysis among these taxa based on the morphology. Fourteen species of Hetaerina and two of *Mnesarete* were sampled in USA, Colombia, Guyana, and Ecuador to reconstruct a molecular phylogeny using the genes COI and the hypervariable loop of the 28S D2. Our results suggest that the species of *Mnesarete* are a cluster within the *Hetaerina* species. This is consistent with Garrison's discussion about the problematic definition of the genus *Mnesarete* due to the violation of some species to fit the genus definition. The *Hetaerina caja* clade shows an intersting rapid diversification along the eastern Colombian Cordillera that can be possible case or incipient speciation or character displacement.

Garrison RW. 1990. A synopsis of the genus Hetaerina with descriptions of four new species (Odonata: Calopterygidae). Transactions of the American Entomological Society 116 (I): 175-259

Garrison RW. 2006. A synopsis of the genera Mnesarete Cowley, Bryoplathanon gen. nov., and Ormenophlebia gen. nov. (Odonata: Calopterygidae). Contributions to Science, Natural History Museum of Los Angeles County, 506: 1-84

6.6 Radiation despite niche conservatism in the Neotropical damselfly genus *Megaloprepus*?

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Today, Neotropical rainforests face on-going destruction due to human activities that result in a contemporary assortment of forest patches surrounded by urban areas. High fragmentation rates along with climate change are the driving forces for species extinction, loss of biological dynamics, separation of populations, and declines in population size and viability. Highly specialized species that are sensitive to forest instability are valuable markers for conservation management, since forest disturbance can rapidly lead to impacts on population structure and ultimately to population decline. Thus, research on the genetic diversity, population structure, and dispersal of 'marker species' has become a promising approach to translate "conservation science into conservation practice".
Among odonates, the most useful bioindicators for tropical forests are species with a wide distributional range but with a narrow ecological niche; the latter makes them sensitive to relatively small environmental changes. A forest specialist that harbors this potential is the pseudostigmatid damselfly *Megaloprepus caerulatus*. As the world´s largest extant odonate, it is distributed throughout the Neotropics from Mexico to Bolivia. Across its geographic range, its fundamental ecological niche is old growth forest with a closed canopy. The literature describes only one species within the genus *Megaloprepus*: *M. caerulatus caerulatus*, with two potential subspecies from Mesoamerica and South America. However, the specific geographical distribution of the potential subspecies is still under debate. Verification of the current taxonomic status of *M. caerulatus*, its phylogeographic patterns, and contemporary distributional ranges is a sine qua non to further discuss the results under the light of forest history and destruction.
To answer the question whether niche specialization has limited radiation over time within the genus *Megaloprepus* or, alternatively, whether independent evolutionary processes in isolated populations have led to diversification, recent patterns of genetic structure, and genealogical relationships in and among eight populations from Mexico and throughout Central America Los Tuxtlas Biosphere Reserve (Mexico), Laguna Lachuá National Park and Protected Area Cerro San Gil (Guatemala), Pico Bonito National Park (Honduras), Biological Reserve Indió Maíz (Nicaragua), Corcovado National Park and Biological Research Station La Selva (Costa Rica), and Barro Colorado Island (Panama) were quantified. Additionally, a phylogenetic framework was established to further analyze the taxonomic status of *Megaloprepus*.

6.7 Cuatro Ciénegas, Coahuila: An oasis of dragonfly diversity in a Mexican desert

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The Cuatro Ciénegas Basin (CCB) is one of the biologically most interesting areas for the study of aquatic life in México. It is an isolated arid area situated in a 40 km wide depression in the center of the state of Coahuila, México. The springs of CCB support more than 70 endemic species. Attempts to document the odonate fauna of this area are few, and some records are based merely on larval stages. Recent adult collections in the area were highly productive. From 2011 to 2012, there were 52 species of Odonata recorded from the water bodies of CCB and its immediate surroundings. The diversity found is remarkable for such an isolated and xeric environment. Eleven new state records have been recorded for the CCB (*Hetaerina titia*, *Argia leonorae*, *Rhionaeschna multicolor*, *Dromogomphus spoliatus*, *Brechmorhoga mendax*, *Dythemis fugax*, *Libellula croceipennis*, *Macrodiplax balteata*, *Micrathyria aequalis*, and *Orthemis discolor*), including *Epitheca petechialis* as a new record for México.

Figure 1. A male *Rhionaeschna multicolor.*
Photo: E. González-Soriano

07 Mixed bag

Plenary talk:
7.1 Biotic interactions with Odonata: a review on parasitism and commensalism

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Besides the major topics of predation and intraspecific actions, especially reproductive behavior, the current knowledge of interactions between the Odonata and other organisms is poor and mainly based on anecdotic descriptions.
So far, the relation between the Odonata and water mites as parasites is the best known system. Recent studies on zebra mussels as colonizers of odonate larvae have revealed a high impact on the development of the latter; therefore, the former constitute more than harmless epizoans. Further relationships have been lost out of sight for a long time, and new ones are arising rapidly as research topics.
There is a wide spectrum of organisms associated with odonates during some part of their life cycle. The Odonata have a variety of endoparasites, ectoparasites, and parasitoids; several are host-specific while others seem accidental. Besides, there are other relationships, such as mutualism and commensalism.
The aim of this review is (1) to give an overview of the current knowledge, (2) to provide a link to very old knowledge, and (3) to offer some insights in the establishment of new scientific approaches from first records and further approaches to advanced studies.

7.2 Dragonfly reactions to frog attacks

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Frogs are common predators of Odonata. We filmed frog attacks on ovipositing *Calopteryx splendens*, *Coenagrion puella*, *Aeshna cyanea*, *Anax imperator*, *Leucorrhinia pectoralis*, and *Libellula quadrimaculata*. The time span from the first movement of the jumping frog to the first movement of the wings was measured as reaction time and to the first flight change as flight time. We found small differences in the reaction times but large differences in the flight times between endophytically and exophytically ovipositing Odonata. However, all species tried to escape rectangularly to the direction of the frogs' jumps.
Frogs were more successful in catching endophytically ovipositing species than in those ovipositing exophytically.

7.3 Edmond de Selys Longchamps, founder of Odonatology

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The year 2013 marks the bicentennial of the birthday of baron Michel Edmond de Selys Longchamps. Who was this man who shaped the classification of Odonata and who described over 700 species, presently regarded as valid, established 134 valid genera in Odonata and described at least eight other valid animal species? How important was his work for the development of odonatology as we know it today? In this presentation, an outline of his life and work will be given: about his background and wealth, about his political carreer, his broad interests in natural history, and his special interest in odonates.

7.4 Demons or angels: dragonfly symbolism in the early 17th century still lifes in the Low Countries

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The still lifes produced mainly between Flanders and the Netherlands during the 17th century are highly realistic pictorial compositions where real-world objects were portrayed as realistically as possible. Although apparently highly descriptive, it is common sense among scholars that such realism is artificial and the combinations of symbolic objects preach moral lessons. Thus, even under the strong influence of Calvinism, the Northern tradition of Catholic symbolism that had been used for centuries could be kept alive. Insects were commonly included, especially in those paintings with floral motifs and set tables, among them the dragonflies. Iconographers agreed that when in confrontation with butterflies they represent the evil, assuming the role of the devil himself. In this respect, two paintings are commonly exemplified: Flower Still Life (Ambrosius Bosschaert the Elder, 1614, The J. Paul Getty Museum, Los Angeles) and Still Life with Cherries and Strawberries in China Bowls (Osias Beert, 1608, Gemäldegalerie, Berlin). In both, inaccurately represented anisopterans are confronted with the butterflies *Vanessa atalanta* (Red Admiral) and *Aglais io* (Peacock), respectively, which are assumed to represent the good side of the scene. Such assumptions were not derived from any systematic study and they are easily placed in context with the consideration of colors and the flower symbolisms, relative position of elements, light etc. It is proposed in the present study that, when in a clear situation of antagonism, nymphalid butterflies can assume the position of evil and dragonflies of the role of good, and due to the cross-shape of their body, they may even symbolize the Christ.

7.5 An automated system for identifying dragonflies from wings

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Dragonflies are excellent ecological indicators for aquatic habitats, but are not always easy to identify. Here, we created and tested a script for the software package, Mathematica, that uses neural networks (NNs) to identify dragonflies to species from scans of their wings. The system was tested with 14 classes: 13 libellulid species classes, with 10-41 individuals each, and one class of "rare" species, containing 27 individuals from 11 species from the Aeshnidae, Cordulegastridae, Corduliidae, Gomphidae, and Libellulidae. After digitization and image processing, two types of information were extracted from the wings scans: 15 traditional morphometric features, which describe relative wing shape, and Gabor-wavelet filter features, which describe the arrangement of edges in an image; coefficients from the latter method were down-sampled using principal components analysis (PCA) and F-statistics. NNs were then trained to positively classify each class and validated to determine classification success rate. The system was optimized by testing different network architectures and five combinations of coefficients. A one-hidden-layer neural network with seven neurons gave the best success rate. NNs trained using the Gabor features down-sampled with PCA in combination with the morphometric features had the best success rate (82.8 %), while those trained with only the morphometric features had the least success (68.9 %). We hope to improve the accuracy of this tool, to incorporate more species, and to make it freely available for use through a website interface with the goal of helping taxonomists, ecologists, government agencies, and others to rapidly and accurately identify dragonflies.

7.6 Dragonflies and cities – species occurrence and diversity in urban habitats

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Urbanisation is one of the major challenges to biodiversity due to transformation of natural landscapes to urban land. Developed areas, such as residential and commercial areas, as well as dense infrastructure, dominantly characterise the urban landscape. Free space mainly remains in form of city parks, domestic gardens, and wastelands, and some relicts of the natural landscape or conservation areas are usually restricted to the urban fringe. Nevertheless, in most cities, a considerable variety of constructed or semi-natural water bodies appears that may offer more or less suitable habitats for dragonflies.

To find out how urbanisation affects dragonfly diversity as well as the occurrence of single species, the available data for more than 40 cities located in Germany and adjacent countries was reviewed and analysed. In average, a number of 44 species (min: 23, max: 59) was recorded in the surveyed cities. The range of appearing species was mainly determined by the regional species pool, with eleven common and widespread species occurring in all cities, including *Coenagrion puella, Ischnura elegans, Aeshna cyanea, Anax imperator, Libellula depressa*, and *Orthetrum cancellatum*. However, in total, 75 of the 81 Central European dragonfly species have been recorded in at least one city. Notably, at least 50 species were able to enter built-up areas and most of them reproduced at urban sites.

The presentation will discuss the influence of urban development and the range of available habitats on dragonfly diversity and point out which species are able to cope successfully with urbanisation and which are not. Finally, it will draw conclusions on how dragonfly diversity could be increased in urban areas.

08 Conservation and management

Convenors: C Stettmer, H Wildermuth

8.1 A conservation program in the Mediterranean for *Lestes macrostigma*

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Lestes macrostigma (Eversmann, 1836) is a stenoecic species that breeds in the brackish waters of some temporary marshes and ponds and lagoons, habitat types that are disappearing. It occurs very patchily across its distribution area and suffers from great abundance variations between years. Consequently, depending on the geographical scale, its red list categories range from NT to CR. In France, this species is included in the National Action Plan for Odonata. Our knowledge of its biology has recently increased. Although females can lay their eggs in several plant species, we found a true preference for *Bolboschoenus maritimus*, which is indicated by a higher rate of stem fitting to oviposition, a shorter time required to lay one egg, and a higher hatching rate for larvae. The influence of salinity on larvae seems surprising: Although *L. ma-crostigma* prefers brackish to fresh waters, the higher the salinity, the higher the larval mortality. In spite of this, as the larvae are relatively tolerant to salinity compared to other dragonfly species, this factor may actually reduce the number of competitors and predators. This would explain the shift of the ecological niche of larvae; but further studies are required to check this hypothesis. These studies are to be carried out in the framework of a temporary pond restoration program, which will take place in the Camargue, southern France. Additionally, this would be an opportunity to assess the dispersal capability of imagines, especially at the teneral stage. These results would be of great interest for the management of *L. macrostigma* populations and to restore its habitat on a larger scale. However, funds are still needed to set up the entire program.

