1st European Congress on Odonatology

Programme and abstracts

2-5 July 2010

Vairão-Vila do Conde

Portugal
In Europe many people from different countries are working on dragonflies at different levels. Important topics in Europe are monitoring, distribution, protection and climate change. At this time there is no European network of Odonatologists. We hope that this first European Dragonfly Symposium will be the start of an sustainable European network and the start of a two year cycle of symposia.

This congress is organized and co-financed by Research Center In Biodiversity and Genetic Resources (CIBIO) and Dutch Butterfly Conservation.

We thank our sponsors for participant grants for making this congress possible!

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Programme

Thursday, 1 July 2010

16.00 WELCOME AND REGISTRATION
19.00

Friday, 2 July

8.30 WELCOME AND REGISTRATION
9.30 OPENING CEREMONY
10.00 Biogeography and evolutionary history of European Odonata
   The biogeography of European dragonflies, with an emphasis on Afrotropical species in the Palaearctic
   Klaas-Douwe Dijkstra - Netherlands
10.25 Phylogeny of Cordulegaster in West Palearctic
   Elsa Froufe, Sónia Ferreira and Jean-Pierre Boudot - Portugal & France
10.40 Siberian taxonomical problems concerning European odonate species
   Oleg Kosterin - Russia
11.10 Coffee-break
11.25 SESSION: Distribution
   An atlas of the European dragonflies: will it ever happen?
   Vincent Kalkman - Netherlands
11.50 How to record and store species locations? The use of Geographical Information Systems, GPS and Free/Open Source software
   Neftalí Sillero & Pedro Tarroso - Portugal
12.05 Odonata in Bosnia and Herzegovina
   Dejan Kulijer - Bosnia and Herzegovina
12.20 An overview of exotic dragonfly species found in Europe
   Andreas Martens - Germany
12.35 Lunch
14.00 Danish Odonata Atlas and newly arrived species.
   Erland Refling Nielsen - Denmark
14.15 Towards the atlas of Croatian dragonflies
   Nino Mihoković and Marija Matejčić - Croatia
14.30 Dragonflies of Moldova: state of knowledge and personal observations (2005, 2009)
   Elena S. Dyatlova, Vadym L. Komyzherko - Ukraine
14.45 A Project Named BOB – Balkan OdoBase
   Miloš Jović, Milen Marinov, Bogić Gligonović, Nurten Hacet, Despina Kitanova and Dejan Kulijer - Balkans
15.00 Dragonflies in Germany - the atlas-project of the GdO (society of german-speaking odonatologists)
   Klaus-Jürgen Conze - Germany
15.15 Distribution and ecology of Sympetrum nigrifemur in the Macaronesian Islands (Odonata: Libellulidae)
   Florian Weihrauch and Rudolf Maikmus - Germany
15.30 Dragonfly composition (Insecta, Odonata) in wetland area of Turopolje region, Croatia
   Vilenica Marina, Mišetić Vlatka, Franković Matija, Kučinić Mladen - Croatia
15.50 Coffee-break
16.10 Review of Macedonian Odonata
   Despina Kitanova and Miloš Jović - Macedonia & Serbia
16.25 An overview on dragonfly (Insecta: Odonata) fauna from Romania
   Cosmin-Ovidiu Manci - Romania
16.40 The Odonata fauna of Albania
   Dávid Murányi - Hungary
16.55 Odonatology in Italy: state of the art
### Saturday, 3 July

**SESSION: Monitoring**

- **9.30** A European Dragonfly Monitoring Scheme: how to get started?
  Tim Termaat, Dick Groenendijk and Arco van Strien - Netherlands

- **9.55** Preliminary study to monitoring the dragonfly fauna (Odonata) in the ET 56 UTM grid square (South-Nyírség, Hungary)
  Attila Ferenc Kalmár, György Dévai and Tibor Jakab - Hungary

- **10.10** The dragonflies of temporary pools in Menorca
  Esther Soler and Marcos Méndez - Spain

- **10.25** Identifying keys to the conservation of *Lestes macrostigma* (Eversmann, 1836): to a European monitoring?
  Philippe H. Lambret - France

- **10.40** VOPHI: an index to assess threatened dragonfly populations and habitats
  Torralba-Burrial, A.; Ocharan, F.J.; Outomuro, D.; Azpilicueta Amorín, M.; Cordero Rivera, A. - Spain

- **10.55** Research of Balkan goldenring (Cordulegaster heros) in Slovenia
  Ali Salamun - Slovenia

**Coffee-break**

**SESSION: Climate Change**

- **11.55** Communities in forest lakes show ecological shifts: indirect effects of climate change
  Göran Sahlén and Ida Suhling - Sweden

- **12.10** Rising temperatures, altered life cycles and their consequences for dragonflies in Europe
  Frank Suhling, Ida Suhling and Otto Richter - Germany and Sweden

**Lunch**

**SESSION: Conservation and habitat management**

- **14.00** Nature conservation response to climate change - some ideas from Northrhine-Westphalia, Germany
  Klaus-Jürgen Conze, Norbert Menke & Matthias Olthoff - Germany

- **14.15** The impact of climate change on two boreo-alpine dragonfly species, *Somatochlora apestris* and *S. arctica*, at the edge of their range
  Geert De Knijf, Ulrich Flenker, Clédrick Vanappelghem, Cosmin O Manci & Vincent J. Kalkman - Belgium, France, Romania and Netherlands

- **14.30** Microevolution through climatic changes? The example of the expansion of *Crocothemis erythraea* in Europe.
  Ott, J., Sánchez-Guillén, R.A. and Cordero-Rivera A. - Germany and Spain

- **14.45** Migrant Dragonflies in the UK: Distributions are flexible, especially in times of climate change.
  Adrian Parr - UK

- **15.05** European Red List
  Vincent Kalkman - Netherlands

- **15.30** Dragonflies on the western fringe: red list and important dragonfly areas of Ireland
  Brian Nelson - Ireland

- **15.45** Construction of a new stream (even) for dragonflies
  André Günther - Germany
16.00 Coffee-break
16.20 Protection of Red List species in the Netherlands: ecological research, monitoring and conservation
Dick Groenendijk and Tim Termaat - Netherlands
16.35 Developmental plasticity as a cohesive evolutionary force between alternate-year odonate cohorts.
Phillip C. Watts and David J. Thompson - UK
16.50 Range-wide genetic diversity of the rare odonate Coenagrion mercuriale: influence of latitude and isolation
Laura K. Gordon, Phillip C. Watts & David J. Thompson - UK
17.05 Workshop on Macromia splendens
Macromia splendens in the Iberian peninsula: status and priorities for future research
Herrera Grao, A.F.; Nieto, A.; Pérez Gordillo, J.; Torralba Burrial, A.; Ocharan Larrondo, F.J. - Spain
18.00 POSTER SESSIONS
18.30 Return to Vila do Conde hotels

Sunday, 4 July
9.30 Departure to Vale do Couce, Valongo (field trip)
15.30 Departure to Porto city
16.30 Visits to Oporto wine cellars
Participants are invited to choose where to dinner at Porto.
Return to Vila do Conde hotels by metro.

Monday, 5 July
9.30 SESSION: Dragonflies across European Borders: North Africa and Middle East
Outside European borders: the Odonata from Palearctic Africa
Jean-Pierre Boudot - France
9.50 The Odonata of the Levant (Eastern Mediterranean): Taxonomy, biogeography, and conservation
Wolfgang Schneider - Germany
10.10 Ecology of the Odonata at the westernmost spot of Africa, the island of Santo Antão, Cape Verde
Andreas Martens - Germany
10.25 About dragonflies and dragons blood! Odonata on the island of Socotra (Yemen)
Elisa Riservato, Jaap Bouwman and Robert Ketelaar - Italy and Netherlands
10.40 Recent advances in UAE and Oman
Robert W. (Bob) Reimer - UAE
11.00 Coffee-break
11.15 SESSION: Miscellaneous
Geographic parthenogenesis in the damselfly Ischnura hastata: A role for metapopulation structure?
M. O. Lorenzo-Carballa, H. Hadrys, A. Cordero-Rivera & J. A. Andrés - Spain
11.30 Latitude patterns in life history, physiology and behavior.
Robby Stoks - Belgium
11.50 Reproductive behaviour of Calopteryx haemorrhoidalis: a species with a surprising phenotypic variation.
Adolfo Cordero Rivera & Ollala Lorenzo Carballa - Spain
12.10 Photographic Guide to the Exuviae of European Dragonflies
Ewoud van der Ploeg and Christophe Brochard
12.25 Lunch
14.00 SESSION: Miscellaneous
Notes to the ecological demands of Cordulegaster heros (Cordulegastridae) in its northern part of area in Slovakia
Otakar Holuša - Czech Republic
14.15 Cordulegaster insignis and C. picta on Aegean Islands: longitudinal distribution patterns and the mechanism behind them
Klaus Guido Leipelt - Germany
14.30 Towards an understanding of Calopteryx splendens
14.45 Fluctuating asymmetry in wings of *Calopteryx* damselflies at species, population and latitudinal levels
   David Outomuro, Saúl Rodríguez-Martínez & Francisco J. Ocharan - Spain

15.00 The influence of season on wing morphology of *Calopteryx splendens* (Harris, 1782)
   Sönke Hardersen - Italy

15.15 Genetic diversity and introgression between *Ischnura elegans* and *I. graellsii* (Odonata: Coenagrionidae)
   Sánchez-Guillén, R.A., Wellemeuth, M., Cordero-Rivera A., Svensson E. and Hansson, B. - Spain

15.30 Preliminary morphometric and molecular investigations on adult specimens of two Lestes (Chalcolestes) taxa

15.45 Project “Popularizácia odonatológie na Slovensku” – its outputs and inspiration for the participants of the Congress.
   Dušan Šácha - Slovakia

16.00 Coffee-break

16.30 Forum

18.00 End of the Congress

19.00 Bus to the Congress dinner venue

20.00 Congress dinner
Outside European borders: the Odonata from Palearctic Africa

Jean-Pierre Boudot

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The overall Dragonfly fauna from North Africa (NA) is rather well known thanks to field investigations which began in the mid-19th century. The number of papers available N of 17°N is in a decreasing order for the various countries: Algeria (54), Morocco (41), Egypt (30), Tunisia (25), Libya (18), Mauritania (7), Sudan (7), Niger (4), Chad (4), Western Sahara (1) and Mali (0). According to geographical features and political situations, some areas have been much less investigated than others. Recent discoveries of new species in Morocco (Selysiothemis nigra, Orthetrum ransonnetii), Tunisia, (O. ransonnetii, Zygonyx torridus) and Egypt (Agriocnemis sania, O. machadoi, Sympetrum siniticum), show that the present knowledge is still incomplete anywhere.

Overall, 91 species have been identified and show a predominant Palearctic fauna, with 54% of Palaearctic, 36% of Afrotropical and 10% of eastern species.

The Mesasiatic, Oriental and Afrotropical species come from ancient eastern and southern immigration waves, which are ascribed to the early Holocene pluvial period (c. 10500-7300 BP). The European taxa are largely glacial relicts from the last glacial times. Most of endemics and semi-endemics derive from European species, are differentiated at the species level and should be linked to older immigration waves induced by former glacial times.

There is a strong difference in the representation of the Afrotropical and European fauna from a country to another. Thanks to the "Nile corridor effect" from the tropics to the Mediterranean, 24% of the NA Afrotropical species are found in Egypt whereas it reaches only 7–18% in the Palaearctic range of the other NA countries. Conversely, presumably due to arid events at the end of the Neolithic (c. 3000 BP), the Egyptian fauna is strongly depleted in European species, with only 2% of the NA European fauna against 14-23% in the best investigated coastal NA countries.

The meaning of the Afrotropical stock differs strongly according to the region. In the Nile Valley, present immigration of Afrotropical species is potentially a continuous S-N dynamic. Oppositely, in other NA countries the Afrotropical stock is present as decreasing disconnected relicts in oases and rivers and is controled by the progression of the desertification since the mid-Holocene.

The quality of most water bodies decreases regularly throughout the whole NA, resulting in the decrease of the most specialised species. The NA IUCN report points out that 34 species are threatened or near threatened, among which endemics and localised relicts are of special concern. Habitat loss or degradation and pollution are the main reasons. Protection needs legislation, research, monitoring, population management and land control. Long-term coordinated actions are required at regional to international levels. Although some competent residents exist in some NA countries, they are not numerous with respect to Odonata and most of field studies originated from visitors. Studies by residents are potentially much more comprehensive than by visitors, as they may extent all year round. They should be favoured in collaboration with non-resident peoples. Such collaborations have been recently initiated in relation to some management plans.
The project started in March 2007 with a declaration of the participants of the GdO´s annual meeting in Dresden to create an atlas of the dragonflies in Germany. The publication of the atlas is planned for 2013. It will be the first time that the knowledge about dragonflies is put together for all 16 federal states because these are independent in the matter of nature conservation and therefore the horizon of faunistic work often lies within the frontiers of these states. So in the first year it was necessary to built up a project group which organizes the atlas throughout germany with a net of coordinators for every one of the 16 federal states (Bavaria, Northrhine-Westfalia, Saxonia, etc.). The next step was the collection of already available and the research for new data. In some states regional atlases were already published and in most countries do exist good databases from which the data could be merged. This was started in autumn 2009 and in a short time around 780.000 datasets were available for Germany with only major gaps in the northeastern states (especially in Mecklenburg-Vorpommern, a state of large area but few odonatologists). Meanwhile exists also a team of authors for the monographs of the 81 in germany so far known dragonfly species and some first prototype monographs are produced. One major aspect of the german atlas project will be to contribute the data to the European Atlas. The talk will deal with the background and the aims of this project but will also show the development and first results. For further details please see: "www.libellula.org" or especially for the atlas-project "www.libellen-verbreitungsatlas.de".
In Germany the climate change is well proved by long lasting monitoring of the major weather parameters like temperature and rainfall. So the average temperature increased significantly for approximately 1°C in the last thirty years in the federal state of Northrhine-Westphalia. Also the annual amount and the distribution pattern of precipitation has changed. The current state of knowledge indicates that this development goes on and a further rising of the average annual temperature of approximately another 1°C is expected. There will be less snow and frost and on the other side more gale and rainstorm. Especially a negative water balance is forecast for major parts of the state.

Against this background the ministry of environment and the agency for nature conservation of Northrhine-Westphalia ordered an analysis of the consequences for the fauna and flora induced by climate change and a counter action plan as a strategy against these. Part of this work has also been the analysis of the dragonflies as a sensitive faunistic group. The 73 so far known species in the federal state of Northrhine-Westphalia are researched for those species which are influenced negatively or positively by the climate change. As one result the species which are influenced negatively and also endangered by other factors (e.g. hypertrophication, lowering of the groundwater table, anthropogenic habitat destruction) and for which the federal state has a special responsibility (e.g. populations at the frontier of their range) are selected. For this eight species (Aeshna subarctica, Coenagrion hastulatum, C. lunulatum, Cordulegaster bidentata, Leucorrhina dubia, L. rubicunda, Somatochlora arctica, S. flavomaculata) proposals for the monitoring and protection measures of the small populations left are made. Key aspects are management and protection of the remaining populations and their habitats and the development of new suitable habitats in the s by the climate change surrounding.
The impact of climate change on two boreo-alpine dragonfly species, *Somatochlora alpestris* and *S. arctica*, at the edge of their range

Geert De Knijf ¹, Ulrich Flenker ², Cédric Vanappelghem ³, Cosmin O Manci ⁴ & Vincent J. Kalkman ⁵

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It is expected that climate change will have a great impact on many species and habitats. This will be greater if populations are found at the edge of their range or are isolated and this can lead to regional extinction. Here we investigate the possible impact on two boreo-alpine dragonfly species, *Somatochlora alpestris* and *S. arctica* at their range margins. Both species were unknown for most parts of South-eastern Europe. In 2007 we found 15 localities for *S. alpestris* and two for *S. arctica* in the Carpathian mountains of Romania. This resulted in a distributional range extension of 500 km towards southeast. Both species are confined to mountain peat bogs in Romania. All localities are situated between 1300 m and 2100 m altitude, where the central 50% are restricted to a small range between 1600 m and 1800 m. Based on the factor altitude we predict a hypothetical distribution map for *S. alpestris*. In addition, we modelled the impact of climate change for two scenarios: a 1.5°C temperature increase and a 3°C increase. The first resulted in an altitudinal range shifts of +200 m and in a distributional shrinkage of 40%, the latter corresponds to an upward range shift of 600 m. Habitat specialists, especially those at their margins of distribution are hardly able to keep pace with climate change. It seems unlikely that mountain peat bogs will develop at rates comparable to those of climate change. This will inevitably result in regional extinctions of boreo-alpine species.
The biogeography of European dragonflies, with an emphasis on Afrotropical species in the Palaearctic

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After a general introduction to the biogeography of European Odonata, the presentation focuses on the African element in our fauna. Although approximately 30 species that are widespread in tropical Africa occur in Egypt and Israel, only eighteen of them reach into the Maghreb, and just thirteen have crossed the Mediterranean into Europe, accounting for about a tenth of the European fauna. Of these, Anax imperator and Crocothemis erythraea are most familiar. In my presentation I detail three recent discoveries of Afrotropical Odonata in the Palaearctic: (1) the record of a relict population of Orthetrum machadoi in Siwa Oasis in Egypt (cf. Dijkstra & Boudot 2010), (2) the separation of the northern species Brachythemis impartita from the purely tropical B. leucosticta (cf. Dijkstra & Matushkina 2009), (3) and the evolutionary history of three species that are recently expanding northwards: Trithemis annulata, T. arteriosa and T. kirbyi (cf. Damm et al. 2010).

Towards an understanding of *Calopteryx splendens*

Henri J. Dumont

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The late Cenozoic cooling brought an end to the sejunct range of *Calopteryx* from Northern Africa across Asia to North America. In North Africa-Mediterranean Europe and West Asia, pleniglacials reduced inhabitable areas to small patches, from which populations could radiate after each deglaciation. Some populations (*Calopteryx intermedia, C. waterstoni*) did that more successfully than others (*C. syriaca, C. exul*). The overarching, successful taxon is *Calopteryx splendens*. It remained taxonomically rather simple in the west mediterranean (*C. xanthostoma and exul*), but split in a pathwork of infrspecific taxa in the East Mediterranean and Ponto-Caspian. None of these emergent taxa show reproductive isolation, and they defy the rules of nomenclature! Uninhibited hybridisation is the rule where two or more taxa meet, only part of which can be picked up morphologically by the male coloured wing patch extent (and sometimes by female wing colours). Molecular techniques currently allow to define these taxa’s gene pools better, but still are in their infancy. Good markers exist and have been used, but so far in an anonymous manner (AFLP). Progress will come as soon as some of these markers can be identified and their base sequence used as a taxonomic criterium.
Dragonflies of Moldova: state of knowledge and personal observations (2005, 2009)

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Moldova is one of the most poorly studied European countries for Odonata. Several publications with some limited information about Moldovan dragonflies are available (Artobolevsky, 1917; Bezvali, 1932; Brauner, 1910; Andreev, 1998; Osenimskiy, 2006).

The geographical locations of some records could not be precisely reproduced based on information contained in old publications. Confirmation is needed for some literary records. Three sources referring to dragonflies of Moldova actually contain information about Romanian territory (Cîrdei, 1956; Prunescu-Arion, 1969; Cîrdei, F., Bulimar, F., 1961).

Based on literary sources and personal observations in 2005 and 2009 (Dyatlova, in press), a checklist of Moldovan dragonflies was created. The list contains 36 species; confirmation is needed for another 4 species known only from literature: Lestes viridis, Erythromma lindenii, Nehalennia speciosa, Aeshna juncea.

Dragonflies in Moldova were studied in 2005 and 2009. In August 2005 data were collected in the Sakharna village surroundings, the middle part of the Dniestr river (9 species were recorded). Between 28th June and 4th July 2009 dragonflies were observed in almost all parts of the country. 25 species were observed during 2009 fieldwork. 4 species (Lestes macrostigma, Coenagrion ornatum, Coenagrion scitulum, Orthetrum brunneum) were recorded for the first time in Moldova, as they have not previously been mentioned in known literature.

For many species we improved our knowledge of their Moldovan distribution. Habitats of every species were described and preliminary maps of species distribution created. The next step to study and protect dragonflies and their habitats is to create an informal Odonata community in the county. A “Dragonflies of Moldova” website will be created and this will stimulate more interest in dragonflies among scientists and amateurs.

The financial support for this research was obtained from International Dragonfly Fund and the European Invertebrate Survey (the Netherlands).
Phylogeny of Cordulegaster in West Palearctic with phylogeographic insights for some species

Elsa Froufe¹, Sónia Ferreira², Jean-Pierre Boudot³, Paulo C. Alves²,⁴ D. James Harris¹,⁴

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The Cordulegaster genus (Odonata: Anisoptera) has a Holartic distribution with eight species present in West Palearctic, most of them with relatively restricted distributions ranges and facing currently conservation problems. Goldenring are easily distinguishable from other dragonflies by their relatively large size and black-and-yellow body pattern, with the eyes meeting in a point on the top of the head. The common goldenring dragonfly, Cordulegaster boltonii (Donovan, 1807) (Odonata: Anisoptera), is the most widely distributed species and is the only representative of the genus in a large part of western and northern Europe. This species is found together with C. bidentata Selys, 1843 in higher parts of western and central Europe, while other species are almost restricted to the southern European peninsulas, well known for exceptionally richness in biodiversity and in where several subspecies have been described.

Presently are recognized two species groups based in morphological similarities named after the widely distributed species. The boltonii group include four species besides C. boltonii - C. heros Theischinger, 1979; C. picta Selys, 1854; C. princeps Morton, 1916; and C. trinacriae Waterston, 1976. The Bidentata group includes three species: C. bidentata, C. helladica (Lohmann, 1993) and C. insignis Schneider, 1845. Species within each group are essentially parapatric and each species substitutes the other, while the presence of a representative of each group is, in most of the areas, common even if occupying distinct ecological niches.

Although some Cordulegaster species have been subject of numerous behavioral and ecological studies, the evolutionary history of this genus remains largely unexplored. Here, we present the first molecular phylogeny of West Palearctic Cordulegaster based on both nuclear and mitochondrial loci. Nucleotide sequences were obtained from two genome regions for 8 Cordulegaster species and 13 subspecies in a total of around 100 individuals, covering the total range of the genus in Europe and North Africa. The sequenced genes are the internal transcribed spacer 1 (ITS-1; 717 bp, partial sequence) and the mtDNA cytochrome c oxidase I (COI; 654 bp, partial sequence).

Our phylogenetic analysis resolves the relationship among species and tends to disagree with some morphology-based subspecies classification hypotheses, namely there was no clear separation among the four subspecies of C. boltonii. On the other hand, the separation of the two subspecies of C. helladica was corroborated by both markers. COI has been shown to be a useful phylogeographic marker within the Cordulegaster genus and although variation with ITS-1 was too low to be useful to assess variation within species, it was useful to confirm the monophyly of all the species (since relying on only mtDNA can be sometimes misleading).

These results provide the groundwork for future analyses, allowing a better understanding of genetic diversity in this group and the identification and prioritization of conservation targets.
Range-wide genetic diversity of the rare odonate *Coenagrion mercuriale*: influence of latitude and isolation

Laura K. Gordon

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Genetic diversity plays a key role in population persistence, for example by enabling adaptation to environmental stochasticity, and is correlated with extinction. Thus it is useful to understand the process that leads to erosion of genetic variation. Low genetic diversity may result from numerous processes, including; inbreeding, bottleneck and founder effects, and genetic drift. Low genetic diversity is commonly associated with small and isolated populations, particularly at species’ range margins.

*Coenagrion mercuriale* is one of Europe’s most threatened damselflies and is protected throughout its range, which extends from the UK, through western, central and southern Europe and into North Africa. There is concern for its future persistence, with particular focus on populations most at risk of extinction through increased isolation and fragmentation. At the northwest edge of its range in the UK, the level of genetic diversity is negatively correlated with the degree of population isolation, with peripheral populations particularly impoverished (among the lowest reported for insects); however, the pattern of genetic diversity at the centre and southern edge of this species’ range is not known.

Here, we quantify, using a panel of 14 microsatellite loci, patterns of variation in genetic diversity among populations of *C. mercuriale* from four key regions located throughout its central and southern European range; (1) United Kingdom, (2) France, (3) Germany and (4) Spain. There will be particular focus on latitudinal and regional trends, and also reference to the level of diversity present at this species’ northwest range margin.

There was no obvious link between latitude and genetic diversity *per se*, but there was substantial variation among regions. Thus, the UK populations showed a significant reduction in genetic diversity (number of alleles and expected heterozygosity) compared with the central European populations as a whole. Variation in diversity was detected among the four regions also, with the UK and Germany having significantly lower diversity (numbers of alleles, $P<0.001$) than France and Spain. As no significant difference in the level of genetic differentiation ($F_{st}$) among populations within regions was detected this variation in diversity is unlikely to be related to isolation effects alone, although there is some evidence for regional isolation in some Spanish populations. Thus loss of genetic diversity corresponds with a lack of variation at range margins in both island and continental samples.
Protection of Red List species in the Netherlands:
ecological research, monitoring and conservation

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Adequately protecting dragonflies is a complicated challenge, which asks for a step-wise strategy and the co-operation of many people. In the Netherlands, six Red List species have been subject of species protection plans on national, regional or local scale in the last few years. Two national species protection plans have been published. One for the localised but rather common *Aeshna viridis* listed at the Habitat Directive and one for the rather elusive and threatened *Somatochlora arctica*. The aim of these plans is to integrate ecological knowledge in restoration projects for these species. For both species examples will be shown. Protection of dragonfly starts with putting endangered dragonfly species on the agenda of policy makers, by making them aware of the endangered status of the species. Research to the causes of the species’ decline is often a necessary first step in the protection project. Research examples of different Red List species include a survey on the ecological needs of *Coenagrion hastulatum* which will be summarised. The second step is to translate knowledge of dragonflies into concrete recommendations for habitat management. This is best done in close consultation with the managers of the nature areas in which the species occurs, or might occur in the future. Ultimately, the protection plan should be presented to a broad public, in order to get the needed commitment for the execution of the desired conservation measures. For example, the local water board, a group of enthusiastic volunteers, local policy makers and the owner of the nature reserve all worked together in the protection of a small brook in the southern part of the Netherlands, to protect the rare *Cordulegaster boltonii*. 
Opencast lignite mining has moulded large parts of Lower Lusatia, a glacially influenced landscape in Eastern Germany. The mining activity has caused strong impacts on natural habitats. On the other hand the young post mining landscape classes among the most species-rich dragonfly habitats in Germany. Especially the large populations of several rheophilic dragonfly species occurring in the mining influenced streams have a high importance for nature conservation in the federal state Brandenburg.