8.2 Conservation of *Coenagrion mercuriale* in Switzerland: research and management

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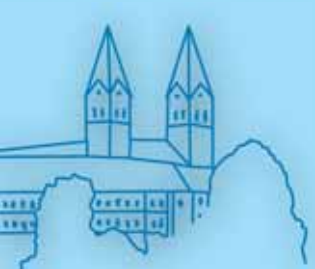
Coenagrion mercuriale is a critically endangered damselfly in Switzerland and a target species of the Smaragd network of protected areas, which is the Swiss equivalent to the Natura 2000 framework of the European Union. The largest Swiss populations of *C. mercuriale* occur in slow-flowing streams and ditches in the Smaragd area Oberaargau, which is located in an intensively managed agricultural landscape. At the start of the Smaragd project, relatively little was known about local habitat preferences and dispersal characteristics of *C. mercuriale* in this region. Therefore, a study investigated habitat preferences of *C. mercuriale*. Subsequently, conservation measures were taken to protect and enhance this habitat. To measure the effectiveness of these actions, the development of populations was monitored yearly. These studies revealed that population sizes were stable or even increasing. Additionally, four new populations were detected at distances of up to 1.2 km from the nearest known populations. Another study focused on connectivity and dispersal between populations of *C. mercuriale*. While closely-located populations were connected by regular dispersal along streams (≤ 1-2 km), dispersal between more distant populations only occurred rarely but also across open land. Furthermore, a campaign was initiated to inform residents of the Oberaargau region about *C. mercuriale.* The effectiveness of the campaign was later evaluated by a survey, which showed that residents of the Smaragd area were well aware of *C. mercuriale*. These results indicate that future conservation management should mainly focus on habitat preservation and restoration, maintaining a well-connected network between populations.



8.3 Distribution and threats to the populations of *Caliaeschna microstigma* (Schneider, 1845) at the western edge of its range

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The distribution of *Caliaeschna microstigma* in Europe is small and restricted to the Balkans only. As its populations have been declining over the past years, the species is classified as near threatened (NT) in the European and Mediterranean Red Lists. In Bosnia and Herzegovina and Croatia, the species reaches its north-western edge of distribution. It occurs only in the Mediterranean region, inhabiting springs, fast-flowing streams, and small rivers. These habitats are critically endangered by human activities and climate change. In Croatia, the species is classified as critically endangered (CR), while in Bosnia and Herzegovina a Red List still does not exist and therefore, the species is not protected.
As population trends of the species are still insufficiently known, research activities were conducted on the distribution and threats to the populations of *C. microstigma* in the western Balkans (Albania, Bosnia and Herzegovina, Croatia, and Macedonia). The first phase of the research covered localities in Bosnia and Herzegovina, Croatia, and Macedonia and has revealed a more detailed and wider distribution of the species than hitherto known. Its habitat preferences in the investigated area were inspected as well. Besides, it was evidenced that in the first instance, these habitats are highly endangered by construction plans for additional hydro power plants and by water extraction projects. Our work will contribute to the development of the monitoring programme, to protection plans, and to long-term conservation of *C. microstigma* in the countries of the western Balkans.

8.4 Habitat conservation for *Cordulegaster heros* in the Czech Republic (Odonata: Cordulegastridae)

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Cordulegaster heros is a species endemic to south-eastern Europe, occuring in the Balkans with several outposts on the foothills of the Eastern Alps and the Carpathians. In 2009, the species was registered for the first time in the Czech Republic. During intensive research in 2011 and 2012, larvae of *C. heros* were found at 21 sites in four catchment areas of small streams in mixed oak-beech forests of the Chřiby Hills in south-eastern Moravia. These streams were characterized as unregulated streams with an average width of flow of 0.35-2.00 m, with slopes of 1-4° and depths of 2 to 15 cm (in pools with depths of 5-65 cm), and with a substrate composition classified as sandy with presence of clay and silt, small gravel, and boulders.
According to the European Red List of Dragonflies, *C. heros* belongs to the category Near Threatened and is included in Annex II and IV of the Habitats Directive of the European Union. Thus, monitoring rules and action to assure its conservation are needed. We summarize the negative impacts on the species' habitat. These include significant changes in the stream bed, such as construction of embankments, longitudinal reinforcement of stream banks, permanent water pollution, extensive long term freights of clay and silt particles, disturbances in the water flow dynamics, reduced sedimentation of organic and inorganic matter, and intensive unsuitable deforestation in the catchment area near streams.
The only way to conserve and promote *C. heros* in Moravia is to protect its habitats, *i.e.*, to eliminate negative impacts on naturally-structured streams and their immediate environment. We propose the foundation of a conservation area of 1,200 hectares within Natura 2000, the EU-wide network of nature protection areas established under the 1992 Habitats Directive, and of two small-scale protected areas to be created according to national legislation.

In management plans, we defined objectives with regard to the meandering upper reaches of streams with sandy deposits in forested stands, as well as appropriate actions: (i) special forest management units with recommendations to adapt the rules of temporal and spatial arrangement; (ii) special regulation of reforestation, i.e., to use only natural methods of forest regeneration; (iii) adaptation of the rules of timber transport to avoid damage to the soil surface not to cross a streambed during timber transport; (iv) establishment of core zones in areas along the watercourses with a width of 40 m along all streams, where also, any kind of timber harvesting is prohibited; (v) regular monitoring of habitat integrity and populations to identify potential threats; (vi) to draft a compensation programme for forest owners affected by application of the management restrictions.

8.5 Distribution and protection of dragonflies of European conservation concern in Bosnia and Herzegovina

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The Odonata fauna of large parts of the Balkans, including Bosnia and Herzegovina, is one of the least known in Europe. In order to enable the long-term conservation of dragonflies, it is crucial not only to have good knowledge on the occurrence of dragonflies and their habitats, but also on the trends of population sizes, and to identify the key habitats for dragonflies.

In 2009, we started with a survey of the dragonfly fauna in the country. The main focus were the species of conservation concern, especially species of European concern, here defined as the IUCN Red List species and the ones mentioned in the Habitats Directive.

We present some results of the survey and give an overview on the distribution and status of the rare, potentially threatened species and those of European concern in Bosnia and Herzegovina. Up to now, 63 species were found, including six species of European concern. A list of 13 rare and potentially threatened species is compiled, and a network of 15 key areas for dragonflies has been identified. A national dragonfly database has been created, holding all available data, including species present in collections, published in literature, and more than 4,000 new records.

A Red List is planned for the future. Most species and several important habitats are not protected at all. Aquatic habitats are increasingly threatened by human activities and, in combination with climate change, will significantly lead to the deterioration of the conservation status of many species in the near future. Karst watercourses are considered to be the most important aquatic habitats and are very important for many species. The main threats are represented by regulations of water flow, construction of dams, climate change, pollution, and introduction of alien species.

8.6 The Dragonfly Association Index – a new tool for the type-specific assessment of lowland rivers

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Species traits of 57 Odonata species occurring in the Bioregion Eastern Ridges and Lowlands within Illies' Ecoregion Hungarian Lowlands were defined by factor loadings of twelve habitat parameters: crenal, rhithral, potamal, standing water, size of water body, flow velocity, water persistence, open water area, open banks, riparian trees, submerged macrophytes, and reed. Based on the species-specific configurations of these habitat parameters, Pearson correlations and cluster analysis (squared Euclidean distances; Ward method) revealed seven dragonfly associations with different habitat needs: rhithral association, potamal assoc., assoc. of open banks, assoc. of open water, assoc. of reed beds, assoc. of reed beds combined with riparian trees and assoc. of temporary waters. Correlations between the associations' habitat requirements and the habitat factors of near-natural river types in this bioregion were performed to define river-type specific association compositions characteristic of small headwater streams, larger meandering and marshy rivers. Based on these results, the Dragonfly Association Index was created to assess the ecological status of these rivers in the 5-tiered system of the EU Water Framework Directive by comparing the type-specific reference situation with the actual status quo. The method can also be applied to evaluate restoration measures.

8.7 An overview on the protection of dragonflies (Odonata) in Europe

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The most important regulation in Europe for the protection of dragonflies is the Habitats Directive (1994), which aims to maintain or restore natural habitats, fauna, and flora in the Member States of the European Union. One of the regulations of this Directive is that Member States have to designate special areas of conservation for the species mentioned in Annex II. Species of community interest in need of strict protection are mentioned in Annex IV. Altogether 16 dragonfly species are mentioned in one of both Annexes. Furthermore, many dragonfly habitats, especially the most rare and threatened, are also protected by this Directive.
In addition, many European countries have national legislation that often protects a different set of species. The aim of these national legislations and their enforcement varies strongly between countries, making a comparison difficult. In some countries, no species are protected, in others a limited number, mostly the species of the Habitats Directive, and in a last group of countries, all dragonflies are protected, so that the netting of dragonflies or even the collecting of exuviae is prohibited.
I give an overview on the species protected in Europe and compare this with the species that are only protected on a national level. From the results of the European Red list (Kalkman et al. 2010), it became clear that many threatened species in Europe are not mentioned in the Annexes of the Habitats Directive and, therefore, don't receive the necessary attention in European conservation policy. Moreover, most of the threatened species are also not covered by national legislation. Therefore, an update of the protection of dragonflies in Europe is urgently needed.

Kalkman VJ, Boudot, JP, Bernard R, Conze KJ, De Knijf G, Dyatlova E, Ferreira S, Jović M, Ott J, Riservato E, Sahlen G. 2010. European Red List of Dragonflies. Publications Office of the European Union, Luxembourg

8.8 Dragonflies – guardians of the rice fields

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In spring 2011, the LEGATO-project (www.legato-project.net), which is funded by the Federal Ministry of Science and Education in Germany, started in Southeast Asia in Vietnam and the Philippines. The target of the project is to advance long-term sustainable development of irrigated rice fields against risks arising from multiple aspects of global change.

The overall objective is the elaboration and testing of generally applicable principles within the frame of ecological engineering – an emerging discipline concerned with design, monitoring, and construction of ecosystems.

Here, the first results of some investigations on the ecology of dragonflies in rice ecosystems are presented, in particular, those carried out in Vietnam, and recommendations for the ecological improvement of the rice fields are given, such as improvement of the system by adding small natural waterbodies to repopulate the rice fields after harvesting.

Dragonflies are good environmental indicators and top-predators in the aquatic system, and therefore, the rice fields in Vietnam have a distinct dragonfly community, including, e.g., *Ischnura senegalensis*, *Agriocnemis femina*, *Orthetrum sabina*, *Pantala flavescens*, and others. In particular, *I. senegalensis* and *P. flavescens* are sometimes abundant and important predators of pests, such as the brown plant- hopper (BPH), *Nilaparvata lugens* (Stål) (Homoptera: Delphacidae). The entomofauna of rice fields is affected strongly by the intensive use of pesticides, which also can be detected by the abundance of dragonfly species and their coenoses (bioindication).