During mining the streams in the area are artificially discharged with pumped groundwater and are characterised by high water quality and high rate of flow. After the end of a mine the remaining natural catchments areas are often too small to ensure an adequate good state of the stream habitats. As part of the compensating measures in the opencast mine ”Welzow-Süd“ an artificial catchment area will be established part by part to supply a very species-rich stream with permanent discharge. Currently the first step including an artificial but free flowing “headwater” is realized. This allows investigating the initial colonisation by dragonflies depending on the hydrological conditions for the first time.
Preliminary morphometric and molecular investigations on adult specimens of two Lestes (Chalcolestes) taxa

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It is questionable whether the two Lestes (Chalcolestes) taxa (viridis and parvidens) are valid species or subspecies. Their distribution is also partly unclarified especially in the Pannon and the Balkan regions. Until recently, the potential occurrence of L. parvidens in Hungary was not taken into account. Based on the literary sources and our recent study L. parvidens seems to be prevailing in Hungary except in the northern parts. According to our research a few intermediate individuals were found particularly at shallow lake Fertő/Neusiedlersee. In this study, we compare morphometric measurements and molecular techniques to find out if these two taxa can be appropriately distinguished. German, Austrian and Hungarian populations were analyzed to realize morphometric and DNA sequence differences. In most cases the morphometric parameters were suitable for discriminating the two taxa. DNA sequences [Internal transcribed spacer (ITS) region of the nuclear ribosomal DNA, mitochondrial NADH dehydrogenase subunit 1 (ND1) gene] have confirmed the identification based on morphometric traits.

Key words: Lestes viridis, Lestes parvidens, morphometric analysis, DNA sequences
The influence of season on wing morphology of *Calopteryx splendens* (Harris, 1782)

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In the genus *Calopteryx*, males generally have pigmented wing spots, a secondary sexual character, the size of which is believed to indicate male quality. This trait has commonly been used to address a number of behavioural and evolutionary questions. However, variability of this character in single populations has only rarely been investigated. It is well known that constraints imposed by the advancing season influence the development of organisms. The effect of these constraints on a number of characters have been explored in insects. For example, size of emerging adult insects often decreases as season advances and the fecundity of females late in the season is often lower. These findings suggest that insects which emerge later in the season have less energy available in comparison with those that developed earlier and that they need to adjust resource allocations in function of the advancing season in order to maximise fitness. Hence it is expected that also adult *Calopteryx* which emerge later should be smaller and that the allometry of costly secondary sexual characters, such as wing spots, should decrease in size later in the season. These hypotheses was tested using a population of *Calopteryx splendens* (Harris, 1782) from Bosco Fontana, Italy. It was found that males caught were on average smaller later in the season and that the allometric function describing wing spot size differed between males caught early and those caught late.
Notes to the ecological demands of *Cordulegaster heros* (Cordulegastridae) in its northern part of area in Slovakia

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*Cordulegaster heros* Theischinger 1979 is Eastmediterranean species occurring in disjunctive area within the Balkan Peninsula in Europe. Its habitat are smaller meandering streams, mostly overshadowed by tree vegetation in hilly landscape. Northern area border is still unclear – a larger unbroken area is known from eastern Austria, Slovenia and south-western Hungary. An isolated area is at present known from western Slovakia as a northernmost occurrence.

The occurrence of *Cordulegaster heros* was studied in detail in the southern part of Slovakia during 1997-2009. The running waters of streamlets and streams (totally at 85 localities) were investigated in detail in regions of potential occurrence, i.e. southern Slovakia – regions of the Borská nížina lowland, the Malé Karpaty Mts., the Cerové vrchovina hills, the Slánské vrchy Hills, the Slovenský kras Hills, the Vihorlat Mts. and Popričný Hills. Data concerning morphology of stream basin, pedological composition of sediments, water quality, state of vegetation and landscape etc. were collected.

At present three regions with its occurrence are known – the Borská nížina lowland, the Malé Karpaty Mts. in western Slovakia and the Revúcka vrchovina Hills in central Slovakia. The species was totally found at 44 localities, which lay at the altitude from 194 to 516 m a.s.l. with its main occurrence in the range of 200-300 m a.s.l. The evaluation of occurrence was based on records of larvae. Its habitats are there natural streams and streamlets with clear water with the width of basin from 20 to 420 cm with the depth of 2 to 18 cm. All localities lie in the forest complexes. The important factor appears to be the absence of any settlement above the localities. The highest found density of larvae (majority last larval instar - 14) was 25 per 0,25 m². The occurrence of species ends in the Malé Karpaty Mts. northwards, where the parent rocks of Mts. changes from crystalline into the limestone. Area of *C. heros* in southern Slovakia is seemingly disjunctive.
A Project Named BOB - Balkan OdoBase

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Balkan Peninsula is one of the least odonatologically explored parts of the European continent. The data on Odonata from the region has been published since 19th century, and many of these references remained “hidden” for quite a long time. In addition to this, recently published data are often hard to access. As the published data are public goods, we have decided to collect it and make available online to any interested researcher. It will be accessible through the Natural History Museum in Belgrade website (www.nhmbeo.rs), the institution that has decided to support our idea.

Our growing database will include data on 76 Odonata species on the territory of 6 Balkan states – Bosnia & Herzegovina, Bulgaria, Macedonia, Montenegro, Serbia and the European part of Turkey. The database is maintained by a data manager (Miloš Jović) and national coordinators (rest of authors). The other sources of information (in form of digital photo, detailed description or proper identification) should be consulted and assessed by the national coordinator prior to entering in the main database. The criteria for inclusion will be available online. So far, such practice has proven to be a very effective way of communication and valuable source of information that builds up important phenological and chorological data.

The database is projected as a comprehensive data-resource decreasing the waste of time in obtaining data for Odonata researchers in both the region and the whole Europe. BOB is planned to be an ever increasing source of data as data will be regularly checked and updated by national coordinators. There is also an open invitation to Odonata specialists from other Balkan countries (or specialists that work on Odonata of the region) to join this project in any stage of its development.
An atlas of the European dragonflies: will it ever happen?

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The project for a European atlas of dragonflies started about five years ago. During that period many countries published distribution atlases and even an atlas of the dragonflies of the Mediterranean was published. But what about this European atlas? Is it ever going to happen?

During this presentation an overview will be given of the current state of the project. The first draft maps of European dragonflies will be shown and an outline of the atlas will be presented. The manuscript will be finished in 2011 and hopefully the atlas will be published in 2012.
European Red List of dragonflies

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Based on the IUCN criteria a Red List was made for the 138 species of Odonata recorded in Europe. Five species were regarded as Not Applicable, as they have no stable populations in Europe. *Cordulegaster helladica* and *Onychogomphus forcipatus* have three subspecies each, of which the taxonomy and distribution are sufficiently well-known to make them eligible for an assessment. Hence, a total of 137 species and subspecies were assessed. Eighteen of these European taxa are endemic to the continent, of which sixteen are either confined to islands, to the Balkan Peninsula or - at least mainly - to the Iberian Peninsula and France.

Approximately one out of seven (15%) of these taxa were found to be threatened in Europe, with a similar proportion being threatened at the EU level. An additional 11% are considered Near Threatened. Most of the threatened species are confined to parts of southern Europe and three key areas for dragonfly conservation in Europe have become evident: the southern Balkan Peninsula, Crete and the Iberian Peninsula. Currently, the main threat to European Odonata is desiccation of their habitats due to the increasingly hot and dry summers combined with intensified water extraction for drinking and irrigation. Other important threats to species living in running waters are water pollution and the construction of dams and reservoirs.
In 2009 a faunistic preliminary survey on nymphs, exuviae and adults was carried out to monitor the dragonfly fauna in and near the water bodies of the 10x10 km sized ET 56 UTM grid square east of Debrecen (E-Hungary) which partially belongs to the Hajdúság Landscape Protection Area. All the water habitat types which can be found in the grid are represented by the sample sites: stream and creeks, ponds, marshes and pools. Many of them are natural but some of them are artificial water bodies (e.g. reservoirs, ditches and canals). Only two large scale faunistic surveys have been made in the grid square up till now. The first was in 1989 and the second was in 2006 and both based on adults. In the course of the first one in 1989, which was complete for the dragonflies’ flight period, 46 dragonfly species were noticed on 71 sample sites. In the course of the second one in 2006, which was almost complete for the dragonfly’s flight period, 33 species were recorded on 44 sample sites. Comparing these surveys have caused difficulties because of the different methodologies and the elapsed time between them. In this way, another survey was needed to monitor the fauna in the grid. The aim of this preliminary study was to plan a monitoring survey which will last at least for two years. The water habitats of the dragonfly fauna here in the grid square are threatened by aridity likely caused by mistreat of the water budget and possibly global warming. One marsh and one pool marked and surveyed in 1989 have already vanished. During the survey there was a considerable drought in the area and most of the habitats were completely dry for 2 or 3 months, and that could be the reason for the relatively low number of species (e.g. we couldn’t collect larvae on most of the sample sites during July, August and September). In 2009 on 68 sample sites 35 species (12 Zygoptera 23 Anisoptera) were recorded and 5 of them are nationally protected (Aeshna isosceles, Somatochlora flavomaculata, Libellula fulva, Orthetrum brunneum, Leucorrhinia pectoralis). These 35 species are the 53.8 percent of the whole Hungarian fauna (65 species). We collected 351 larvae and 24 exuviae and identified 1804 adults in the field. The most diverse habitats were the small watercourses with 31 species and the ponds with their not much less 29 species. The dragonfly-fauna of the pools consisted of only 15 species and the marshes had 13 species.

Key words: Odonata, adult, nymph, exuvium, ET 56 UTM grid.
New records of *Somatochlora sahlbergi* from Finland

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New records of *Somatochlora sahlbergi* from Finland are presented with notes on adult behaviour. Most earlier records concern larvae and adults have been seen rarely. In 2009 many adults were found in Nuorgam, northernmost part of Finland. Additionally, *S. sahlbergi* was recorded for the first time in Lapponia enontekiensis in 2007. The presentation also includes photographs of other Finnish dragonflies.
An annotated checklist of the Macedonian dragonfly fauna is presented in the paper. Checklist includes 61 species. Presence of *Lestes sponsa* (Hansemann, 1823) in Macedonia is recorded for the first time. Besides all available literature data, this review includes unpublished records of Odonata mainly from the mountainous areas of the country.

Twelve species are of international importance (based on their presence in EU Habitats Directive Appendices and/or the status of threat presented in the European Red List). Status of these species in Macedonia is briefly discussed according to present knowledge of their distribution and factors that represent threat to existence of the known recent populations.

This review also includes a list of species which were not recorded and expected to be found on the territory of Macedonia.
Siberian taxonomical problems concerning European odonate species

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In the Palaeaerctic, odonates are very well investigated in Western and Central Europe and then in the Far East, especially Japan, while the tremendous landmass of Siberia between these extremities, on one hand, has rather poor fauna and, on the other hand, is not well studied, in spite of enormous efforts of Belyshev and his discipiees in the second half of XX century. Meanwhile there exist pairs of related western and eastern taxa of uncertain status, which should be resolved in Siberia. A wide range of taxonomic solutions is expected for different cases. Sympatry with ecological segregation of Somatochlora metallica and S. exuberata recorded at the Yenisey sources (Todzha depression of Tuva) is an example of a solution in favour of bona species. No doubt that the western Ophiogomphus cecilia, the eastern O. obscurus and the Inner Asian O. spinicornis are good species, but so far only two former were once recorded in sympatry in the Lena upper reaches, although their ranges should contact or overlap over long distances in Siberia. Two species groups within Leucorrhinia, the dubia-group and rubicunda-group, enjoy a continuous transpalaearctic distribution, each represented by a western/eastern pair of taxa: dubia/orientallis and rubicunda/intermedia, respectively, but within each pair little is known what happens at the joint of their ranges. In Tuva, populations of the former group are somewhat intermediate between dubia and orientalis, used to be considered as subspecies, while the latter group is represented by true rubicunda. and the border with intermedia is still to be located somewhere easterly. Within Erythromma, the eastern taxon humeralis used to be considered as bona species in spite of very weak differences from E. najas. In Tuva, they were found to be isolated by the Taksyl Mt. Range and to inhabit different landscapes (steppen versus taigous), yet a case of contact is to be found for a proper solution. In Siberia, Enallagma cyathigerum cyathigerum and E. c. risi represent a northern/southern pair and occupy a taigous versus forest-steppen and steppen (often brackish) water bodies, respectively, but transitory specimens are found in zones of contact: Middle Ural, Vasyugan Bog, Altai and Tuva, while populations of the upper Lesser Yenisey basin in SE Tuva seem to be entirely transitory, thus suggesting a subspecies status of this pair of taxa. They were meanwhile claimed to be bona species basing on the molecular phylogenetic analysis. More strikingly, the taxa aenea (western) and amurensis (eastern) within Cordulia were recently proposed to be bona species in spite of lack of any phenotypic differences and continuous distribution of the genus in Siberia. However, phylogenetic analysis based on ‘molecular clock’ is unable to reveal borders between biological species since speciation is rather a discontinuous process. Dichotomy ‘species/subspecies’ should be resolved using more laborious approaches of population genetics, able to evaluate gene exchange in a zone of contact between populations. The International Code for Zoological nomenclature is indifferent to the species concept used, but the Mayerian concept of biological species should be retained and not replaced by the so-called ‘phylogenetic species concept’, since the former concerns actual relations between compared entities in present while the latter just reconstructs their relations in the past.
Odonata in Bosnia and Herzegovina

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Bosnia and Herzegovina is small country (51,129 km²) with very specific and diverse landscapes and habitats within three biogeographical regions (Mediterranean, Alpine and Continental). From sea level up to more than 2300 m above sea level there are numerous natural and artificial lakes, karst fields with specific hydrology, lowland and mountain streams, rivers and marshes.

Knowledge of dragonfly fauna of Bosnia and Herzegovina is very poor and not as good as those of other countries in the region. Bibliographic records on dragonfly fauna in Bosnia and Herzegovina are very rare with small number of species and localities and in terms of time they are very old. Most data originates from Adamovic (1948), who revised the material from the collection of the National Museum of Bosnia and Herzegovina.

During 2009 new research started and a database is built with more than 1200 records of Odonata from literature, collections and field work. New data on distribution and species occurrence in Bosnia and Herzegovina are gathered.

Information on current research and status of knowledge of dragonfly fauna of Bosnia and Herzegovina will be presented.
Identifying keys to the conservation of Lestes macrostigma (Eversmann, 1936): to a European monitoring?

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*Lestes macrostigma* (Eversmann, 1836) is a stenoeic threatened species with a patchy distribution. Evaluated by the IUCN as Vulnerable in Europe and Endangered in EU27, it has a strong conservation status from regional to international scales. One of the priority actions to lead toward its conservation is to protect areas where this damselfly occurs. In already protected ones, wildlife managers can act on biotope to make it suitable to the species, as in Marais du Vigueirat (Camargue, France) where water and grazing are under control. For such proper management, they need to know what are the ecological requirements of *L. macrostigma*. However its biology and ecology have been poorly studied. Since 2007, together with European odonatologists and other scientists, we have studied in Marais du Vigueirat various subjects such as phenology and daily activity, oviposition behaviour, influence of temperature and salinity on larval development. Regarding already known factors that influence its biology and ecological differences that can occur between some areas, it appears essential to assess how consistent are our first results in time and in space. Hence, we encourage to lead similar and additional studies. We also wish to erect a coordinated European network in order to monitor *L. macrostigma* with similar methods throughout its whole range.
Cordulegaster insignis and C. picta on Aegean Islands: longitudinal distribution patterns and the mechanism behind them

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During spring and autumn 2001 a survey was carried out on the Aegean islands of Thassos and Samos dealing with the longitudinal distribution patterns of two Cordulegaster species, C. insignis and C. picta. Whereas larvae of C. insignis were restricted to springs and springbrooks, larvae of C. picta dwelled in springs and springbrooks as well as in larger streams. If both species co-occurred in the same catchment, C. picta occurred more downwards. As the findings were comparable with the situation in Central Europe – with C. bidentata as the ‘spring-dweller’ and C. boltonii as the ‘stream-dweller’ –, it was attempted to explain these patterns. Experiments in artificial streams revealed behavioural differences in response to current between the ‘spring-dwellers’ and the ‘stream-dwellers’: whereas C. insignis and C. bidentata showed a high proneness to drift, the behaviour of C. picta and C. boltonii was more effective to withstand strong hydraulic stress. These differences may explain, why C. insignis and C. bidentata are restricted to habitats with low discharge and current velocity, namely springs and springbrooks.
Geographic parthenogenesis in the damselfly *Ischnura hastata*: A role for metapopulation structure?

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Hypotheses proposed to explain geographic parthenogenesis (i.e. the observed pattern of non-overlapping distributions of sexual and parthenogenetic populations) are mostly based on the idea that asexuals may persist in the long term if they escape from negative interactions with either sexual lineages and/or biological enemies, and thus parthenogenetic populations will be more likely to occur in places that are difficult for sexuals to colonize.

The damselfly species *Ischnura hastata* has sexual populations in North America, whereas parthenogenetic populations of this species are found only at the Azores archipelago. In order to gain insight in the origin and distribution of parthenogenetic *I. hastata* lineages, we have used microsatellites, as well as mitochondrial (COI) and nuclear (EF1-α) DNA sequence data to examine the population genetic structure of this species over a wide geographic area. Our results suggest that sexual *I. hastata* populations conform to a large subdivided population that has gone through a recent spatial expansion. The parthenogenetic populations found in the Azores islands are likely to be the result of a single long distance dispersal event. The great distance between North America and the Azores archipelago could have prevented sexuals for arriving and outcompete parthenogens during the initial generations, thus allowing for the fixation of the obligate parthenogenetic lineage in this archipelago. The relative stability of the habitat in the Azores, coupled with a low incidence of predators, parasites and competitors in the islands, may have also contributed to the maintenance of asexual populations.
The Atlas of Dragonflies and Damselflies of Catalonia

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Formed in 2003, OXYGASTRA - the Catalan Odonatological Society - is currently working on the first atlas of the odonats of Catalonia and it is expected that fieldwork in 2010 will complete the coverage of the 395 10 x 10 km quadrats that constitute the study area. Modern and historical records have been combined in an on-line database (over 30,000 records) that contains the raw information for the distribution maps, species accounts and statistical analyses to be included in the publication scheduled for 2011.

Fieldwork is based initially on cartographical research into possible reproduction sites and then on site visits by volunteers or by a paid worker, each quadrat in Mediterranean areas being visited three times a year (spring, summer and autumn), in montane areas twice a year and in high mountain areas just once a year. To date three new species (Macromia splendens, Gomphus graslini and Cordulia aenea) have been detected during the field work and in all 66 of the 69 known Odonata from Catalonia have been recorded during the atlas period. Funding for the fieldwork has been received from the Catalan Institution of Natural History and for specific species and sites from the Department of the Environment and Housing of the Catalan Autonomous Government.
An overview on dragonfly (Insecta: Odonata) fauna from Romania

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As stated in last monographic works that cover Europe (Askew, 2004 and Dijkstra, 2006) the knowledge on dragonfly’s fauna from Romania is still insufficient. Until now several works were done with the aim to gather all data known or try to characterize the dragonfly fauna from Romania (Cârdei & Bulimar, 1965; Lehrer & Bulimar, 1979; Paina, 1977; Plattner, 1968; Pór, 1956). From these is to be remarked the monograph published by Cârdei & Bulimar in 1965 that is still used as a “master book” in Romania. New papers where published, after those dates, bringing confirmation of presence for some species or new species in the Romanian fauna. The presence of Epitheca bimaculata is confirmed (Manci & all, in preparation), Nehalennia speciosa has been rediscovered (Manci, in preparation), the discovery of Cordulegaster heros (Beutler, 1988), Somatochlora meridionalis (Beutler, 1988) and Somatochlora arctica (Knijf & all, in press) just to name a few.

We started studying the dragonfly fauna from Romania in 1993 in the western part of Romania (a paper on this is ongoing). An extensive study of what is present already in different collections scattered in different museums all over Romania has started and one paper was already published (Manci, 2007) and two are ready to be sent for publishing. Here it is worth to mention the on-line database found at: http://dragonfly.nature4stock.com/. A red list of dragonfly fauna from Romania is ongoing preparation as well a program to study the Natura 2000 species from several areas is in progress.
Ecology of the Odonata at the westernmost spot of Africa, the island of Santo Antão, Cape Verde

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In August 2009, the odonate fauna of the island was surveyed by recording adults and collecting larvae and exuviae at 26 localities, mostly situated in the northwest of the island. Based on the results of this survey and literature data on the Cape Verdes it is obvious that the resident odonate fauna consists of only five species, namely Anax imperator, Crocothemis erythraea, Orthetrum trinacria, Trithemis annulata, and Zygonyx torridus. Three additional species, Anax ephippiger, Pantala flavescens and Sympetrum fonscolombii, represent seasonal invaders which do not establish permanent populations on the island. Surprisingly, there is no zygopteran species recorded from the island so far although a few occur on the neighbouring islands. The breeding habitats of the resident odonates on the island comprise short perennial stream sections in large wadi beds (‘ribeiras’) that are intensely used for agriculture as well as artificial irrigation tanks. The odonate assemblage is very uniform, a tendency for being a specialist was found in two species on the micro-habitat level only; Z. torridus prefers micro-habitats with current water and O. trinacria micro habitats with fine sediments. Due to the absence of fish, crabs and large water beetles the larva of A. imperator appears to be the top predator in freshwater habitats.
So far, in Europe odonates are not known to be alien species in the wild. Because of their high mobility as adults, Odonata, as other aquatic insects, are able to colonize new river catchments and new areas quickly and without direct anthropogenic activity. Because of this, most odonate do not fit the strict definition of nooazoans/alien species.

Real exotic odonate species are mainly introduced via pet and aquaristic trading. There is a long list of spp. identified from larvae and imagines identified from home aquaria and green houses in Europe. It is suggested that the major reason for incidental introduction is the trading with exotic water plants. So far, there is no case known from a foundation of a breeding population. Currently, in Europe tropical plants for aquaristics are mainly imported from Singapore, Indonesia and Thailand, and it is suggested that exotic Odonata also originated in one of those countries.
Toward the Atlas of Croatian Dragonflies

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Most recent records of 64 dragonfly species occurring in Croatia are presented on a 50 km x 50 km UTM map grid. A level of knowledge of Croatian dragonfly fauna is presented on a 10 km x 10 km UTM map grid, with a brief discussion on the challenges of mapping dragonflies in Croatia. A biogeographical account of existing distribution patterns is provided, together with prospects of Atlas publication.
The Odonata fauna of Albania

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Contrary to most other European countries, the dragonfly fauna of Albania is poorly known. The number of hitherto reported species is 56 (less than the half of the European fauna) but many further species are expected.

The number of records are especially scarce, as only twelve papers published faunistical data from the country. Seven of these are older than 60 years, their data were critically discussed and completed with new records in the work of Bilek in 1966. During the last 20 years, four further faunistical papers add 16 species to the previously known 39 Albanian dragonflies.

The exploration of the different regions and the different habitats are rather unbalanced. Only the coastal plain, the running waters and some of the alpine lakes can be regarded as more or less well explored, while most of the inland still waters and many mountainous areas are essentially unknown.

The coastal areas share a typical Mediterranean fauna, while the inland lacks the southern species, resembling to the Northern and Central Balkans. Widespread European species that are missing from the Southern Balkans seem to be restricted to alpine lakes in Albania (e.g. Aeshna cyanea (Müller), Cordulia aenea (Linnaeus) and Libellula quadrimaculata Linnaeus). The main faunistical curiosity of the country is Pyrrhosoma elisabethae Schmidt that is restricted to Southern Albania and Western Greece. Lestes dryas Kirby is added to the Albanian Odonata list herein.

Some of the species found in the country raise taxonomical problems. The Southern Albanian populations of Cordulegaster bidentata (Sélys-Longchamps) likely belong to a separate subspecies, as well as the coastal population of Lestes virens (Charpentier). In addition, Albania is a border zone between the subspecies of Calopteryx splendens (Harris) and of Ischnura elegans (Vander Linden), thus, some populations show intermediate characters.
Dragonflies on the western fringe: red list and important dragonfly areas of Ireland

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Ireland sits on the western edge of Europe and it cannot be denied that the dragonfly fauna is depauperate. Nevertheless the fauna is of biogeographical interest and in many places dragonflies can be the most abundant and visible aquatic animals. The results of the red listing of the Irish species and identification of important dragonfly areas will be presented. The distribution and threats to these species will be outlined and discussed. The trends apparent in some species will be related to changes in habitat quality of Irish freshwater habitats.
Climate change and Alien Invasive Species (AIS) - a deadly cocktail for dragonflies?

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About two decades ago a strong change in the distribution patterns of European dragonflies started and this process is still ongoing – presently even again increasing. Firstly, Mediterranean species were moving to the north invading central and northern Europe (e.g. Coenagrion scitulum, Erythromma viridulum, Crocothemis erythraea, Anax imperator, Aeshna mixta, Aeshna affinis), and recently also African species were invading Europe and presently expanding their ranges rapidly (e.g. Trithemis kirbyi, Selysiothemis nigra).

These trends are mainly the result of the changes in the abiotic factors "temperature" and "precipitation", altering the biology of the species as well as of the biotopes. E.g. the higher temperature in the waters leads to more generations: an example is *Ischnura pumilio* in Germany, becoming now bivoltine and having also bigger populations with stronger tendencies to expand in new waters.

Furthermore, the lack of water due to the reduced precipitation in some areas leads to strong changes in the biocoenosis: mainly moorland and alpine species (e.g. Somatochlora arctica, *S. alpestris*, *Aeshna juncea*, Leucorrhinia dubia, Coenagrion hastulatum) are negatively effected by drying out of their biotopes, as well as species of springs and small rivulets (e.g. Cordulegaster bidentata). As a result of this process the moorland species are losers of these climatic changes and remain on the Red Lists and some are even in higher rankings.

The ubiquitous and euroecious species (*Anax imperator*, *Libellula quadrimaculata* and *L. depressa*, *Ischnura elegans*) on the other side are the winners. This process also leads to a change of the whole coenosis in the waters, as not only the composition of the dragonfly fauna changes: the effects are registered in all taxa resulting in a general change in the food webs and biodiversity of the waters.

Presently a new threat becomes more and more important: Alien Invasive Species (AIS). As a consequence of the globalisation, introductions by aquarists and fishermen many new species can be found in the waters. Some of them also do reproduce and are increasing their ranges, out of these species some are having negative – some even dramatic – effects on the biocoenosis.

In particular some fish (e.g. *Ctenopharyngodon idella*) and crayfish species (e.g. *Orconectes limosus*, *Procambarus* sp., *Procambarus clarkii*) could be identified as dangerous for the native dragonfly fauna, as they are altering the biotic conditions or the food chain (e.g. reduction of water plants – lack of substrate for oviposition) or as they are strong direct predators for the larvae. As these AIS often are favoured by higher temperatures, both factors now may have synergistic and cumulative effects.