8.9 How are Australia's listed dragonflies doing?

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The listed Australian dragonfly species are introduced. Conservation status and its original reasoning, habitat, and distribution of all listed Australian dragonfly species are given. The habitat photos include one particular habitat per species. The specific distribution maps show all available records with those from before the listing and those since the listing being pointed out. The records are superimposed on maps showing the potentially suitable range predicted on matching environmental conditions (climate and habitat characteristics) from the recorded locations for the present and for 2080, considering a scenario with average temperature rising by approximately 5°C. Also presented is some information on behavior, ecology, biodiversity, taxonomy, and systematic status and position gathered at least partly by increased attention to the listed species. It is concluded that, in spite of additional records and sometimes considerable range extensions, the conservation status of the listed species is appropriate as anthropogenic impact is increasing, particularly from population growth and climate change.

9.1 Molecular phylogenetic analysis of the Libellulidae of Mizoram, northeastern India, using mitochondrial Cytochrome Oxidase I gene marker

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Mizoram represents an important part of the Indo-Myanmar biodiversity hotspot situated in the southernmost part of northeastern India. In the present study, 26 species of the Libellulidae were recorded for the first time from Mizoram, from the genera *Acisoma, Aethriamanta, Bradinopyga, Brachydiplax, Cratillia, Crocothemis, Diplacodes, Neurothemis, Orthetrum, Pantala, Potamarcha, Rhyo-themis, Tetrathemis, Tramea, Trithemis*, and *Tholymis*. To compare the similarity between the species, CO1 mitochondrial sequence was used to calculate the p-distance and was found to be highest between *Potamarcha* and *Neurothemis* and lowest between *Tramea limbata* and *Tramea basilaris*.

Phylogenetic analysis was done using Maximum likelihood and Maximum parsimomy method in PAUP; in MP analysis, the two *Tramea* species were placed as sister–species and all three *Neurothemis* species were recovered as sister clades. The *Orthetrum* species had high support values, except *O. sabina*, which was nested in a different clade. In the Maximum likelihood analysis tree, all the *Neurothemis* species, two *Tramea* species, and the four *Orthetrum* species, each formed sister clades and *Potamarcha obscura* was basal to all the other species.

9.2 Contrasting the diversity of odonates in the five islands within the Straits of Malacca

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Records of Odonata collected on five islands within the Straits of Malacca, namely Pulau Langkawi (Kedah), Pulau Pinang, Pulau Pangkor (Perak), Pulau Carey (Selangor), and Pulau Besar (Melaka) off the west coast of Peninsular Malaysia are presented. A total of 58 species belonging to 12 family groups were identified. The highlights of the collection are a species endemic to Pulau Langkawi and one new record for Peninsular Malaysia. Although no other endemics were found in Pulau Besar, Melaka and Pulau Pangkor, Perak, all were first records for the islands. The Shannon diversity index indicated that Pulau Pinang is relatively diverse (H' = 2.945), followed by Pulau Langkawi (H'=2.916), Pulau Pangkor (H'= 2.346), Pulau Besar (H'=2.12), and the lowest diversity index was for Pulau Carey (H'= 1.949).

9.3 Population, distribution, and habitat characteristics of *Zyxomma obtusum* in the City and Regency of Malang, East Java (Odonata: Libellulidae)

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Zyxomma obtusum is a crepuscular species with white body color, and it has a distinctive habitat that is different from other dragonflies. The cryptic species prefers shaded ponds, and therefore, it is not easy to find. Our research aimed at studying populations, distribution, habitat characteristics, and environmental factors of the habitat of *Z. obtusum*. The study was conducted in the City and Regency of Malang, East Java, from October to December 2012. Data collection in the study area comprised habitat characterization, including the substrate type of waters where *Z. obtusum* was found, the recording of aquatic and riparian vegetation, the depth, temperature, humidity, and pH value of the waters at each recording site. The results demonstrate that there were four *Z. obtusum* distribution centers, i.e., Tlogomas Recreation Park, Wendit aquatic zone, Dieng Valley, and Sawojajar Fishing Pool. Each location exhibited different habitat characteristics and different frequencies of *Z. obtusum*. The greatest total frequency was found in the Valley of Dieng with 22 individuals, including a daily frequency of eleven individuals on the 3rd day of observation. The smallest total frequency was found in Tlogomas Recreation Park with six individuals. *Zyxomma obtusum* preferred muddy pond waters with a temperature range from 23.1 to 29.1°C, with a range in relative humidity of 69-92 % and a light intensity between 145 to 8028 lux. It was on the wing at ponds with depths from 14.0 to 66.5 cm and pH values ranging from 6.6 to 8.1. Each recording site had different riparian vegetation, comprising among others the species *Muntingia calabura*, *Roystonea regia*, *Salacca zalacca*, and *Artocarpus heterophyllus*. Such plants can play a role in controlling the microclimate of *Z. obtusum* habitats and constitute the place for its inhabitation.

9.4 Characteristics of the odonate assemblages of African biomes

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The aim is to present an overview on the dragonfly species assemblage compositions of various African biomes. The analysis is based on the Odonata Dragonfly Database of Africa (ODA), which included 91,000 records at date of analysis. All dragonfly records, i.e., point locality data, were assigned to one of 20 biomes and to one of 10,195 sub-basins (Hydro1K) within these biomes. For 20 % of these sub-basins, recording data were available. I compare species compositions between the biomes by analysing species-rank-abundance and components of species richness, such as alpha and gamma diversity, both based on relative numbers of sub-basins in which each species is recorded (species presence). The recorded species richness per biome (gamma diversity) ranged between 518 species in tropical rain forests and 53 species in Subtropical Mountains in northern Africa. The highest species number per sub-basin (163) was, however, in the Tropical Moist Deciduous Forests biome in southern Africa. As expected, species-rank-abundance curves were steepest in the harsher, i.e., arid, environments, and those biomes were dominated by the most widespread species, which were then recorded in a large number of basins. For instance, *Pantala flavescens* was present in 79 % of basins in the Tropical Deserts in southern Africa, but just 28 % of all Rainforest sub-basins.

10 Life histories

Plenary talk:
10.1 Life history patterns revisited: Seasonal regulation and cohort splitting in temperate-zone Odonata

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Life history theory has stimulated the study of the life cycles of temperate zone Odonata as explained by a combination of biotic interactions and seasonal climatic constraints. However, information on voltinism shifts and cohort splitting is still scarce.
The temporal emergence window in temperate climates ensures a successful reproduction, and that a resistant stage can be reached before winter. This requires regulation of development via anticipatory mechanisms to accelerate development (in pre-emergence development) or to postpone emergence (in pre-hibernation development). The responses involved seem to be a seamless transition between a costly accelerated development and a delayed development (diapause sensu latio). At lower voltinisms, splitting of year-class cohorts is the rule rather than an exception, and this split is often initiated early. Theoretically, the slow cohort can then trade the costly extra year, via control of growth and morphogenesis, for reduced exposure to predators, an optimal adult size and emergence time, less competition with fast growers, and a safe overwintering stage.
There is often a late-stadium, two-step photoperiodic reaction with different responses to photoperiod in different stages determining the location of the cohort split. At higher latitudes, pre-hibernation development is delayed by long days, terminated and reset by the short days finally inducing winter diapause, and in spring pre-emergence development is stimulated by long days (time constraint). Pre-hibernation development is re-entered by smaller larvae under excessive time constraint, causing the split. Enduring, constant photoperiods are not conducive to fast growth.
Cues and proximate responses are discussed.

10.2 Larval development of six European *Lestes* species

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Hitherto, data about larval development and number of larval stadia exist for four out of seven European species of the genus *Lestes* (reviewed in Jödicke 1997: 162). According to the data compiled by Jödicke (1997), all European species have a rapid, univoltine development with between nine and 13 stadia including the prolarva. This is at the lower end of the 8-17 larval stadia generally needed for larval development by Odonata (Corbet 1999). All European species of the genus *Lestes* can develop successfully in temporary water bodies. However, *Lestes barbarus, L. dryas* and *L. macrostigma* are specific for this unique type of water. To find out whether there are developmental differences between those European *Lestes* species that are more or less restricted to temporary waters and those that can use both temporary and permanent waters for reproduction, *L. barbarus, L. dryas, L. macrostigma, L. sponsa, L. virens*, and *L. viridis* were reared in the laboratory from hatching to emergence. The number and duration of each larval stadium and the time span each species needed for the different stadia and for total development were documented. Furthermore, head width and total length of larvae of each stage were measured to document the growth progress. The data of the six *Lestes* species studied were compared in order to find explanations on how they are adapted to survival in temporary water bodies.

Corbet PS. 1999. Dragonflies: Behaviour and ecology of Odonata. Harley, Colchester

Jödicke R. 1997. Die Binsenjungfern und Winterlibellen Europas: Lestidae. Die Neue Brehm-Bücherei 631. Westarp Wissenschaften, Magdeburg & Spektrum, Heidelberg

10.3 Photoperiod and variation in developmental rates in core and peripheral populations of the damselfly *Lestes sponsa*

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Genetic and phenotypic variation in developmental and growth rates along latitudinal gradients may benefit our understanding of the evolution of latitudinal compensating mechanisms. We explored compensatory developmental mechanisms with respect to photoperiod in central, northern, and northernmost populations of the damselfly *Lestes sponsa*. In addition, genetic variances in developmental and growth rate were evaluated across the populations.

Lestes sponsa is strictly univoltine with egg overwintering throughout its geographic distribution. Larvae from each region were grown under common garden conditions in both high and low latitude photoperiods.

All populations shortened development time and accelerated growth as a response to high latitude photoperiod. The elevations and slopes of reaction norms differed between populations, and this resulted in a genotype-by-environment interaction in development time and growth rate.

Genetic variance (Vg) in development time was significant; however, it did not differ across populations. Vg in growth rate was non-significant. Reaction norms in development time and growth rate also showed non-significant Vg.

Results supported the presence of countergradient variation in development time and growth rate as more seasonally time stressed populations took shorter times for development and grew faster than less time stressed populations. Slopes of reaction norms indicated that the latitude compensating mechanism was mediated by photoperiod. While growth rate seems to be genetically constrained for further evolution, development time has a potential to evolve, though at a similar rate across study regions. Reaction norms seem to be canalized with respect to photoperiod.

10.4 A model for simulating dragonfly life cycles: application for studying latitudinal compensation hypotheses

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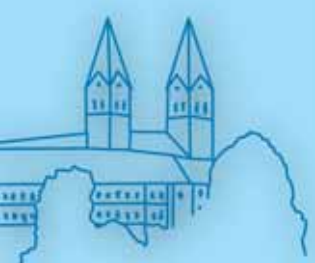
In this presentation, we aim to introduce a newly developed modelling framework for simulating dragonfly life cycles. The core of the model is a stage structured population model comprising multiple environmental responses; in this case, temperature response and responses of seasonal control mechanisms to changes in phototoperiod, i.e. diapause induction. The framework requires a system of partial integro differential equation, which was solved by using the Software tool COMSOL Multiphysics, which supports equation based modelling in an interactive environment.

The model can be applied to investigate various questions; for instance, the advantage of regulated versus unregulated life cycles for species occurring in different environments. In this presentation, we show results of applying the model to investigate different latitudinal compensation hypotheses, namely the thermal adaptation hypothesis and the countergradient variation hypothesis. The results are compared to the outcome of laboratory experiments as well as to field data. The model organism was *Leucorrhinia dubia*, a fairly widespread odonate occurring in the temperate and boreal zone.



11 Ecology

11.1 Predation and pollution in a warming world: what can we learn from latitudinal gradients?

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Under global warming, animals will not only need to deal with the temperature increase but also with changed interactions with prey and contaminants. We applied a space-for-time substitution approach using a series of common garden warming experiments to study the foraging rates and the vulnerability to contaminants for *Ischnura elegans* damselfly predators along a latitudinal gradient spanning >1,500 km. Damselfly foraging rates showed thermal plasticity and strong latitudinal differences consistent with adaptation to local time constraints. Our results further suggest the invasion success of northward moving predators as well as prey to be latitude-specific. We also observed a striking latitude-specific effect of temperature on the zinc-induced mortality pattern; local thermal adaptation along the latitudinal gradient made Swedish, but not French, damselfly larvae more vulnerable to zinc at 24°C. Latitude- and temperature-specific differences in zinc vulnerability may be related to the amount of energy available to defend against and repair damage since Swedish larvae showed a much stronger zinc-induced reduction of food intake at 24°C. The pattern of local thermal adaptation indicates that the predicted temperature increase of 4°C by the year 2100 will strongly magnify the impact of a contaminant such as zinc at higher latitudes unless there is thermal evolution and/or migration of lower-latitude genotypes. Our results underscore the critical importance of studying predation and the vulnerability to contaminants under realistic warming scenarios taking into account local thermal adaptation across natural temperature gradients.

11.2 Farmland versus forest: comparing changes in Odonata species composition in western and eastern Sweden

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Despite the loss of natural ecosystems in the developed world during the past millennia, anthropogenic landscapes still sustain much biodiversity. Our question was, whether ten year changes in regional Odonata faunas are comparable between farmland and forested areas, or if the species pool of farmland areas respond in other ways than that of forest. We used data of dragonfly larvae collected from 16 lakes in a farmland area in south-western Sweden in the years 2002 and 2011/12, and compared these to data from 34 lakes in a forest area in south-eastern Sweden in the years 1996 and 2006.

The species-richness in the agricultural region increased by 17 % but decreased by 13 % in the forested region. The changes in occurrence and regional distribution were similar in both areas, affecting 71 % and 69 % of the species pool. Average extinction rates were comparable between the agricultural and the forested region (38 % and 43 %) while colonization rates differed greatly (64 % and 114 %). The species composition differed between the regions; the forest lakes harboured a 29 % larger species pool. It is possible that in the forested region, the regional species pool in areas surrounding the study sites could counterbalance the extinctions and have a positive effect on changes in species composition. We assume that the different habitat structures of the waters in the agricultural and the forested regions and changes in temperature are the main driving forces behind the shifts. The mean seasonal air temperature has increased by circa 0.5°C in both regions when compared with ten-year periods before each sampling year.

11.3 Habitat selection of larval *Macromia clio* and *M. daimoji* in Taiwan (Odonata: Macromiidae)

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Data about larval microdistribution of *Macromia* species are largely deficient. At least it is known that there are two main groups according to their behavioural and morphological traits: the sand-dwellers and the "vegetation"-dwellers (*i.e.*, species that cling to vegetable obstructions, root mats, or mossy rocks). In order to investigate microdistribution of two species occurring in Taiwan, experiments were carried out using 25 larvae of *M. clio* and 15 larvae of *M. daimoji*. The larvae could select between four different substrate types: gravel, sand, sand covered with leaves, and a cobblestone surrounded by sand. Larvae of *M. daimoji* preferred the substrate type 'sand' and were mostly covered with sand partially or completely. In contrast, larvae of *M. clio* preferred 'sand covered with leaves' and were often covered partially or completely by leaf litter. However, they were never found buried in sand. In *M. daimoji* the results of the experiments correspond to observations in the field. In the experiments, larvae of *M. clio* clung rarely to the offered cobblestone, although in the field they had been often found on vertical structures, such as roots and rocks.

11.4 Sex-ratios, survivorship, and phenology in a sexual population of *Ischnura hastata* from Cuba (Odonata: Coenagrionidae)

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A capture-mark-recapture study was performed in a sexual population of *Ischnura hastata* in Cuba during May-June 2012. A total of 240 males and 918 females were marked. During most days, the sex-ratio was heavily female-biased, with males representing only 16 % of mature individuals. Nevertheless, among newly emerged and immature individuals, an even sex-ratio was found.
Mark-recapture histories were analysed using the Cormack-Jolly-Seber model, with MARK (survival and recapture rates) and POPAN (population size) software. We used the corrected Quasi Akaike's Information Criterium (QAICc) to select the most supported model given the data. This model suggests that survival and recapture rates show daily variation, but the effect of sex on these parameters is not relevant. The estimated recapture rate was only 0.208, with a daily survival rate of 0.539. Using model Phi(g) p(g), survival rate was estimated as 0.448 for males and 0.553 for females, with a recapture rate of 0.332 for males and 0.192 for females. Daily population size was estimated as 3-60 males using Jolly and Manly-Parr methods, but was about 6-1,000 females (Jolly) or 6-300 (Manly-Parr). For a comparison with the situation in the field, a sample of egg clutches from this population was reared in the laboratory. Results of laboratory rearing indicate that sex-ratio is 50 % but males emerge on average 12 days earlier than females. These results suggest that female-biased sex-ratio is not explained by differences in survivorship alone. The biological relevance of these findings is discussed.

11.5 Field notes on the oviposition of *Ceriagrion coromandelianum* (Fabricius) in central India (Odonata: Coenagrionidae)

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Ceriagrion coromandelianum (Fabricius) is one of the most common damselflies on the Indian subcontinent. It flies among bushes and breeds in stagnant pools, small garden tanks, tubs, and ornamental cement ponds containing submerged and/or floating vegetation. The oviposition behavior of *C. coromandelianum* was observed for 50 days (25th March – 12th May, 2008) between 09:30 and 11:30 h a.m. at the Botanical Garden of Hislop College, Nagpur, Central India (21010'N, 79002'E), where small cement tubs are utilized to grow macrophytes. The tubs mostly contained floating (water lilly *Nymphaea nouchali* and/or duckweed *Lemna paucicostata*) and submerged (*Hydrilla verticillata*) plants. The tubs made a perfect breeding site for *C. coromandelianum*. The tubs were surrounded by bushes of flowering plants, and by afternoon, this area fell in the shadow of the college building. During the study period, the average maximum and minimum temperature was 31.8°C and 23.5°C, respectively, while the average precipitation was 6.86 mm. *Ceriagrion coromandelianum* generally exhibited contact guarding, endophytic oviposition, singly or in groups. A total of 152 ovipositions were recorded during the study period. *Ceriagrion coromandelianum* displayed a refined hierarchy of preferences for oviposition and chose floating leaves of *N. nouchali* (68 %) over *L. paucicostata* (22.5 %) and submerged *H. verticillata* (9.5 %). In an uninterrupted oviposition bout, the female deposited 283 eggs in 16 rows (N=5) on the undersurface of *N. nouchali* leaves. The tiny leaves of *L. paucicostata* held 7.8 eggs in 4.8 rows (N=10). In *H. verticillata*, the internode region of the stem could house 25.4 eggs (N=10). One or two eggs were found neatly inserted in the thin leaf base of *H. verticillata*. Decaying plant material was never used for oviposition.

The females visited the water only for copulation and oviposition, while the males could be spotted at all times around the shrubs near the ovipositing site. The total number of single males and females recorded were 117 and 25, respectively. On the other hand, 26 non-ovipositing tandem pairs were observed around the water body. Seven pairs exhibited the ritual of 'water-touching' after completing oviposition. Females rested in tandem between oviposition bouts for 5-15 min in a characteristic stance, with stiff straight abdomen positioned at 45 degrees. The males belong to the 'sit and wait' type of mate-location mode. They were less localized, more tolerant to intruders and did not exhibit site tenacity. They also exhibited some peculiar behavior such as 'abdominal bobbing' and also mimic 'oviposition posture' of the female. Some males had the abdominal tip slightly bent downwards. Single males chased or followed the tandem couples but did not seriously try to break the tandem. The males acquired the typical sentinel posture during oviposition, which helped not only to counter the threat of predation and interference but also initiated group oviposition.

11.6 Embryonic development and inter-specific predation in three species of the genus *Sympetrum*

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Three species of the genus *Sympetrum*, *S. frequens, S. darwinianum* and *S. infuscatum*, are widely distributed across Japan and are commonly found in rice paddy fields. In recent years, *S. infuscatum* has become more abundant, while *S. frequens* and *S. darwinianum* have decreased or disappeared from rice paddy fields.

First, I focused on the effect of temperature on the development, diapause and hatching of eggs in order to better understand overwintering mechanisms. Embryos of the three species were carefully observed, and their embryonic development was divided into seven stages. Distinct embryonic developmental patterns were recognized at the five temperatures tested (6, 11, 16, 21 and 26°C). At low water temperatures, katatrepsis of *S. frequens* was completed more rapidly than that of *S. darwinianum* and *S. infuscatum*. At higher temperatures, the egg hatching rate of *S. frequens* was significantly lower than that of *S. darwinianum* and *S. infuscatum*. The eggs of *S. frequens* exhibited thermal responses that allowed the eggs to adapt to higher temperatures in winter. The eggs of *S. infuscatum* developed more rapidly at higher temperatures than did those of other species.

Second, we focused on the variability of the frequency of cannibalism and intraguild predation (IGP) with density, larval size, and food availability. Cannibalism occurred only once in 96 pairs involving *S. darwinianum* and *S. frequens* larvae, but it increased dramatically irrespective of food availability among *S. infuscatum* larvae. IGP did not occur in combinations of *S. frequens* and *S. darwinianum*, but it did increase dramatically for combinations of *S. infuscatum* and the other two species. These results indicate that *S. infuscatum* has an advantage over the other two *Sympetrum* spp. in rice paddy fields.

11.7 The impact on domestic dragonflies by invasive alien species: examples from Japan with the recent expansion of an alien damselfly

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The problem of the serious impact of invasive alien species on the natural fauna, especially on freshwater organisms including the Odonata, has been observed in Japan during the past twenty years. Here, we discuss several cases of invasion:

In the 1990s, American Crayfish rapidly increased their population sizes in several important conservation areas of Odonata and executed a very serious impact on both water plants and dragonflies. A well-known example is the Okegayanuma marsh in the Sizsuoka Prefecture in central Japan, where American Crayfish had occurred for a long time already; but in 1998 their population suddenly increased. As a consequence, several endangered species became abruptly extinct in the marsh, including the highly endangered *Libellula angelina* and *Epitheca marginata*. A similar phenomenon happened in the Aichi prefecture in 2004.

The alien fish species Black Bass and Blue Gill also have negative impact on the local odonate fauna, preying not only on larvae but also on adults. Video recordings show the predation of, e.g., *Sympetrum uniformis* by Black Bass.

In the oceanic islands of Ogasawara, five endemic species of Odonata have been recorded. In the 1960s, during the American government days, the Green Anolis, an alien lizard, was introduced, probably from Guam. This species gradually expanded its population size and distribution. Finally during the 1980's in the Chichi-jima islands, almost all diurnal species disappeared, and later studies make clear that Green Anolis predation lead to local extinctions.

The alien plant species *Bischofia javanica* invaded domestic forests and led to a closing of the tree canopy, which resulted in the phenomenon that the endemic damselfly *Rhinocypha ogasawarensis* and other species lost their reproductive areas and rapidly decreased in the Haha-jima islands. After the extermination of the alien tree, the *R. ogasawarensis* population soon recovered.