After a short review on recent developments and trends of the distribution and ecology of Odonata in Europe the possible consequences for nature conservation and the future for native dragonfly populations are outlined.
Microevolution through climatic changes? The example of the expansion of *Crocothemis erythraea* in Europe

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Species may respond to climate change by shifting in abundance or expansions of ranges, by going extinct, or by adaptive evolution. In the past 2-3 decades *Crocothemis erythraea* showed a very remarkable expansion from the Mediterranean to central Europe. In Germany it crossed the entire country in two decades and now it is also indigenous in the northernmost federal states. Also in other European countries, like the Netherlands, Poland, Czech Republic etc. it showed a clear northward expansion and in others – like France – it became much more widespread. This expansion could be seen as a direct effect of climatic changes, as the species followed the increase in temperature.

It is not clear how climate change will affect the level of genetic variation in natural populations. When new populations are founded by a few individuals, the loss of genetic variation could happen by genetic drift and/or by the increase of inbreeding coefficients. As the northern populations are now several hundred to a thousand kilometers away from the original populations it might be, that there are already also changes in the genetics of the species. To test this hypothesis, we perform phylogeographic analyses of *Crocothemis erythraea* over a large part of its geographic range all over Europe and also in Africa using two mitochondrial genes: Cytochrome b and mitochondrially encoded NADH dehydrogenase 1.

The sequence of Cytochrome b showed out of 367 bp, there were 15 polymorphic sites revealing a total of 15 mutations. The total haplotypic diversity was 0.0854. The proportion of individuals with unique haplotypes in the southern populations (24%) was similar to that of the northern ones (25%). Haplotypic diversity was comparable between the South (0.833) and North (0.871), and nucleotide diversity in North was (0.00615) comparable again with the South (0.00595). In ND1 sequence out of 446 bp, there were 9 polymorphic sites revealing a total of 9 mutations. The total haplotypic diversity was 0.0917. The proportion of individuals with unique haplotypes in South of the distribution range was (50%) slightly greater than the northern ones (41%). Haplotypic diversity in southern populations was (0.833) lower than in northern populations (0.924) and the northern nucleotide diversity (0.00486) was also higher than in the southern populations (0.00374).

**Preliminary results** showed that genetic diversity was comparable between North and South of the distribution (for the two genes), not finding evidences of loss of genetic variation. This study on *Crocothemis erythraea* reveals the first genetic characterization of a dragonfly expanding its range as a consequence of climatic change.
Fluctuating asymmetry in wings of *Calopteryx* damselflies at species, population and latitudinal levels

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The developmental stability of a bilateral organism is reflected in its ability to produce symmetrical traits under multiple pressures during its growing life. Fluctuating asymmetry (FA) means subtle deviations from perfect symmetry in bilateral traits as a result of a developmental control. FA is commonly used as a measure of developmental instability, although it remains doubtful its use as a fitness indicator. According to theory, the greater the functional importance of a trait, the lower the level of FA is. This means that secondary sexual traits are expected to show higher levels of FA. Size may affect the level of FA as well.

The levels of FA (right minus left sides) were studied in wings of males of the damselflies *Calopteryx virgo meridionalis* Séllys, 1873 and *Calopteryx xanthostoma* (Charpentier, 1825), using populations at three different latitudes. Male wings show a secondary sexual trait, the pigmented wing patch, allowing us to compare levels of FA in naturally and sexually selected traits. Data were acquired using digital images of scanned wings. Obtained levels of measurement error, analysed by mixed models, were low and acceptable.

No differences at latitudinal or at population levels were found. Significant differences in FA levels between species were recorded only for some traits of the frontwings: wing patch length, wing area and partially the wing patch area. Differences between front- and hindwings were only significant for wing length in *C. virgo meridionalis*, showing higher levels in the hindwing. Levels of FA in the secondary sexual trait were significantly higher than the rest of the traits only for *C. virgo meridionalis*. At species level, positive correlation between size and level of FA was only recorded for hindwing patch length in both species and for hindwing length in *C. virgo meridionalis*. Finally, levels of FA within species did not correlate with the percentage of pigmented wing, which is a supposedly honest, quality-indicator trait.

Some FA estimates were significantly different between species, but not at a latitudinal or at a population level. Males of both species show a courtship during which hindwings are displayed to the potential mate while frontwings are beating. It might be expected that levels of FA in the hindwing patch will be lower than in the frontwing patch; in the same way, frontwings might be expected to show lower levels of FA in size. However, only wing length FA was higher in the hindwings for *C. virgo meridionalis*. Moreover, only in this species the level of FA in the wing patch was higher than the other measured traits. Size effects were relatively important and great care must be taken when FA is analyzed. Apparently, levels of FA were not a good fitness estimator in this study.
Migrant Dragonflies in the UK: Distributions are flexible, especially in times of climate change

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Dragonfly migration is perhaps most obvious in the large-scale wanderings of Hemianax ephippiger and Pantala flavescens in the tropical/sub-tropical Old World, and in the north-south movements of a number of species, such as P. flavescens, P. hymenaea and Anax junius, in North America. Regular long distance migration in Europe is apparently less pronounced, but Sympetrum fonscolombii is an important example and the phenomenon is likely under-appreciated. Arrivals of rare species (such as Anax parthenope and Aeshna affinis in northern Europe) will thus attract attention, but any arrivals of more common species will be less obvious. In addition to this type of movement, other species show related phenomena, with e.g. S. flaveolum and Libellula quadrimaculata intermittently producing large-scale ‘irruptions’. Other species, such as e.g. Lestes barbarus, Ischnura pumilio and Erythromma viridulum can also be highly dispersive under suitable conditions.

In response to climate change, arrivals of migrant dragonflies in Britain have altered dramatically over the last 2 decades, and at present new species are being recorded about once every other year. Presumably the breeding ranges of the species involved are expanding closer towards Britain, and/or weather conditions facilitating migration are becoming more frequent. Following the increased arrival of migrants, a number of species have started to breed. E. viridulum in particular has established a substantial population in the UK, in line with events elsewhere in NW Europe. The ability of E. viridulum to travel in large groups (influxes of 200 individuals at a single site have been observed) has no doubt facilitated colonisation. The chances of all migrant species permanently colonising Britain, even with favourable climatic conditions, is however less clear. It is possible that while ‘facultative’ migrants might readily colonise, ‘obligate’ migrants may have a nomadic lifestyle that prevents permanent self-supporting colonies being produced. Although S. fonscolombii and probably A. parthenope now breed in the UK in most years, much still remains to be discovered about their precise breeding status. In particular, locally-bred second generation individuals of S. fonscolombii disperse rapidly and may not contribute to colony stability (further study at a pan-European level is required to determine exactly where they go). By analogy with the American A. junius, it is however possible that some migrant species may in time develop a more sedentary sub-population that does become resident.

The phenomenon of dragonfly migration is an interesting and complex one. In contrast to the situation with e.g. bird migration, the underlying biological principals are only now being unravelled. The impact of migration on both short- and long-term Odonate distributions is also now becoming increasingly appreciated, though here too further research is still needed. The extent to which species will respond differently to ongoing climate change is, for example, a key area for further study. The present increased co-operation in European dragonfly research should go a long way towards helping answer many of the remaining unresolved issues.
Danish Odonata Atlas and newly arrived species

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Work has been done by several people in Denmark the last couple of years, to establish data for the distribution of Odonata. This was initiated by the European Atlas project currently being worked on all over Europe. Old records in Danish museum collections has been registered and brought to a database together with private data and data collected by many volunteers using a Danish Internet site for registration of observations of all fauna and flora.

The talk will give a brief overview of the status of establishing a Danish Odonata Atlas.

A brief overview of the Odonata species that has appeared as "newcomers" in the Danish fauna during the last 20 years will be included.
Recent advances in UAE and Oman

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Over the past few years, the number of people interested in dragonflies has increased in the UAE and Oman and with that attention, our knowledge of them has increased. Between the Natural History Groups in Abu Dhabi, Dubai and Al Ain and the UAE birding community, the UAE in particular is receiving much better coverage for records of odonata. In the past few years a number of species have been added to the lists for UAE and Oman including Orthetrum ransonnetii and Ischnura fountaineae.
Socotra is a small archipelago of four islands in the Indian Ocean. The archipelago consists of the main island of Socotra (3,625 m²), three smaller islands (Abdal Kuri, Samha en Darsa) and small rocky outcrops. It lies some 240 kilometers east of the coast of Somalia and 380 kilometers south of the Arabian Peninsula. Socotra is one of the most isolated landforms on the earth of continental origin. Because of this isolation a third of its plant life is nowhere found else on the planet. Also within the fauna a lot of species are endemic for this archipelago. From Socotra a total of twenty species of dragonflies are known, concerning African as well as Asian species. The only endemic dragonfly of Socotra is Azuragrion grantii. The main island of Socotra was visited four times over the period 2008-2010 by two different teams. This presentation will show the diversity of the dragonfly fauna (distribution, habitats and conservation) on the island with special attention to Azuragrion grantii.
Odonatology in Italy: state of the art

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For the number of dragonfly species, Italy represents one of the richest countries in the mediterranean basin. However, the number of dragonfly experts and volunteers is rather low and the efforts for the protection of this insect group is currently not high on the national agenda of conservation priorities.

From the year 2006 onwards the odonatology in Italy has progressed in leaps and bounds because a group of people, working as volunteers, increased the exchange of information on the Odonata of Italy and actively promoted this subject. In the year 2009 these efforts resulted in the birth of the "Italian odonatological society", named ODONATA.IT. This new and active society has a number of aims and projects which are discussed.
Reproductive behaviour of *Calopteryx haemorrhoidalis*: a species with a surprising phenotypic variation

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European *Calopteryx* species have been the subject of many behavioural, ecological and taxonomic work. The Mediterranean species *C. haemorrhoidalis* shows large variation in body and wing coloration and several subspecies have been described based on these morphological characters. Nevertheless genetic analyses with allozymes and DNA markers have revealed very little variation among populations, and several researchers have suggested that it has not valid subspecies. Here we review the reproductive behaviour of an Italian population of *C. haemorrhoidalis*, whose males show metallic black body coloration and compare it to described behaviour from a Galician (NW Spain) population where males show metallic violet coloration with reddish reflects. We map the distribution of both colour phenotypes, and show that they are geographically separated. Samples collected in several localities in the Iberian peninsula, France, Italy and Mediterranean islands (Sardinia, Sicily) show almost no variation in several DNA markers (nuclear ITS and mitochondrial 16S). In the Italian locality, *C. haemorrhoidalis* females are sometimes seen in mating with with *C. splendens* males, and a putative hybrid male is described. When females were hand paired to males of both species, copulation lasted 2.04±0.30 min (N=22) in *C. haemorrhoidalis*, 2.01±0.15(36) in *C. splendens*, and 1.93±0.18(12) in hybrid matings between male *splendens* and female *haemorrhoidalis*, but only 1.20±0.14(9) between males of *haemorrhoidalis* and females of *splendens*. The reduction in copulation duration was exclusively due to a shorter stage I. In both species and hybrid matings sperm was almost completely removed from the bursa, but only partially from the spermatheca, with a tendency for greater spermathecal removal in hybrid matings. Female *haemorrhoidalis* sometimes expel a drop of sperm after mating (35% of 23 matings whose males realized a precopulatory courtship), but most females (61%, N=31) expel sperm when hand-paired to a conspecific male. This suggests that females might be exerting cryptic choice of sperm. Preliminary results using AFLPs will be discussed.
Macromia splendens in the Iberian peninsula: status and priorities for research


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Macromia splendens is among the most remarkable of the European dragonflies: it is a very large insect, occurring only in three countries, and restricted to a very specialised and rare habitat (clean rivers with deep and slow waters). Being the only European Macromia, it has a great value for conservation. During the XX century the number of records of this species was extremely low in the Iberian peninsula, and the distribution maps indicated its presence in only three small areas, widely separated. Nevertheless, in the last 15 years several regional surveys have shown that the species is more common than previously thought and has been recorded in Galicia, Castilla-León, Basque Country, Catalonia, Extremadura and Andalusia, and in Northern, Central and Southern Portugal. It inhabits rivers from the Atlantic and Mediterranean regions, large, small and even dammed, acid and calcareous waters, with permanent and temporary waters, demonstrating that it is not so specialised as the first records seemed to indicate. The current status can therefore be globally evaluated as positive, with no immediate threats for conservation in the North and West, but very local and decreasing in the South, and with very small populations in the East (some likely extinct in Valencia). We know almost nothing on its basic ecology and behaviour, and most observations were done at the Atlantic range, and might be not representative of the ecological requirements in the Mediterranean rivers. We are currently planning a study of its genetic variability and phylogeography over the complete areal, and identified several priorities for research: (1) determining larval development times in representative localities of the Northern, Central and Southern populations, (2) quantitative evaluations of population size by means of exuvia counts, (3) detection and characterization of the mating rendez-vous and reproductive behaviour. We present here a methodology proposed for long-term monitoring of population size and a first predictive model of occurrence used to guide prospections in new areas.
Science makes excellent discoveries, but they do not always reach the lay public. Similarly, although nature conservation tries to protect natural heritage for the public good, it is mostly considered as a barrier for the development of the country. This is mainly due to the lack of communication between the expert and the lay parts of the public. This was also the case of dragonflies, wetlands and their conservation in Slovakia. In order to help solve this problem, we decided to present dragonflies and their relationships with human society to the people of Slovakia within the project "Popularizácia odonatológie na Slovensku (Popularisation of odonatology in Slovakia)". The project was carried out in 2006-2009 with the financial support of the state agency APVV. More than 20 experts and volunteers were involved. Activities of the project were aimed at the creation of modern information media: a website, a presentation-methodical CD, a documentary, a poster, a set of postcards and an exhibition. The media were interconnected (e.g. the website address was mentioned within all other media) in order to maximise their effect.

Since there were various target groups (ranging from primary school students to adults and expert public), the media were designed in such a way as to enable all these groups to find information interesting for them. The exhibition, the postcards and the poster are the "first contact" tools, which is why they are graphic, visually attractive. The CD and the film also accentuate the graphic aspect, but they are also rich in information, which is presented in a very comprehensive way. The most information-rich medium is the website. It is multilevel-structured, so that the clicks down the menu lead from very simple pages (more graphics, less text, mainly simple information and curiosities – for primary schools), through pages of medium sophistication (still many graphic elements, but also more texts with information for the secondary school level) to "expert pages" with mainly texts intended for university students and experts.

Teachers are one of the target groups, and so the media include elements usable in the process of education. This was taken into account mainly in the creation of the website, the CD and the film. The main menu of the website is organised into logical chapters dealing with various topics (morphology, life history, species etc.). The website contains online games in one chapter of the main menu and online tests in each chapter with the exception of the photo gallery.

The CD is also divided into 5 chapters, out of which one is a logical educational line (including tests), one comprises 14 methodical materials teachers can use in schools, one is a gallery and one consists of games.

The film duration is about 30 minutes, so it is easily projectable within one lesson.

A very successful lecture has been prepared which is usually presented at the exhibition openings. As one of the aims of the project was to mobilise dragonfly-amateurs, we have developed an interactive online identification key of Slovak dragonfly species. This key can be found on the website in the chapter dealing with species. Meanwhile, the pilot project of mapping the endangered species was launched, the results of which are promising.

It is our aim to continue with a follow-up project, which would engage schools and amateur-entomologists in the mapping of dragonflies in Slovakia. We are currently trying to raise the funds necessary for running this follow-up project.
Notes to conservation of dragonflies in Northern Slovakia

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Northern Slovakia, which lies on the border with Poland, includes historical regions of Orava, Turiec, Liptov and Spiš. Its landscape is very diverse, ranging from about 400 to 2600 m a.s.l. and encompassing habitats of still and flowing waters with acidic to alkaline conditions. Wetland habitats are locally well preserved, with 3 sites included in the Ramsar-List: Mokrade Turca, Rieka Orava a jej prítoky and Mokrade Oravskej kotliny. The fourth Ramsar site (Jaskyne Demänovskej doliny) is a spelean ecosystem. Five national parks have been declared on this territory: Tatranský národný park, Národný park Nízke Tatry, Pieninský národný park, Národný park Veľká Fatra and Národný park Malá Fatra, plus one nature park (Chránená krajinná oblasť Horná Orava). Several NATURA 2000 sites are proposed in the area. Despite these facts, this territory has long remained “a white spot” on the dragonfly-map of Slovakia.

In order to evaluate the conservation status of dragonflies in Northern Slovakia, a research was carried out in 2000-2009 and its results were combined with the previously published data. 62 species of dragonflies have ever been reported in this region. The individuals referred to in the past as Cordulegaster boltoni appear to belong to C. bidentata (due to the misidentification by the authors). The presence of Coenagrion pulchellum and Gomphus vulgatissimus is doubtful, since the evidence of these species consists exclusively of larvae (no imagoes were observed). All other species were identified correctly.

Several species of Community interest appeared in the area: Sympecma paedisca, Coenagrion ornatum, Ophiogomphus cecilia, Leucorrhinia pectoralis and L. caudalis. Also many species of national importance, included in the national Red-List are present, among them: Coenagrion hastulatum, C. armatum, Aeshna subarctica, A. isosceles, A. coerulea, Brachytron pratense, Somatochlora alpestris, S. arctica, Orthetrum coerulescens, Sympetrum pedemontanum, Leucorrhinia dubia, L. rubicunda. Nehallenia speciosa and Coenagrion lunulatum were reported in 1920´ and 1950´, respectively, at present they are considered extinct in Slovakia. Whether S. paedisca, C. armatum and Anax parthenope have autochthonous populations in the area remains unresolved.

Several thermophilous species build their populations in northern Slovakia: Erythromma viridulum, Aeshna isosceles, Brachytron pratense, Sympetrum fonscolombei, S. meridionale, Crocothemis erythraea, Orthetrum albistylum and O. brunneum among them. This possibly indicates climate change in the region.

As for the regional aspect, Turčianska kotlina, Oravská kotlina, Vysoké Tatry and Spišská Magura seem most valuable, because most endangered species concentrate there. Turiec has autochthonous populations of C. ornatum, O. cecilia and several species of national interest. Orava, Tatry and Spiš host assemblages of tyrphophilous species, such as L. pectoralis, L. dubia, L. rubicunda, A. subarctica, S. alpestris, S. arctica and C. hastulatum. Wetlands in Liptov are most influenced by human impact.
Communities in forest lakes show ecological shifts: indirect effects of climate change

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It is known that dragonflies in northern areas react rapidly to climate change, showing strong responses over time spans as short as ten years. Rising temperatures displace species northwards, thus making northern species move north (or die out) while southern species take their place in the local ecosystem. But this turnover of species has other effects on the local communities: not only species composition but also abundance will change.

To compare effects in regions with different climate and different vegetation we surveyed lakes in two areas at almost the same latitude in central Sweden: a coastal area with 30 lakes and another 30 lakes in an inland area. The coastal area is an area of some small scale agriculture mixed into hemiboreal forest where in turn small scale clear cutting takes place. Some of the area is a nature reserve. The inland area is a more homogenously forested landscape of hemiboreal to boreal forest also with limited forestry due to it being a nature reserve. We sampled dragonfly larvae along the shoreline, surveying all plant communities present. Sampling was performed at a time of year (June-July) when also univoltine species are present. The larvae were determined to species and analysed together with samples taken from the same lakes but ten years earlier. At the same time we analysed climate data from nearby weather stations, enabling us to get a monthly measurement of changes in temperature and precipitation in the areas, comparing the ten years prior to both sampling occasions.

We found that the dragonfly communities changed between sampling occasions, but more pronounced in the coastal area where both the disappearance of rare/northern species and the influx of southern species was higher. We found changes in habitat preference between sampling occasions, also this aspect more pronounced in the coastal area. Most notable is the shift of univoltine species (Sympetrum, Lestes) from habitat generalists into a more restricted water quality. Also, species known to be selective in their choice of waters (e.g. the FHH species Leucorrhinia pectoralis), shifted into a more generalist life, being present in a high percentage of waters in the region but still without occurring in a high number of individuals in the lakes. Thus, we showed that climate change induced ecological shifts in local communities, but changes takes place at different speed in different environments, depending on lake surroundings. In a coastal area, dispersal rates are higher and the landscape open, favouring dispersal (especially of species favouring an open landscape). In a forested area dispersal is slower, favouring only forest-adapted species, and climate change-related temperature alterations (and changes in precipitation) less pronounced.

The lesson we can learn is to be prepared for more changes in species composition, abundance and rarity then we can predict from just local dying out plus a general northern movement. The changed communities will alter the ecology of the species when niches are opened up and closed due to altered interspecific competition.
Research of Balkan goldenring (Cordulegaster heros) in Slovenia

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The Balkan goldenring is an endemic Cordulegaster species from the south-east Europe. Regardless of its size (largest European dragonfly), it is an imperceptible species, living only in primary habitats, small shadowed streams in woody hills. Slovenia is the country where the species’ largest populations have been recorded. Upon the proposal of the Republic of Slovenia, the species has been added to Annex 2 and 4 of the Habitat Directive and its habitats should be part of the Natura 2000 network. In Slovenia, Natura 2000 network was established in 2004, with the Balkan goldenring already a part of the network. Sites were determined using known data of the species’ presence (329 localities). Contrary to other dragonfly records, where adults prevail, the findings of larvae were in a majority (264 localities).

From the autumn 2005 to the summer 2006, the first quantitative study of larvae of the Balkan goldenring was carried out at Gorčko Regional Park and Natura 2000 site in north-east Slovenia within the framework of the »Zonation plan for the selected Natura 2000 areas« project (Phare Cross border Cooperation Programme Slovenia - Austria 2003). As the larval habitat is known, only suitable 100 m sections of the streams were surveyed. 10 samples were made at each section of the selected microhabitats. Other animal species were recorded, together with some physical data such as type of substratum, percentage of shade and width and depth of the stream. 376 stream sections were sampled, with the Balkan goldenring present in 147 of them. Altogether, 895 larvae were found (Me=5, min-max: 0-25). Local densities of the larvae were estimated to be as high as 10 larvae/m2.

From the given data, the population size of the Balkan goldenring larvae within Gorčko Park was estimated to be over 100,000. Larvae were found mainly in the middle part of the streams. The upper parts are often located near villages and polluted or without suitable substratum. The situation changes in the streams’ middle parts, while in their lower parts human impact increases again. Larvae were also found in the regulated parts of the streams, which was ascribed to the size of the Balkan goldenring population at Gorčko. In 2007, the same method was used again on a smaller Natura 2000 site in north Slovenia, with comparable results, especially when comparing the number of larvae per kilometre of a stream.

At biogeographical seminars, the coverage of the established sites for the Balkan goldenring was assessed as insufficient minor in the Alpine region and as insufficient moderate in the Continental region of Slovenia, which commits the government to add the species to the existing Natura 2000 sites and to establish additional sites for the species. A project for establishing suitable sites is under way. The same method of sampling larvae is in use. 8 survey areas were determined, where sampling will be repeated four times, with additional 25 sites to be surveyed once each. Mainly areas, where streams and surrounding forests are in a natural state, were selected. The project will be concluded in the autumn 2010, with a proposal for the Balkan goldenring sites to be included in the Natura 2000 network as a result.
Genetic diversity and introgression between *Ischnura elegans* and *I. graellsii* (Odonata: Coenagrionidae)

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Hybrid zones generally represent areas of secondary contact after speciation events and are of interest in the study of evolutionary processes. Genetic approaches can examine the potential for introgressive hybridization and genetic diversity. In this study, we used newly developed microsatellite markers for *I. elegans* to 1) genetically characterize hybridization between *Ischnura elegans* and *Ischnura graellsii* in Iberia where the two species are in sympatry and to 2) investigate genetic diversity of *Ischnura graellsii* and *elegans*, over a large part of their geographic range.

The Bayesian statistical framework provided by the program STRUCTURE revealed that *Ischnura elegans* individuals appeared to have recent mixed ancestry as a result of introgression with *Ischnura graellsii* in Spain where the two species are sympatric. This finding suggests that introgressive hybridization is a common phenomenon that plays a significant role in the diversification of *Ischnura*.

Analyses also indicated low but significant genetic sub-structuring between populations (*I. graellsii* global F<sub>ST</sub> = 0.027 and *I. elegans* global F<sub>ST</sub> = 0.064) which increased with geographic distance. In *I. elegans* populations there was evidence of a longitudinal signature in the population structure (East to West), but not for a latitudinal cline, and a significantly lower level of genetic diversity in the western area of the sampling range (i.e. in Spain).
How to record and store species locations?
The use of Geographical Information Systems, GPS and Free/Open Source software

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Years ago, researchers have been using maps and compasses to record the location of a species. Now, with Geographical Information Systems (GIS), GPS and Free/Open Source softwares many problems can be avoided. The main problem is to associate uncorrected geographical coordinates to the species. This is immediately solved with the use of GPS. Free/Open Source softwares like CyberTracker can help to record species locations in an easy way. Records can be stored in a reliable and secure way with Geographical Information Systems. However, researchers should take care of geographical and projection coordinate systems and some minimal knowledge is necessary. Finally, I present the Atlases of Amphibians and Reptiles of Portugal and Europe, as examples of robust and complete structures for storing and managing large chorological databases.
Sixteen species of dragonflies were detected at 12 temporary pools on the island of Menorca, representing 76.2% of the species mentioned for this island. Species richness per pool, ranged from 0-12. Four kinds of phenological patterns were detected: spring-only (4 species), autumn-only (2 species), summer hiatus (3 species) and intermittent (7 species). Of the 14 environmental variables analysed, only water temperature (negatively), redox potential and surface area (both positively) influenced species richness. Three species could be considered as rare in terms of abundance, two in terms of distribution and one according to both abundance and distribution.

The main threats that must be taken into account in order to manage temporary pools in Menorca and protect their odonatofauna are associated with excess livestock, not most suitable agricultural practices and excessive growth of vegetation.

Two criteria are suggested to select which ponds to preserve: the number species found there and the presence of any species of special interest.
Within the context of global warming and associated range shifts there is a surge of studies on latitude patterns in the phenotype of species. Despite their striking northward range shifts relatively few studies looked at these latitude patterns in damselflies. This may inform us on microevolution of these traits in response to abiotic variables associated with latitude. I present an overview of finished and ongoing studies in lestid and coenagrionid damselflies where we documented latitude patterns in a variety of life history, physiological and behavioural traits and discuss how the joint study of all these aspects may be needed to fully understand these patterns. Patterns in adult body size can differ widely among species with besides the typical increase in body size in northern populations, also a U-shaped pattern. Similarly, while larval growth rates often are higher in more northern populations to compensate for the shorter growth season, some species show the opposite with faster growth rates in more southern populations. This is likely due to changes in voltinism along the latitude gradient. The emerging pattern in a key physiological variable, immune function, is one of increasing immune function in more northern populations. I will discuss these patterns, their codependence, some potential underlying reasons and implications for biotic interactions and range shifts.
Rising temperatures, altered life cycles and their consequences for dragonflies in Europe

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Besides range expansion, altered life cycle patterns are the most visible signal of dragonfly responses to recent climate change. Since dragonflies are poikilotherm organisms their metabolism is directly responding to the ambient temperature. Thus, rising temperatures, which have already been recorded and are predicted to be even more severe in future, should lead to alterations in all aspects of dragonfly life cycles. This may lead to temporal mismatches with other environmental variables relevant for the survival of dragonfly populations. The aim of our contribution is reviewing the known facts about temperature on growth rates and voltinism. We investigated temperature response of growth by laboratory experiments mainly in Libellulidae. Physiological structured mathematical models were used to simulate life cycle duration with various types of seasonal regulation. We will try predictions of consequences of rising temperatures for voltinism and phenology of some European dragonflies in future considering the regionally different climatic conditions. With the aid of such models we will also stress the question how temperature as environmental factor may influence present and future distribution of species in Europe.
A European Dragonfly Monitoring Scheme: how to get started?