A recently established, new population of the damselfly *Ceriagrion auranticum* rapidly expanded in the southern Kanto area (Kanagawa Prefecture and Tokyo). Naturally, this species occurs in southern Japan, very distant from the new southern Kanto population. As a result of molecular phylogenetic studies, it became clear that this population in fact belongs to another clade, far from the natural Japanese population, giving evidence that this new population was introduced, maybe with the import of water plants from southeastern Asia.

12 Watch the dragon, see the change: Odonates as indicators of ecological integrity and climate change

Convenors: J Ott, JP Simaika

12.1 Watch the dragon, see the change

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Most rapid freshwater bioassessment methods currently in use depend on sampling aquatic larvae from multiple taxa, and tend to be measured at a lower taxonomic resolution. The need for cost effective, yet reliable aquatic bioindication methods has driven research into simpler methods. Their conspicuousness and the ease of their identification, has made adult dragonflies icons of freshwater biodiversity research. In Europe and South Africa this research has driven the development of indices at a high taxonomic resolution based only on adult dragonflies. As a taxon dragonflies have been shown to be very good surrogates for other freshwater taxa, while the reverse is not true. Adult dragonflies are now used to indicate not only ecological integrity, but also changes in land use, climate, and restoration success. Here I review the research and development of indices of ecological integrity using dragonflies, the variation of their applications, and the advantages and disadvantages of their use.

12.2 How to monitor the unknown

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It is generally well-known how to monitor dragonfly populations by the recording of adults, larvae or exuviae. For most species this is a normal and well-established practice in ecological research and landscape planning projects.
On the other hand, some species with a particular ecology, which are hard to find or not easy to distinguish from similar species, are often – when searched specifically – not that rare as previously expected.
Here some European examples are presented (*e.g.*, *Ischnura pumilio, Coenagrion scitulum, Gomphus flavipes, Somatochlora arctica, Epitheca bimaculata, Cordulegaster bidentata*) and general recommendations for future monitoring programmes for these species are given.

Figure 1: *Cordulegaster bidentata* female, just emerged. Photo: Bernd Kunz (28 Mai 2013).

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12.3 Placing the Odonata in the context of the biological response to environmental change: a case study using UK records

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Odonata have a long history of recording in the UK, making them ideal for study in the context of global environmental change. It has been suggested that odonates can be "barometers" for global change, acting as surrogate taxa from which the responses of other species can be inferred. However, the use of odonates as bioindicators of change in this way relies upon (i) a consistent response of odonates to climate change, and (ii) an agreement between the responses of this group and the responses of other taxa. I will present data illustrating the shifts in range and phenology in the Odonata in comparison to recent environmental change. I will then compare the Odonata to 37 other British taxa, including mammals, amphibians, reptiles, vascular plants, lichens, fungi, crustaceans, arachnids, collembolans, and 14 other taxa of insects, totalling almost 30 million records over the last 300 years of recording in the UK. This overview will highlight the location of Odonata within the context of biological responses to changing environmental conditions, and the extent to which the odonate response is representative of the general biological signal.

12.4 Getting the measure of freshwaters using dragonflies in a changing world

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Freshwaters are changing rapidly under human pressure. In accordance with the Aichi Biodiversity Targets, this requires a concerted effort to manage freshwaters for optimal improvement. Any management, however, requires assessments of the extent to which those freshwaters have moved away from the natural, reference condition, and once managed for the better, to determine how effective the conservation management activity has been. For these assessments, an efficient, sensitive and cost effective methodology is required. Such a methodology, known as the Dragonfly Biotic Index (DBI), has been developed in South Africa using adult dragonflies both as environmental and as biodiversity indicators. This method involves the use of three sub-indices based on dragonfly geographical range, Red List status and sensitivity to anthropogenic change. The DBI correlates well with macroinvertebrate communities normally used for such activities. However, the use of dragonflies is more sensitive (as it operates at the species level) and is easier to use (requiring only observations from the bank). The methodology has been tested extensively in the field and is regarded by freshwater assessment practitioners as having great value. In response to this popularity, a Handbook of Freshwater Assessment has been developed, which gives details of how to implement the DBI across South Africa. The method is now also being developed in slightly modified form for the whole of the African continent by a team of odonatologists.

12.5 Use of DBI in southern South America: first steps in Argentina

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The DBI is a compound index based on three subindices: size of geographical distribution, risk of extinction and sensitivity to habitat change, and has proven to be an effective index for assessing ecological integrity, habitat quality, and recovery in restoration programs in South Africa.
In order to give a DBI score to a species, it is necessary to know its distribution area, its threat status, and its sensitivity to habitat disturbance. Despite the extensive fieldwork done in Argentina, not all the information needed to assign DBI scores is readily available:
1. Geographic Distribution: The last checklist of Argentina included 256 species. A complete database is still under construction; and it consists of more than 5,000 records.
2. Threat status: This is the weakest point when trying to assign DBI scores. From the total species of Argentina only 171 have been assessed based on IUCN Categories and Criteria.
3. Sensitivity to habitat disturbance: Descriptions of collecting sites have been recorded for the last 15 years. Efforts have been made to categorize them according to the level of disturbance.
In order to overcome the lack of information related to threat status, we plan to give national DBI scores by measuring the level of protection of the species. This can be achieved by overlapping modeled distribution maps of Argentinean species with those of protected areas. Although these scores will not be able to be used comparatively with other countries, it will provide a useful tool to assess ecological integrity and habitat quality in Argentina.
For the DBI to be useful, good field guides need to be made. There is only one guide available for the Yungas region. A photographic database is under construction mainly for Buenos Aires and Corrientes.

12.6 Dragonfly monitoring in the Netherlands: abundance trends versus distribution trends

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The Dutch Dragonfly Monitoring Scheme has been running since 1998. It aims to generate population trends (trends in abundance) for as many dragonfly species as possible. A few hundred voluntary observers have been counting dragonflies along fixed transects, using a standardised field protocol. After 15 years however we conclude that our goals are only partially achieved. Trends in abundance are obtained for 71 % of the species, but some obstinate bottlenecks remain. Most importantly, in some regions only few volunteers could be recruited, leading to undersampling of some regions which might lead to biased national trend estimates. Furthermore, counting dragonflies along fixed transects is neither suitable for species with an opportunistic habitat choice, nor for species with (very) low numbers of adults along the waterside. In order to improve the monitoring scheme we have asssessed trends in distribution, next to trends in abundance. These distributional trends are based on opportunistic data *(i.e.*, records collected without a standardised field protocol), analysed with occupancy models. We showed that the distributional trends give similar information on the decline and increase of species, but have a lower risk of bias because of the much better geographical coverage of the data. Reliable distribution trends are available for 85 % of the species. On the down side, distributional trends are less sensitive: it takes longer to detect a trend in distribution than in abundance. A pilot study with five different countries in northwestern Europe showed that occupancy modelling can be successfully used to generate supranational distribution trends for dragonflies as well. Our future aims are to incorporate distributional trends into our national monitoring scheme and to assess pan-European distributional trends in dragonflies.

12 Watch the dragon, see the change: Odonates as indicators of ecological integrity and climate change

12.7 Can post-mining areas be considered 'secondary biodiversity hotspots'? Dragonflies already know the answer

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This study focuses on dragonfly biodiversity in human-altered and human-made freshwater ecosystems, with emphasis on the ecological significance of (post-)industrial aquatic habitats, particularly in post-mining areas. It was found that the distribution of several dragonfly species, in particular habitat specialists, whose occurrence is usually unique within the wider regional frame, can be associated with specific industrial anthropogenic habitats as, *e.g.*, spontaneously originated mine subsidence pools. These secondary habitats should not be a priori regarded as ecological traps, because they often are the available habitats of highest quality. We also assume that metapopulation dynamics is a crucial adaptation of dragonflies enabling long-term survival in such environment. Local extinctions on unsuitable sites as an indirect result of mining activity are effectively compensated for by (re-)colonization of other, newly formed sites.

12.8 First results of dragonfly monitoring via an 'Ecological Area Sample' in North Rhine-Westphalia, Germany

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The necessity of a standardized monitoring to control the development of the biodiversity has been discussed in Germany since the 1980s. In North Rhine-Westphalia a monitoring scheme for this purpose was introduced in 1997 and has been called 'Ecological Area Sample' (Ökologische Flächenstichprobe, or ÖFS). It comprises of a network of approximately 200 sample areas (1 x 1 km) that are distributed randomly within the area of the German federal state. Each sample area is surveyed by the same method every six years, resulting in a regular annual survey of 30 areas. Until 2010, the surveys included basically birds and biotopes. It has been proven that the statistical examination of the yearly surveyed sample areas is able to indicate important trends of the 'normal landscape'.
Since 1996, the 'Working Committee Dragonflies in North Rhine Westphalia' (AK Libellen NRW) has collected all available data of dragonflies and compiled a database with about 180,000 data sets until today. However, these data are very heterogeneous and difficult to interprete, especially regarding trends in presumably 'common' species.
Therefore, in 2011 and 2012 a monitoring of dragonflies in the sample areas of the 'Ecological Area Sample' was conducted by a standardized method. This meant that – similar to the Dutch monitoring scheme fixed 100 m-transects were counted uniformly at least five times a year, from May to September.
First results reveal that there are special problems to maintain the standards in a base line survey. They however also show that the received information indicates well the current status of the common species known from the database of the Working Committee and thus might be able to indicate future trends.

13 Poster

13.1 The egg chorion architecture of the dragonfly, *Paragomphus lineatus* (Selys, 1850) (Odonata: Gomphidae)

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Paragomphus lineatus (Selys, 1850) is a small gomphid with striking blue-green eyes, a bold yellow and black striped body and long curled anal appendages. It is commonly found in India, Nepal and west of the Turkish Mediterranean coast. The female oviposits in shallows, either at the edge of a sandy beach, or in the ripples flowing over a graveled or pebbly bottom or in tiny brooks with sandy bottom. The larva is a stream-dweller and burrows in sand, but breeding also takes place in still waters since the eggs which are deposited in tiny brooks at times are swept into the marshes during heavy rains.

The egg chorion of this exophytic riverine dragonfly was examined using light and scanning electron microscope. The egg of *P. lineatus* is sub-spherical, measuring 490±12 µm in length and 320±10 µm in width. It possesses a very large flat-top, nipple-shaped micropylar apparatus. The height of the apparatus is 120±6 µm; the basal and apical diameter is 162±5 µm and 43±3 µm, respectively. The outer surface of the chorion is uniformly sculptured with strong hexagonal reticulations. Each hexagonal reticulation is 40-55 µm long and 25-35 µm broad. These hexagonal reticulations are shaped by the fusion of tiny pustules (3-4 µm) formed as semicircular elevations of the chorion. The area lying in the hexagonal reticulation is also filled with 7-10 pustules. Though rough, the inner surface of the chorion is devoid of any reticular pattern. Although the chorion appears undifferentiated, in sections, a uniformly thin exochorion (6-8 µm) and a multilayered endochorion (4-6 µm) can be clearly observed. The micropylar apparatus is composed of a central, tubular micropylar projection which terminates as a flat top bearing a central elevated knob around which six/seven micropylar orifices are arranged in a circle. The micropylar projection is surrounded by a thick mass of nipple-shaped sticky jelly. This jelly is loosely placed on the egg chorion and is attached to the micropylar projection along the apical rim of the flat top. The surface of the jelly is rough and undulating. The development of the micropylar apparatus takes place during the late vitellogenic and choriogenic stages of egg maturation. The jelly mass is exochorionic in origin and is deposited by the follicular epithelial cells which surround the oocyte.

The eggs of the family Gomphidae are divided into two groups: The first group has slightly elongated eggs with sculptured chorion and thick anchoring threads at the posterior end, while the second group is of smooth and round eggs with jelly-like substance around the anterior micropylar projection. The egg of *P. lineatus* holds an intermediate position between these two groups with heavily sculptured chorion and thick mass of jelly around the micropylar projection. The egg chorion of *P. lineatus* is discussed with respect to phylogeny and oviposition behavior of the female.

13.2 Report of the 18th International Symposium of Odonatology at Hislop College, Nagpur, India, 2008

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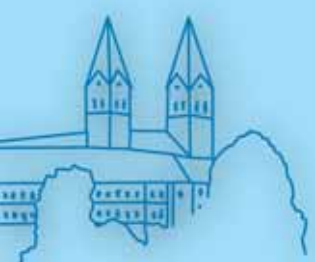
The 18th International Symposium of Odonatology was organized from 5th to 9th November 2008 by the Post Graduate Department of Zoology, Hislop College. This coincided with the major event of the Quasquicenntenial celebrations of the College. It was co-sponsored by the South Asian Council of Odonatology and the Wildlife wing of Maharashtra state, Forest Department. This was the second time that the symposium was held in India, as the 9th ISO had been organized at Madurai, Tamil Nadu, in 1988. The special theme of the symposium was "Dragonflies of South Asia; Dragonfly biodiversity and Conservation and Effects of Pollutants". Over 110 registered participants including 17 odonatologists from eight different countries attended the symposium. This global symposium proved a platform for teachers, research scholars and students, especially from the South Asian regions, to personally interact with each other and share their experiences and findings.



The Symposium was inaugurated by Dr. S.N. Pathan, Vice Chancellor, RTM Nagpur University, Nagpur on 5th November 2008. It comprised 32 oral presentations, 24 poster presentation, four audio-visual presentations, four plenary sessions and a mid-symposium field trip.

During the symposium, around 150 photographs were displayed at the dragonfly photography competition and exhibition. Students from the local fine arts colleges actively participated in the painting and drawing competition and came up with wonderful sketches, paintings and slogans to conserve dragonflies. Most of the photographs and artworks were sold or donated to the guests and participants.

A post symposium tour to Tadoba-Andhari Tiger Reserve and Pench Tiger Reserve to study dragonflies around the core water bodies of these regions was organized in collaboration with the Wildlife Wing of the Maharashtra Forest Department from 10th to 13th November 2008. Around 10 foreign delegates and 11 Indian delegates participated in this tour.

A manual 'A Bibliography on Indian Odonatology" by Dr. R.J. Andrew and Dr. T.R. Mitra along with a compact disc on "Common Odonates of Central India" (which was later printed as "A handbook of Common Odonates of Central India") by Dr. R.J. Andrew, Dr. K.A. Subramanian, and Mr. A.D. Tiple, was released during the symposium.

As noted by two German participants, Dr. W. Zessin and Dr. A. Günther, ….*it was a pity that so few participants from Europe and America were present at the symposium… we learned to mix our feelings and whenever we thought a little differently, we put it under the phrase we had coined, "think Indian" to be able to adjust ourselves. It was a remarkable, unforgettable and interesting meeting, which will remain in the excellent memories of all the participants. India is a happening and stimulating different world than the one we Europeans are familiar with and it has an impression, which we all can take home with us… India for us Europeans is rightly, both dream and nightmare…*

I, as President of the South Asian Council of Odonatology, offer once again the services of my team to organize the International Congress of Odonatology 2017 in India and welcome you in the traditional Indian way of greeting - *Namaste, Attithi Deo Bhavao…*

13.3 Testing hypotheses for wing coloration in *Polythore* damselflies through morphometric and phylogenetic analyses

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The damselfly genus *Polythore* contains 21 described species, distributed in Andean rainforests and Amazonian lowlands. Wing coloration in these species is among the most elaborate known in the damselflies. While wing color in damselflies is thought to be the result of sexual selection, an alternative theory has been suggested for *Polythore*: that these colors are under selection for mimetic resemblance to local toxic Ithomiinae and *Heliconius* butterflies. We here present an initial investigation of this hypothesis, quantifying how wing forms differ through morphometric analysis of wing images, and comparison of these results to phylogenetic analysis of individuals displaying these different wing forms. Landmarks that represented the pattern shapes within wings were digitized on scanned wing images in TPSdig2 and analyzed using the Procrustes protocol. Phylogenetic relationships were determined through analysis of a portion of the cytochrome oxidase I (COI) mitochondrial genome with Maximum Likelihood (ML) and Bayesian Inference (BI) methods. Our results suggest that, while discrete wing patterns exist in *Polythore*, these wing forms do not represent phylogenetically distinct groups: thus, wing color does not appear to be a good indicator of species. Different wing forms are found to group together on the landscape, an expectation in line with the mimicry hypothesis.

13.4 Ultrastructure of spermatozoa of the dragonfly, *Anax guttatus* (Burmeister) (Odonata: Aeshnidae)

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Anax guttatus is one of the most common aeshnid dragonflies in central India. It is found patrolling along the water bodies, mostly during the post monsoon season. The present paper describes the ultrastructure of the spermatozoa of this aeshnid dragonfly. In *A. guttatus*, the mitochondria accumulate at the base of the nucleus to form a single nebenkern during spermiogenesis. An electron dense matrix "centriole adjunct" is formed at the base of the nucleus that surrounds the nebenkern. The acrosomal vesicle migrates to the anterior end of nucleus. Ultrastructure of the spermatozoa reveals that its elongated head lodges an apical inverted, 'T'-shaped double layered acrosome and a long, electron dense nucleus, while the tail is composed of the axoneme, a pair of identical mitochondrial derivatives and the lateral/ osmophilic bodies. The nucleus is displaced on one side by the axoneme. The axoneme consists of microtubules and these are arranged into nine peripheral doublets and two central tubules. The mitochondrial derivatives and lateral bodies surround the axoneme at the tail region of the spermatozoa. A large number of cristae are evident in the longitudinal section of the derivatives. The spermatozoa of *A. guttatus* are therefore characterized by several unique features like the absence of a centriole, a spiked double-layered acrosome, and a long nucleus with a sub-central axonome running all along its length. The mitochondrial derivative runs parallel to the axoneme while a pair of lateral bodies is located parallel to the mitochondrial derivatives.

13.5 Dragonflies from the Páramo ecosystem of the Colombian Andes, with the descriptions of *Oxyallagma* sp. nov. and of *Rhionaeschna* sp. nov. (Odonata: Coenagrionidae, Aeshnidae)

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We present results of collections of Odonata conducted in the unique Neotropical high mountain ecosystem 'Páramo', between 2007 and 2013. Three new records for Colombia and two hitherto undescribed species, viz one from the genus *Oxyallagma* Kennedy, 1920, and one from the genus *Rhionaeschna* Förster, 1909, were identified. Descriptions of the new species, comments on the plasticity of the characters of their populations, photographs, maps, illustrations, natural history notes and a key to the species of Odonata registered are provided.

13.6 Rediscovery of *Proneura prolongata* (Odonata: Protoneuridae) and other new Odonata records from the unexplored Colombian Amazon

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As with most taxa present in Colombia, the study of dragonflies is still in its exploratory phase. This work reports the results of two trips to the Amazon region (2011 and 2012) in order to collect Odonata. New records for the country were found, including the rediscovery of *Proneura prolongata* Selys, *Denticulobasis garrisoni* Machado, and an undescribed species in the genus *Calvertagrion* St. Quentin.

13.7 Rock and Roll Dragonfly: a study on the symbolism of dragonflies in the lyrics of Western contemporary popular songs

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Dragonflies are recurrent icons of the contemporary world. Their outlines can be easily recognized in jewelry, clothing, decorative objects, etc. The word "dragonfly" has been used as the title name of enterprises, associations, public houses, internet sites, and musical groups. In order to find more evident clues about that fascination and, consequently, about the symbolism of dragonflies in the West, 100 songs of the pop-rock universe recorded during the last decades, whose titles are or contain the English epithet "dragonfly" (or "dragonflies"), were collected. Their registers were obtained directly by the exam of albums by various artists (CDs, LPs, etc) or indirectly through searches at internet sites. Each lyric was checked against its respective recording. Besides the lyrics, the material contained in album covers (like images, introductory and dedicatory notes) was considered with the aim of contextualizing the use of the word "dragonfly". Data were acquired in two surveys: (1) a contextual interpretation of the meaning of the lyrics and (2) a survey of recurring terms. The earliest registered song is "Dragonfly" from the homonymous album of the English folk group Strawbs (1970). In most lyrics, the dragonflies clearly assume a symbolic role associated with situations of conclusion or change, representing the death (or its agent) or disembodied souls. This effect was intensified in several albums, where the song appeared as the last track, as in Josh Clayton-Felt's "Dragonfly" (from "Spirit Touches Ground", 2002), or at the end of the first side of a vinyl record, as in Paul McCartney and Wings' "Little lamb dragonfly" (from "Red Rose Speedway", 1973), bringing a sense of renewal with the turn of the disc to the second side.

13.8 Moulting pattern and mortality during final emergence of the damselfly, *Ceriagrion coromandelianum* (Fabricius), in central India (Odonata: Coenagrionidae)

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Emergence at final metamorphosis of Odonata makes a fascinating topic to study since it is not only a spectacular event but also a highly complex process in which many different types of rhythmic movements participate to release the pharate adult from the larval exuvia. Daily collection of all final instar exuviae also helps understand several aspects of emergence. This presentation not only describes and evaluates the chain of events occurring during the final metamorphosis and emergence of Ceriagrion coromandelianum, but also evaluates the event of mortality during emergence. Daily emergence of C. coromandelianum was recorded from open cement tanks/tubs located in the garden of Hislop College, Nagpur, India, for 50 days (22nd January to 12th March 2011). A total of 12 complete and successful emergences of *C. coromandelianum* were recorded to recognize the pattern of emergence.
Emergence is asynchronous, diurnal and occurs between 7 am to 5 pm. The process of emergence is divided into three observable stages. Stage-I starts when the final instar larva leaves the water body and searches for a suitable place to moult. The larva then begins shuddering, quivering and shaking its body in a synchronized pattern to detach the trapped imago from the exuvia. The imago exerts pressure on the thoracic tergites until the cuticle splits. Stage-I ends at this step. Stage-I ranges from 20-68 minutes and occupies 33 % of the total moulting period. Stage-II starts when the head and thorax of the imago emerges out of the split exuvia. The imago struggles to remove the trapped abdomen from the larval exuvia. Stage-II ends when the telescoped, shrunk imago with collapsed wings steps out. The abdomen is light yellowish in colour and the wings are opaque. The abdomen of the females at this stage bears a pinkish segmental band which dissipates later. Stage-II ranges from 8-25 minutes and occupies 11 % of the total moulting period. During Stage-III, the wings start expanding but are opaque; pigmentation of the body begins from the thorax and extends towards the abdominal tip. Meanwhile water is regularly ejected forcefully from the rectum. Soon the whole body develops its species specific coloration. At the same time, the expanding wings gain transparency, unfold and separate out and now the imago is ready for its maiden flight. Stage-III takes 48-102 minutes and occupies 56 % of the total moulting period. A total of 243 emergences occurred during the observation period; 158 emergences occurred in tanks containing *Pistia stratiotes*, while 65 emergences in tanks containing *Nymphaea nouchali* plants. A total of 20 deaths (mortality rate 8.2 %) were recorded during emergence. Failure to moult (15 %) and the failure to emerge out of the exuvia (85 %) were the two foremost reasons of mortality. This presentation also describes in detail an unsuccessful moulting event of the pharate adult with its wings trapped in the exuvia.