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Dragonflies are among the best studied animal groups in Europe. Over 30 European countries have distribution data on Odonata available. This makes dragonflies a very suitable group for future biodiversity monitoring on a European level. Since the European Commission shows a growing interest for biodiversity monitoring, the time is there to start a European Dragonfly Monitoring Scheme. The success of the European Butterfly Indicator (coordinated by Butterfly Conservation Europe) can serve as an example.

Several methods can be used for dragonfly monitoring, which differ in the degree of standardisation of field method and the needed sampling effort. Sampling effort is a major drawback for countries with only few dragonfly recorders. Therefore, a method with a small minimum sampling effort is most welcome. Three different possible methods are briefly explained and commented. The easiest way is to use regular distribution data (like atlas data, already available for many countries) in an site-occupancy model. Doing so, trends of species can be calculated by comparing presence-absence data from repeated visits. A comparative study in the Netherlands showed that this relatively simple method yielded sound trends, which are comparable with trends derived from a monitoring method with a standardised field method and high sampling effort.

We suggest to get started with dragonfly monitoring in separate European countries, using ‘daily lists’ and site-occupancy models. Because of the relatively low sampling effort, most countries are expected to be able to join. Within a limited period of time it will be possible to calculate combined trends for species in Europe or a part of Europe.
VOPHI: an index to assess threatened dragonfly populations and habitats

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Monitoring dragonfly populations show us interesting points on dragonfly biodiversity, conservation status of species and suitability of habitats and management actions in Odonata. Dragonfly monitoring programs should have a standardised methodology to detect variations among populations and among years, and conservation threats in each population. When monitoring threatened dragonfly species we should choose the least invasive methodology. Here we propose a new method to assess and monitor localities of threatened dragonflies, the VOPHI methodology (beta version) based in transect methods. This method has been developed in the frame of the project "Conservation status of Habitats Directive species in Spain", funded by the Spanish Ministry of the Environment and Rural and Marine Affairs (TRAGSEA). VOPHI weights four population variables and four habitat variables: (1) exuviae, (2) adults, (3) reproductive pairs, (4) ovipositions, (5) extension of emergence habitat, (6) extension of reproductive habitat, (7) natural habitat conservation, and (8) alien (invasive) species presence. These variables are related with population structure (1, 2), population reproduction (3, 4), habitat extension (5, 6) and habitat quality (7,8). In the VOPHI equations, the most important variables for populations are 1, 4 and 3, while for habitats are 5, 6 and 7. Thresholds in the Habitats Directive reporting conservation status classes (favourable, unfavourable-inadequate, unfavourable-bad) are proposed for each variable (different for each species) and for the final equations. Results on computer exploration of VOPHI method are given, analysing hypothetical situations for those variables in simulated populations. This method is designed for long-term monitoring programs of Spanish populations of species protected by the Habitats Directive. The best candidates for the method are the three anisopteran species of the Habitats Directive with widespread distributions in Spain: Gomphus graslinii, Oxygastra curtisi and Macromia splendens; which might be monitored in the same localities in several areas. VOPHI might be also used in Coenagrion mercuriale monitoring programs, although with some changes in variables utilized. Thresholds are also given to other two dragonfly species of the Habitat Directive recorded from Spain, but without populations localized nowadays: Lindenia tetraphylla and Leucorrhinia dubia. Dynamic calibration of VOPHI variables thresholds might be necessary when more field data will be available.
Photographic Guide to the Exuviae of European Dragonflies

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Since childhood I am really fond of anything having six legs. Dragonflies are of major interest since about 10 years now, but their larval stage has long been unknown to me. When I found an exuvium of *Epitheca bimaculata* during a research in Poland in 2007, I was really amazed by the beauty of this lightweight pieces of chitine. Directly I collected many more exuviae in the area of the research and so I started a collection. When I returned to the Netherlands, my friend Christophe (a professional nature photographer) was amazed by what I took home. He also did not take exuviae to serious, but his mind changed when he saw the worth of studying them. Together we decided to try being Europe’s first publishing a photographic guide with exuviae of all species with populations in Europe (without Russia). After some testing it got clear we could make it, so we searched for a publisher, that we found easily in the Netherlands. Now, in March 2010 we really started photographing and collecting and we hope to finish this enormous job within 3-4 years.

Why do we do it? Most of the tables that are now available to give a name to each exuvium are only supported with drawings. Mostly they are marvellous and species can be identified without major problems, but to have a comparison with a “real” specimen provides more certainty in many cases. Because we can make use of microscopic photography we are able to picture each detail of the larvae (for instance the small spine on the labial palp of *Enallagma cyathigerum*), so a complete view of the important parts of each species can be shown with sometimes extreme enlargement.

It is clear that exuviae (or larval founds) tell much more about the presence of populations of species rather than flying adults do. With this guide we hope to get more people study dragonflies and their populations by research to exuviae.

Because we are not able to find exuviae of all European species our selves, we need to ask for support from dragonfly-enthusiasts all over Europe. With this presentation, we hope to get known in Europe and get in contact with experts who can help us completing our collection, but maybe even more important, we hope to give more people the possibility to get studying those amazing objects.
Dragonfly composition (Insecta, Odonata) in wetland area of Turopolje region, Croatia

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Wetland habitats are the most threatened ecosystems due to water-drainage, excessive exploitation and pollution, which is why they are increasingly disappearing all around Europe. To maintain the high species richness, it is essential to maintain a variety of biotopes. Therefore, wetland area of Turopolje is an important habitat for biodiversity conservation in Croatia. In biodiversity conservation dragonflies serve as umbrella species representing specific biotic wetland assemblages. They are used as bio-indicators for freshwater ecosystems’ quality due to their sensitivity and complex food web. Literature data of the dragonfly findings on Croatian territory are relatively poorly represented. Also, dragonfly fauna in Turopolje area is very poorly researched. The primary objectives of this research were to determine dragonfly fauna and their distribution in Turopolje region. The survey was conducted from August 2007 until May 2009 at 9 localities. All investigated localities differ in their vegetation structure and amount of present water. Vegetation alliance for each locality was determined at a sight. For estimation of dragonfly composition per locality, Shannon-Weaver and Simpson index of diversity were used. 22 species with 307 specimens of dragonflies were determined, most of them belonging to the Libellulidae family. Only 1 species was recorded for families Lestide, Platycnemidae and Corduliidae. Species *Calopteryx splendens* (Harris, 1782), *Coenagrion puella* (Linnaeus, 1758) and *Ischnura elegans* (Vander Linden, 1820) were the most abundant species. On the other hand, species *Pyrrhosoma nymphula* (Sulzer, 1776), *Lestes barbarus* (Fabricius, 1798), *Brachytron pratense* (Müller, 1764), *Epitheca bimaculata* (Charpentier, 1825), *Gomphus vulgatissimus* (Linnaeus, 1758), *Orthetrum cancellatum* (Linnaeus, 1758) and *Orthetrum coerulescens* (Fabricius, 1798) were recorded only for 1 locality. Also, endangered and protected species *Erythromma najas* (Hansemann, 1823), *Lestes barbarus* (Zygoptera), *Aeshna isocelaes* (Müller, 1767), *Epitheca bimaculata* and *Orthetrum coerulescens* (Anisoptera) were recorded.

Shannon-Weaver and Simpson index of diversity showed that vegetation structure is one of the main factors that affect the composition of the dragonfly communities. Future investigations should include the entire Turopolje region as well as dragonfly larvae and sheds sampling.
Developmental plasticity as a cohesive evolutionary force between alternate-year odonate cohorts.

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A common feature of many insect life histories is the presence of discrete stages – such as egg, larva or juvenile - that may be separated by an obligate or facultative diapause, thus providing a mechanism to delay development during adverse conditions. Any factor that creates variation in developmental timing may partition a population into discrete cohorts. Where there is continued failure to recruit outside the natal cohort then alternate cohorts will have their own internal dynamics, eventually leading to independent demographic and evolutionary trajectories - this has implications for conservation management. Odonates are a convenient model to study the evolutionary consequences of such developmental variation as this taxon displays inter- and intraspecific variation in voltinism.

We quantify the genetic signature of apparent demographic isolation between alternate year (\textit{i.e.} semivoltine) cohorts of \textit{Coenagrion mercuriale} in the UK; for example, demographic surveys at one site (Aylesbeare, UK) uncovered a temporally stable (for 5 generations between 1991-2001) pattern of odd-year cohorts that were between 3 and 5 times more abundant than even-year cohorts. By genotyping (at a panel of 14 microsatellite loci) alternate-year cohorts at 9 locations across its range in the UK, we find consistently low levels of genetic divergence between sympatric cohorts of \textit{C. mercuriale}. This lack of divergence is indicative of developmental plasticity whereby some individuals complete their development outside the predominant two year (semivoltine) period. Thus, despite contrasting population sizes, alternate cohorts are connected by gene flow that places them on a similar evolutionary trajectory and buffers against loss of genetic diversity. Developmental plasticity permits a response to local conditions and may facilitate response to environmental change.
Distribution and ecology of *Sympetrum nigrifemur* in the Macaronesian Islands (Odonata: Libellulidae)

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The Macaronesian endemic *Sympetrum nigrifemur* – sometimes regarded as a subspecies of *S. striolatum* – has been assessed as 'Endangered' in the IUCN Red List until only recently, when it was downgraded to 'Least Concern' in March 2010. However, exact data on the actual distribution, the phenology and the ecology of the species are still scarce. To shed some light on the species' situation, we have compiled a list of more than 170 records, approximately half of them hitherto unpublished, which significantly improve today's knowledge on the distribution and phenology of *S. nigrifemur*.

The islands colonised by *S. nigrifemur* are Madeira, Gran Canaria, La Gomera, La Palma and Tenerife. Single records of probable vagrants are available from Selvagem Grande and Lanzarote. It has hitherto not been recorded from the Azores, from Porto Santo, El Hierro, Fuerteventura, and from the Cabo Verde archipelago. *Sympetrum nigrifemur* is on the wing throughout the entire year, as imaginal records are available from each month. Reproductive activity, i.e. oviposition, was recorded in January, February, March and November. Records of larvae have been taken in February, April, August and October, and emergence was recorded during April, May, August, September and October. A tentative analysis of the hitherto known phenology would point to two possible options for the life cycle of *S. nigrifemur*: Firstly, a univoltine cycle, with long-living individuals that experience the emergence of the new generation in the following spring; this scenario includes a probable aestivation in higher regions during summer and/or a reproductive gap during winter. Secondly, a bivoltine cycle with a rapid summer generation may be possible as well. However, of course it has to be considered that the available preliminary data may be misleading, because the vast majority of records were taken during winter months, when European odonatologists spend their holidays on these islands. Therefore we must conclude that the developmental cycle of *S. nigrifemur* is not clear yet and further studies are urgently needed, especially during summer.

*Sympetrum nigrifemur* has been recorded from sea level up to 1,600 m in La Palma. The highest reproduction records were taken in Madeira, at 1,300 m. Successful larval development probably occurs even in brackish waters. Most imaginal records were taken near running water, but a fair number of observations also occurred far away from any potential reproduction site, e.g. in forest paths, suggesting a high mobility and vagrancy of adults. However, actual proofs of successful reproduction so far were always associated with pools or potholes in streambeds of running waters that are often temporary. The substrate of breeding sites was variable, from sand or gravel to rock. The vegetation of the sites also varied from dense to a bed of algae only. Oviposition was also recorded several times in seemingly unlikely surroundings, such as the *Levadas* in Madeira. The benthic larvae typically exercise a sit-and-wait foraging tactic and are opportunistic in their prey choice.
Abstracts posters

Contribution of Students’ Research Camp "Kornati NP 2009"
Organized by the Biology Students’ Association “BIUS” to the
Knowledge and Mapping of Croatian Dragonflies - Scientific
Necessities vs. Balkan Constraints

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During the period between 19th and 25th September 2009, field research on Dragonfly and Damselfly fauna (Odonata, Insecta) of Kornati National Park (NP) was conducted. Work was mostly done on the island of Kornat and the rest was done on the islands of Žut, Lavsa and Mana. According to the only data available so far (Franković, 1980-s, pers.com.), there was a total of 8 species in the NP area (Appendix 1). Since that time, a couple of natural and artificial habitats have been lost. This 2009 research found only two habitats that were recognized as stable. Considering such a poor number of habitats, we take the number of 8 species that we have found as a great success for the Dragonflies and Damselflies, as well as for the authors. Two of those species (Lestes parvidens Artobelevski i Sympetrum fonscolombii Selys) have never before been found on the grounds of Kornati NP. We also wish to encourage further research of the bioindicating Odonata fauna of Croatian islands.