13.9 Ostracoda on libellulid larvae

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In May 2008, in a nature reserve at Lake Zurich, Switzerland, an exuviae of *Libellula quadrimaculata* with 22 attached ostracod individuals was discovered. Ostracoda are small crustaceans that live in all kinds of water bodies and are well-known to be preyed upon by odonate larvae. However, they have hitherto not been regarded to be among the phoretic organisms that were recorded sitting on them (Corbet 1999).
Subsequently, more exuviae of dragonflies with ostracods on them were found at localities in Switzerland and Germany by B. Kunz, H. Wildermuth and ourselves. The ostracod specialist C. Meisch from Luxembourg kindly identified the species and found three different species: *Isocypris beauchampi*, *Potamocypris* sp. (*similis* or *variegata*), and *Cypridopsis vidua*, on exuviae of *Orthetrum albistylum*, *O. cancellatum*, *Libellula depressa*, and *L. quadrimaculata* respectively.

The ostracods may attach to larvae of Odonata

- to avoid the fine sediment at the bottom of the water body
- to reduce their risk of predation
- to feed on detritus from food remnants of the odonata larvae (commensalism)
- to be transported to a habitat with better life conditions (phoresy)

A photograph taken by B. Schneider at a pool near Winterthur, Switzerland, and showing two ostracods on an imago of *Sympecma fusca* seems to support the last hypothesis.

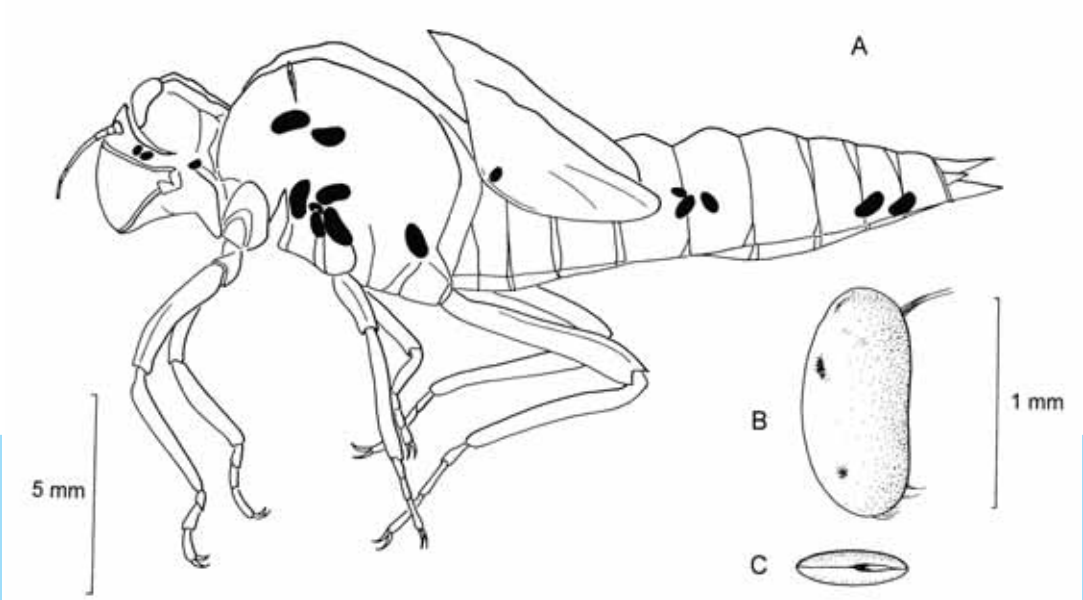

Figure 1: Exuvia of *Orthetrum cancellatum* with several Ostracoda individuals attached. Drawing by courtesy of Hansruedi Wildermuth.

Corbet PS. 1999. Dragonflies: Behaviour and ecology of Odonata. Harley, Colchester

13.10 Negative effects of the invasive crayfish, *Procambarus clarkii* (Girard, 1852), on Odonata communities: a case study in Tuscan retrodunal wetlands (Italy)

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Globally, more than 20 crayfish species have been introduced beyond their native range. One of these, the red swamp crayfish, *Procambarus clarkii* (Girard, 1852), native of eastern North America, is now invasive in five continents. This species has a high fecundity, great ecological plasticity and is considered one of the 100 worst alien invasive species (AIS) in Europe. The aim of the study was to evaluate the impact of *P. clarkii* on Odonata communities, by sampling exuviae and by observing adults, in sites with different predation pressures (presence of fish only, presence of *P. clarkii* and fish, and absence of both). The results show little variation in adult assemblages, whereas considerable differences were detected among records of exuviae. Exuviae assemblages of the different sites had comparable species richness, but those with fish and *P. clarkii* had higher evenness and the number of individual exuviae collected was much lower. In synthesis, the Odonata assemblages from sites which contain *P. clarkii* and fish were nested subsets of those where *P. clarkii* was absent. The results of this study suggest that *P. clarkii* has a strong impact on Odonata communities.

13.11 Where do non-territorial *Calopteryx* males settle? Deterioration of best habitat diminishes non-territorials number

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Where to breed and what reproductive tactic to adopt can strongly influence population dynamics. According to classic ecological models, non-territorial males should settle in the weakest habitats as a result of lost competition or overcrowding in reproductive sites – the 'defeated male' hypothesis. In contrast, according to evolutionary game-theory models, non-territorial males should settle in the vicinity of high quality sites and delay reproductive activities until these habitats are vacant for them – the 'male-player' hypothesis. However, non-territorial male spatial distribution has not been experimentally tested yet.

I performed two types of field experiments to test these hypotheses: male-removal and patch-quality manipulation. I used *Calopteryx splendens*; males of this species exhibit both territorial and non-territorial behavior. Territorial males establish their territories on floating vegetation clumps, which vary continuously in quality and are easy to manipulate. If the 'defeated male' hypothesis is true, the deterioration of a high-quality site should increase the number of non-territorials in a population. On the other hand, if the 'male-player' hypothesis is true, a similar manipulation should decrease the number of non-territorials. I found that deterioration of high quality habitat reduced the number of non-territorial significantly more than that of territorial males. The habitat restoration resulted in arrival of non-territorials only in the case of high quality sites. The proportion of takeovers of the high quality territories was significantly higher than of low quality territories. These results support assumptions of the 'male-player' hypothesis and indicate that non-territorial damselflies are more sensitive to habitat quality changes.

13.12 The Odonate Habitat Index (OHI) revisited: an improved methodology tested in six Alpine Italian rivers

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Dragonflies are usually considered as reliable bioindicators of ecological integrity, habitat heterogeneity and hydrological dynamics of water bodies. For these reasons their use can be particularly worthwhile in the evaluation of the condition of the river corridor, especially in those rivers where large areas of the corridor are occupied by bars, islands and floodplain. The use of the bioindicators provided by the European Water Framework Directive (WFD), that are strictly aquatic organisms (e.g., diatoms, macrophytes, benthic macroinvertebrates and fish), could lead instead to an incomplete evaluation of the condition of the river corridor and in particular of the riparian zones.
Chovanec & Waringer (2001) developed a dragonfly-based assessment system to evaluate the condition of the river-floodplain system, following the requirements of the WFD. In this work we propose an improvement of this methodology, with a strong emphasis on quantitative adjustments to make it more standardized and robust. Modifications concern both species-specific parameters, like the "habitat value" and the "indication weight", that are needed to calculate the OHI (Odonate Habitat Index), and the classification scheme for assessing the ecological status of river reaches. We tested this improved methodology over a set of a total of eighteen reaches of six Alpine Italian rivers, which differ in ecological and morphological conditions and in the degree of human impact.

Chovanec A, Waringer J. 2001. Ecological integrity of river-floodplain systems assessment by dragonfly surveys (Insecta:Odonata). Regulated Rivers: Research & Management 17: 493-507

13.13 Contribution to the *Nosoticta salomonis* complex

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Four specimens of the genus *Nosoticta* from the Bismarck Archipelago, Papua New Guinea, have been investigated. Two males and one female come from the New Ireland Province and one male from the New Britain Province. The male originating in New Britain probably pertains to *Notosticta salomonis*, whereas the specimens from New Ireland are neither similar to *N. nigrofasciata* Lieftinck, 1932, nor to *N. salomonis* (Selys, 1886). Therefore, the specimens from New Ireland are proposed to be a new species of *Nosoticta*.

13.14 2013 – Year of anniversaries of great odonatologists

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In commemoration of the 200th birthday of Michel Edmond de Selys Longchamps, the year 2013 is rightly called the 'Selys Year' in odonatology. However, it should not be forgotten that 2013 is also a year of anniversaries of many other great odonatologists.

Anniversary of birth

275th Anniversary of birth

Pietro Rossi - born 23 January 1738 in Florence, was an Italian scientist and entomologist. He is worldwide known as the first professor of entomology (at that time called 'Insectology') and was one of the first entomologists using the Linnaean binomial nomenclature.

13 Poster

200th Anniversary of birth

Michel Edmond de Selys Longchamps - born 25 May 1813 in Paris, was a wealthy Belgian aristocrat, liberal politician and scientist. He was educated at home and never attended a university. Nevertheless, he was one of the leading researchers in the field of odonatology. Selys has described 894 species of which nowadays 726 are still valid. He created 141 valid genera.

Friedrich Anton Kolenati - born 12 September 1813 (according to other sources 1812) in Prague, was an Austrian physician and naturalist. During many research expeditions he collected a lot of entomological material, including Odonata. Kolenati has described three species of which two are still valid.

125th Anniversary of birth

Sándor (Alexander) Pongrácz - born in May 1988, was a Hungarian zoologist with a focus on fossil insects. He was the first entomologist who has examined among other the complete dragonfly fauna of Lake Neusiedl (easternmost province of Austria) and the surroundings of Kőszeg (West Hungary).

100th Anniversary of birth

Syoziro Asahina - born 10 June 1813 in Tokyo, was a Japanese medical entomologist and is still regarded as the most important odonatologist in Asia. One of his many odonatological research focuses was the genus *Epiophlebia*. Asahina has described 118 species of which nowadays 110 are still valid. He created five valid genera.

Anniversary of death

225th Anniversary of death

Moses Harris - deceased in 1788, was an English entomologist and engraver. He was the first entomologist in the United Kingdom using the Linnaean binomial nomenclature. As a naturalist, Harris wished to understand the relationships between the colours, and how they are coded. Harris has described five species of which nowadays one is still valid.

200th Anniversary of death

Johann Heinrich Sulzer - deceased in 1813, was a Swiss physician and entomologist. He was the author of two of the first books on insects to adopt Carolus Linnaeus's binomial system. Sulzer has described three species which nowadays are still valid.

100th Anniversary of death

Filip Trybom - deceased in 1913, was a Swedish zoologist, who collected material on many research expeditions. He has described three species of which nowadays two are still valid.

75th Anniversary of death

Longinos Navás - deceased 31 December 1938, was a Spanish Jesuit priest and entomologist specialized in Plecoptera and Neuropteroidea. He mainly worked on collection material from museums. But he also ordered material from collectors from overseas. Navás has described 105 species (one fossil species) of which nowadays 48 are still valid. He created four valid genera (one fossil genus).

50th Anniversary of death

Frederic Charles Fraser - deceased 2 March 1963, was an English entomologist who devoted himself entirely to dragonflies, mostly in the British Museum (Natural History) where his collection is maintained. He was a fellow of the Royal Entomological Society. Fraser has described 462 species of which nowadays 333 are still valid. He created 49 valid genera.

13.15 Variation of abundance at emergence of *Cordulegaster bidentata* (Selys, 1843) in the Carpathians of the Czech Republic

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Cordulegaster bidentata Selys is a European species occurring in forest spring areas and very small streamlets. In the Czech Republic its centre of occurrence is in the western Carpathians.
Our study was conducted in a small spring area in the Moravskoslezské Beskydy Mts., near Ostravice in the valley of Mazák (altitude 680 m a.s.l.), in the eastern part of the Czech Republic. The spring area and a contiguous streamlet, with a total length of 70 m, were situated in a small valley in a large forest complex (stemwoods).
The species' emergence was studied during 2008 to 2012 from May to June. In 5-7 days' intervals we recorded the numbers of exuviae, including their position on the vegetation and their sex. The aim of this study was to record the entire emergence of one year, and to determine changes in the population size between years that might reflect a population trend.
A significant difference in abundance was found between recording years, with decreasing tendency (2008: 58 exuviae collected in total, 2009: 53, 2010: 1, 2011: 7, 2012: 1). The character of the locality was only partially altering; we noted changes in vegetation coverage, and in 2010 at the end of May there was very rainy weather that flushed the lower half of the study site. The highest number of emerged individuals was found during the first days of the emergence period in early June, and emergence ended at the end of June.
Despite these significant differences in emergence, the annual number of adults at this site on the wing during July was not affected.

13.16 Importance of karst poljes for the protection of rare and threatened dragonfly species

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The Dinaric karst is the largest, continuous karst area in Europe and extends from Slovenia to northern Albania. The central and largest part of this region belongs to Bosnia and Herzegovina. The poljes, large depressions sharply bordered by steep slopes, are specific geological formations and one of the most outstanding examples of karst landscapes in the world. Although karst areas are generally known as dry places, many poljes in the Dinaric karst are wetlands of international importance with a great diversity of freshwater habitats. The poljes in Bosnia and Herzegovina are among the best preserved, but remain insufficiently protected and increasingly threatened by large scale water management projects. Although in Croatia and Slovenia the poljes are included in the Natura 2000 network, in Bosnia and Herzegovina, the lack of information is the most signicant gap that limits the creation of an efficient protected area network. The dragonfly fauna of the poljes in Bosnia and Herzegovina is insufficiently known. In order to investigate species distribution and habitats in the poljes, multiple surveys were conducted from 2009 to 2012. Up to now, 55 dragonfly species have been found in the poljes, compromising 87 % of overall dragonfly fauna of the country. Several rare and threatened species were found in the poljes: *Coenagrion ornatum*, *Ceriagrion tenellum, Caliaeschna microstigma, Lindenia tetraphylla* and *Cordulegaster heros*, including the most significant populations of *C. ornatum* in the country.
This presentation gives an overview of the dragonfly fauna of the poljes in Bosnia and Herzegovina and the importance of these unique and ecologically specific habitats for the preservation of rare and threatened dragonfly species.

13.17 Next generation sequencing yields the complete mitochondrial genome of the scarce blue-tailed damselfly, *Ischnura pumilio*

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We report the complete mitochondrial genome of the scarce blue-tailed damselfly, Ischnura pumilio (Odonata, Coenagrionidae), using next-generation sequencing on genomic DNA. A de novo assembly provided a single contiguous sequence of 15,250 bp that contained the A+T rich region and all standard coding regions. Gene configuration is similar to other odonate species and comprises 13 protein-coding genes, two rRNA genes (12S and 16S rRNA) and 22 tRNA genes. We found the presence of a unique intergenic spacer in I. pumilio and confirm that the intergenic spacer s5 mentioned by Lin et al. (2010) is likely to represent a synapomorphy between Anisoptera and Zygoptera. This is the first mitogenome sequence obtained for a member of the Coenagrionidae and demonstrates the utility of next-generation sequencing technology to obtain A+T rich mtDNA genome sequences without prior sample processing or primer design.

Lin, C-P, Chen M-Y, Huang J-P. 2010. The complete mitochondrial genome and phylogenomics of a damselfly, Euphaea formosa support a basal Odonata within the Pterygota. Gene 468: 20-29

13.18 Hybridization between *Calopteryx splendens* and *C. haemorrhoidalis* in central Italy (Odonata, Calopterygidae)

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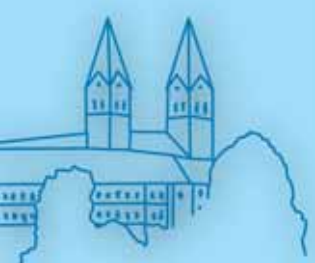
Spontaneous matings between male *C. splendens* and female *C. haemorrhoidalis* (1-2 % of the total number of observed matings) occur in the river Forma Quesa (Central Italy, Pontecorvo, Frosinone province), where both species coexist. Putative hybrid individuals showing a mixed phenotype have been also occasionally found in the same river. Here we report the molecular characterization of three suspected hybrid individuals collected in this population in 2001 (n=1) and 2012 (n=2). Results of microsatellite genotyping of these individuals were compared with a sample of *C. haemorrhoidalis* (n=24) and *C. splendens* (n=24) collected at the same population, and have confirmed the hybrid origin of these three specimens. Regarding microsatellites, differences were found between the hybrid from 2001 and the hybrids from 2012. Whereas the first individual shows alleles that appear in both parental species, suggesting it is an F1 hybrid, individuals collected in 2012 show private alleles for eight out of the 12 loci analysed, and only a little portion of the genome in common with *C. splendens*. Sequencing of mitochondrial gene NDI indicated that the hybrid from 2001 is of *C. splendens* maternal origin and the hybrids from 2012 would be of *C. haemorrhoidalis* maternal origin, which suggests, contrarily to behavioural observations, that matings in both directions are possible. Our results confirm the hybrid nature of these individuals, and although sample number is limited, they also suggest that introgression could be occurring in this population.



13.19 The role of olfaction in dragonflies: a possible involvement in prey perception

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Odonata are generalist predators with a varied diet, in which Diptera prevail numerically. Vision plays a fundamental role in the behavior of predation, while the role of other senses has been so far entirely neglected. Recent ultrastructural and electrophysiological investigations have revealed that adult dragonflies and damselflies show coeloconic sensilla on their antennae with olfactory sensory neurons. The present study aims to investigate the involvement of olfaction in prey detection by the damselfly *Ischnura elegans* (Odonata: Coenagrionidae). Behavioral responses of virgin specimens of both sexes of this species were assessed by bioassays in wind tunnel in which the test was made up of about 200 alive preys (*Drosophila melanogaster*; Diptera, Drosophilidae) placed in a container of cotton (that made the prey not visible by the damselflies), while the control was constituted by an identical empty container. The results indicate that adults of I. elegans are attracted by prey even in the absence of the visual stimulus: the residence time [%] in the area of emission of the stimulus is significantly higher in the presence of the test compared to the control; latency [sec.] of the first stop in the same area is significantly lower in the test compared to the control. The same parameters were considered in other bioassays to discriminate the role of smell in the presence of sight and sound.

13.20 Olfaction in dragonflies: an electrophysiological screening on the antennae of *Libellula depressa* and *Ischnura elegans*

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Odonata are typically visual dependent insects. In this regard, there is an extensive bibliography on dragonfly vision, while studies on other sensory abilities are rather scanty. The presence of olfactory sensilla in dragonflies and damselflies antennae has been recently demonstrated by ultrastructural and electrophysiological investigations, while no data on the chemical ecology of the Order are available to date. This research aims to evaluate the response of dragonfly and damselfly olfactory neurons in the antennae to certain odors belonging to the following categories: green leaf volatiles, vertebrates related volatiles and volatiles emitted by stagnant water. These categories were selected as potentially relevant to the dragonflies' behavior of feeding, breeding and orientation. A fourth category is represented by compounds eliciting a response in the coeloconic olfactory sensilla of Drosophila antennae. These sensilla are considered ancient sensilla and show a peculiar kind of receptors (ionoreceptors) that make them especially sensitive to acids and ammines. This survey was conducted by electroantennographic recordings (EAG) from the antennae of *Libellula depressa* (Libellulidae) and by single cell recordings (SCR) from the antennae of *Ischnura elegans* (Coenagrionidae). These data provide a useful basis for behavioral investigations to clarify the involvement of smell in the biology of the Odonata and can be useful to trace evolutionary trends in insect olfaction, in consideration of the old origin of the Odonata.

13.21 Phylogenetic relationships of the Neotropical family Polythoridae (Odonata)

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Damselflies of the Neotropical family Polythoridae comprise six genera (*Chalcoptheryx, Chalcothore, Cora, Euthore, Polythore*, and *Stenocora*) with approximately 58 species. *Euthore* and *Polythore* are medium-sized damselflies with an amazing diversity in wing color patterns, including orange, reddish, white and black spots. On the other hand, *Chalcoptheryx* species are smaller organisms with metallic blue or orange hind-wings. Even though there are differences of wing color patterns between and within the genera, they do not change in classical traits involved in reproductive isolation in most odonates, such as male cerci. The question arises how this group diversifies through time without a clear mechanical isolation that is found in other groups of damselflies and dragonflies. Our aim in this study is to reconstruct the first family level phylogeny using a Bayesian analysis with mitochondrial (COI, ND1) and nuclear DNA (H3, Efα1) that will help us to understand the diversification process of this group and the biogeography of the Neotropical region.

13.22 The impact of the European beaver *Castor fiber* on the dragonfly fauna (Odonata) of the northern Eifel, Germany

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In 1981 the European beaver, *Castor fiber*, returned to the Hürtgenwald, a woodland ecosystem in North Rhine-Westphalia, Germany. Ever since their reintroduction, beavers have colonized numerous mountain streams of this forest. Due to their landscaping skills, they have adapted the environment and thereby created habitats for countless new plant and animal species.

In 2011 and 2012, this process was evidenced during an investigation on the dragonfly fauna of the Hürtgenwald. For this investigation, four different types of biotopes with specific criteria were selected: beaver-ponds (1), abandoned beaver-ponds (2), middle courses unaffected by beavers (3) and springs (4). For each type, a sampling site was chosen in three different streams and analysed on nine dates between April and September.

The investigations showed that the number of species increased sixfold, while the density of individuals grew likewise. However, the most outstanding discovery was not only the increased number, but the composition of newly immigrated species. Dragonfly assemblages with representatives of diverse origin and habitat preferences were discovered at all three investigated beaver colonies. Thus a coexistence of dragonflies requiring running water (*e.g.*, *Cordulegaster boltonii*) and species depending on standing water bodies (*e.g.*, *Ischnura pumilio*) were observed at beaver ponds. Even pioneer species like *Libellula depressa* occurred as numerously as species like *Platycnemis pennipes*, which require water bodies in advanced succession stages.

The species mentioned are just a few examples of the numerous species that naturally do not occur in the same habitat, but which can be observed coexisting at beaver ponds. In this context, the oldest of these three investigated beaver colonies is of particular interest. Here, mesotrophic conditions and sufficient developing time led to the formation of marshes and quaking bogs (*Sphagnum*). The fact that four red list species (*e.g.*, *Leucorrhinia pectoralis* and *Ceriagrion tenellum*) were recorded at this specific colony demonstrates the relevance of these particularly rare habitats.

13.23 Zygopteran genital structure: An insight

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How can we examine reproductive organs of holotypes without the risk of damage? How can we gain an insight into structure and functionality of reproductive organs in dragonflies without taxidermy? For these questions and for several more, microcomputer tomography (micro ct) can be the answer. Results of micro ct-scanning used to examine the secondary copulatory organ of several species of Platycnemididae are shown; the working progress is explained.

List of Authors

List of authors, with reference to the according abstract number. Abstract numbers in bold refer to first authors of a presentation, respectively.

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