Dragonflies in mosquito larvae control: a laboratory experience on predation

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The aim of the study was to evaluate the suitability of dragonfly larvae for the biological control of mosquitoes, in particular in lentic, temporary water bodies in there are no entomophagous fish. Odonata larvae were collected in the field and chosen among those of the last three instars. Mosquitoes of the species Culex pipiens were reared in the laboratory and their larvae used for the experiments once they reached the 3rd or the 4th instar. 24 hours before the experiments the odonate
larvae were transferred to mesocosms with no food. Experiments were carried out in aquariums with a metal net inside to simulate a macrophyte substratum, filled with 8 litres of water, sieved to avoid the presence of other prey. One odonate larva and 20 mosquito larvae were put in each aquarium. After 24 hours the number of remaining mosquitoes was counted and, at the same time, the number of mosquito pupae or dead mosquitoes were recorded. For each odonate larva the total body length (except for caudal lamellae for the Zygoptera) was recorded, together with the moult or moult signs. Each odonate individual was used only once. About 260 specimens of nine species of Odonata (Chalcolestes viridis, Lestes barbarus, L. virens, Coenagrion puella, Ischnura elegans, Erithromma lindenii, E. viridulum e Sympetrum sanguineum, Sympetrum striolatum) were used for the experiments. We considered the ratio (in %) between the number of consumed mosquito individuals and the available ones as measure of the predation rate in 24 hours. We did this because the available mosquitoes were the result of difference between the initial number (20) and the dead and pupate individuals, so that the available mosquitoes could have been different among different odonate larvae. Results have shown average consumptions ranging from 27% to 40% in the case of Coenagrionidae and from 33% to 40% in the case of Lestidae; average consumptions of Sympetrum were 57% and 75% for S. sanguineum and S. striolatum respectively. No significant correlation was found between the number of available mosquitoes and the predation rates. The expected positive correlation between consumption and larval size was significant in two cases only, while the effect of the moult was not significative. The study was financed by a grant from the Latium regional administration, (research project LILAZ, dragonflies in biological control of mosquitoes) to G. Carchini.

The increase of African Dragonflies in Southern Iberia: climate change or better observation

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There are eleven species of African Dragonflies in Southern Iberia. One species, Trithemis kirbi was first recorded in 1996 and the remaining ten species have all increased the number of sites on which they have been recorded since 1990 by a minimum of 100% and in some cases the increase has been by a factor of ten or more. It is tempting to view this increase as an obvious result of a warming climate. However, there is another explanation which relates to the poor state of field observation in this region.

I have analysed published information for southern Spain and Portugal south of 40 degrees of latitude. Pre 1990 a total of 1543 species site records (1 species on 1 site irrespective of date represents a species site record) were identified. After 1990 and up until 2008 a total of 6452 species site records were identified, which is an increase of 320%. The proportion of African species to the whole of the southern Iberian fauna for the two periods is as follows:

Pre 1990 – 320 species site records (20.7% of total fauna)
Post 1990 – 1345 species site records (20.8% of the total fauna)

In summary no change in overall species site records and, therefore any increase in range for African species, can be claimed. Perhaps the most telling statistic in the analysis is that the species that has increased most since 1990 is Macromia splendens which has risen from 1 site prior to 1990 to an
impressive 45 sites currently. *Macromia splendens* is a endemic to France and Iberia and the example indicates the weakness of recording in the region. It is to be hoped that this paper will encourage odonatologists to visit and record in this diverse but much under recorded region.

Abundance and diversity of dragonfly four years later of the construction of the Alqueva Reservoir

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Few studies have investigated the impacts of river impoundment for reservoir construction. Their construction deeply changes the dragonfly habitat structure especially shoreline vegetation. This study investigated the effects of the impoundment of the Guadiana River and its tributaries on dragonfly after four years. A total of 17 dragonfly species (11 Zygoptera and 10 Anisoptera) representing six families were recorded in 21 sites in the years 1999 and 2003. *Aeshna mixta, Coenagrion caerulescens, Coenagrion scitulum, Sympetrum foscolombei, Sympetrum meridionale* and *Sympetrum striolatum* were sampled just before the impoundment and *Anax parthenope, Onychogomphus forcipatus, Orthetrum coerulescens, Trithemis annulata, Platycnemis acutipennis* and *Platycnemis latipes* were recorded only after construction of the reservoir. We concluded that four years earlier the construction of the Alqueva Reservoir did not change dragonfly species richness possibly because of species overlap, but species composition was modified. Changes in marginal vegetation can have been important to new species composition.

Monitoring Odonata community: a case study in retrodunal wetlands

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Odonate communities are frequently used as indicators of environmental quality and different methods are commonly employed to monitor assemblages, such as observation of adults, surveys of resident species, sampling of larvae and collection of exuviae. However, since the detectability of species may considerably change according to sampling method, direct comparisons among differently sampled assemblages may be misleading. Furthermore, given that life-stages differ in mobility (eg. aerial adults vs. aquatic larvae) and ecological needs, they may be subjected to different ecological constraints, making generalization about habitat quality, based on only one survey method, questionable. Unfortunately, direct comparisons of results obtained when sampling different life-stages in a same set of habitats are rare. In this study the results obtained from simultaneously
sampling adults, breeding adults, larvae and exuviae were compared. Nine retrodunal ponds within the “Migliarino, San Rossore, Massaciuccoli” Regional Park (Tuscany, Italy) were repeatedly sampled during May-September 2008. A total of 22 species were found when pooling all data. However, when analysed separately the methods yielded different results. Firstly, some species were only found using certain methods but not other. Secondly, univariate measures of diversity (α, β, γ-diversity, estimated number of species using the Chao2 method) obtained from the four sampling methods were considerably different. For example, the β-diversity index, which quantifies the difference in species composition among ponds, was lowest when considering adult dragonflies and highest when analysing exuviae. A reverse trend was observed for the other index. Furthermore when analysing which environmental feature was correlated to species richness among ponds, remarkably different results were obtained for the four methods. For example, when considering only adult dragonflies, species richness was significantly correlated to the amount of tree cover on banks of the ponds, while species richness of exuviae was positively correlated only to pH of the water. The presence of Procambarus clarkii (Girard 1852) influenced richness estimated for larvae.

Finally, differences in assemblage composition reconstructed using the different methods were also evident when the data were analysed using multivariate techniques (Mantel test, nonMetric-Multi Dimensional Scaling), and when environmental variables were fitted onto ordination plots using the ENVFIT method, different variables were selected as important to explain difference in assemblages composition. It is evident from the data analysed that the different survey techniques employed are not interchangeable and that monitoring of Odonata has to be based on carefully chosen method, which reflects the aim of the study.

The National Action Plan for Odonata: a French contribution to European conservation network for threatened dragonflies

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According to the IUCN, 14% of European dragonflies are in critical danger of extinction. In France, 50% of the area of wetlands has disappeared since 1950, mainly because of soil drainage or habitat destruction. We have mainly information on Odonata species distribution but the real conservation status is poorly known.

Within the framework of the National Strategy for Biodiversity, France decided to develop a national action plan for Odonata. The Office for insects and their environment (OPIE) was assigned by the French Ministry of Ecology to define and implement this National Action Plan from 2010 to 2013. 18 species of endangered dragonflies are involved. Some of them are also endangered at European level.
The main objective of this plan is to assess and improve the conservation status of these species in our country. The plan relies on three kinds of actions: (1) knowledge improvement on ecology and conservation management requirements, and on species distribution, (2) conservation management at different landscape scales to increase population habitat quality and (3) communication and training of involved actors. For these actions, we establish priorities taking into account pre-existing knowledge and threat degrees. The highest priorities are:

- Document data on species,
- Organize a national monitoring of endangered species,
- Develop and implement specific conservation projects,
- Develop a documentary resource centre,
- Training technical agents involved in aquatic areas management.

The national plan will be spread in 22 regions of metropolitan France. According to the national specifications, each region will draft its own action plan for Odonata. Each region has the possibility to expand this program to regionally endangered species. Every regional plan will be synchronized by a national operator to meet the objectives of the national action plan. Indeed, the conservation of specific populations should be considered on a trans-regional scale and, if necessary, on a trans-national scale.

**Dragonflies and Seasonal Streams in the Sierra Morena Mountains (southern Iberian Peninsula)**

Manuel Ferreras-Romero & Joaquín Márquez-Rodríguez
*Universidad Pablo de Olavide, de Sevilla (Spain)*

Observations of adults belonging to twenty species (seven Zygoptera) and eight families were carried out in two seasonal streams of the Sierra Morena mountain range, in the province of Cordova, Andalusia, southern Spain; thirteen of those spp were observed in both watercourses. Only two spp of libellulids with a vast range in African continent (*Crocothemis erythraea* and *Orthetrum chrysostigma*) were recorded. In the reaches visited there was not superficial water flow for three (La Cabrilla stream, LC, 30SUH200084, 395 m a.s.l.) or four months (Guadiatillo stream, Gt, 30SUH252040, 290 m a.s.l.). On the banks riparian forest was very fragmented in both streams. No pollution source was identified. Nine and ten spp were recorded in June and July, respectively; in November four spp only. During spring or early summer reproductive activity (copulations, ovipositions) of *Erythromma lindenii* and *Orthetrum brunneum* was observed, and also emergence of *Onychogomphus forcipatus* (exuviae collected) and *Sympectrum striolatum* (tenal individuals). During the autumn profuse reproductive activity of *Lestes viridis*, *A. mixta* and *S. striolatum* was recorded. Teneral individuals of *E. lindenii* and *O. chrysostigma* observed in middle August could show bivoltinism at least in these two spp. *Oxygastra curtisii* (LC & Gt) and *Libellula depressa* (LC) were two interesting species recorded.

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**Theoretical model of spatial distribution over Romania for two dragonfly species, Calopteryx virgo and Calopteryx splendens (Insecta: Odonata: Calopterygidae)**

Cosmin-Ovidiu MANCI, Cristian DOMSA, Andrei CRISAN ¹

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To have accurate maps with species distributions is one of the main goals when studying species. Due too many reasons it is almost impossible to do that in a traditional way, from the field. This leaves us with creating a theoretical model for distribution.

In recent years, predictive modeling of species distribution, based on environmental variables and presence data, has become an important tool in population studies (with all of their associated uncertainties). Our aim is to produce this type of maps (at several scales) starting from the distributional known data (from field, paper, collections) and ecological data which will be combined with environmental data. This, correlated with different GIS layers, will permit us by filling the gaps to extrapolate to a probable areal of the species in a given area. Using the maximum entropy method for modeling species geographic distribution, based on presence only data, we will compile the existing information in national wide distribution maps. As already stated, this is a theoretical model thus it cannot be treated as an absolute. For verification we will choose random points to be checked in the field. One of the main goals is to create a reproducible technique that can be applied to other rare or endangered species (like Nature 2000 species).

We have built the model for two of the Calopteryx (Insecta: Odonata) species. This species can be considered common in Romania: Calopteryx splendens in the low-land area and Calopteryx virgo at higher altitudes.
An overview of dragonfly (Insecta: Odonata) fauna from Greece

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Although the territory of Greece has not been covered fully by researches which aim to study dragonflies, we can say that today, the fauna of Greece is known well enough, especially due to studies carried out by Wolfgang Lopau. The most complete study was done by Lopau & Wendler, who published in 1995 the "Arbeitsatlas zur Verbreitung der Libellen in Griechenland und den umliegenden Gebieten, Rasterkarten nach den in der Literatur vorhandenen Nachweisen sowie unveröffentlichen Beobachtungen". They are the first that put together all the data for Greece known until that date. After this, Lopau in 1999, 2000 and 2005 and other researchers published several large papers that add a considerate amount of data to the general knowledge of the fauna of Greece.

Our interests are to put on paper and on maps all the known data for Greece, to explore the biogeographical importance of the species and to comment on their conservation status. This will be done in parallel with the creation of an on-line database, where all the records will be placed on maps. This will/can be found at: http://greekdragonfly.nature4stock.com. A characterization of the dragonfly fauna from a biogeographical point of view will be carried out as well. A red list of the dragonfly fauna of Greece is in preparation and a project to study the Natura 2000 species from several areas is in progress.

Dragonflies in Focus - Putting Dragonflies on the Map

Steve Prentice

British Dragonfly Society, c/o Natural England, Parkside Court, Hall Park Way, Telford, TF3 4LR, UK

Britain is on the northern edge of the range of many of the 42 resident and migrant Odonata species. Climate change is contributing to the movement of a number of these. Habitat destruction also poses a considerable threat. The British Dragonfly Society has started the Dragonflies in Focus (DiF) project which aims to provide better quality information on the distribution and abundance of dragonflies and their aquatic environment.

The major output of the project is the production of a new, revised national atlas. The "Atlas of the Dragonflies of Britain and Ireland" was published in 1996 including data recorded up to 1992. Since the last atlas was published new species are being established in Britain, as demonstrated by the rapid spread of Small Red-eyed Damselfly Erythromma viridulum which was first recorded in 1999 and has now been recorded throughout the south-east of England. In 2008 the Willow Emerald Damselfly Lestes viridis was recorded on two sites in North Kent and Suffolk. By 2009 the species had spread to over twenty sites in Suffolk. During the first two years of the atlas project 39% of 10km squares in Great Britain have been recorded including England 49%, Wales 65% and Scotland 18%. Future efforts will be focused on under recorded areas in Northern England and Scotland.
In parallel to plotting the distribution of Odonata the BDS has started the UK Dragonfly Monitoring Scheme to monitor changes in species abundance. A further impetus came from the Dutch dragonfly monitoring scheme: a request to adopt their methods and contribute to a European-wide monitoring programme. 52 transects were carried in 2009 with the 2010 aim to have transects in every Vice County.

Encouraging recording for the new national atlas and taking part in the monitoring scheme will increase the profile of the BDS and put dragonflies more securely ‘on the map’ in the UK. The project aims to achieve a long-term, sustainable programme of volunteer recording activities through a network of enthusiasts gathering and using information about dragonflies in the UK.

Authoritative and reliable information on dragonflies including all records contributed to the national atlas project are made available through the National Biodiversity Network.

**Dragonfly protection in the Netherlands: a stepwise approach**

Tim Termaat¹ & Dick Groenendijk

¹Dutch Butterfly Conservation, PO Box 506, NL-6700 AM, Wageningen, the Netherlands, tim.termaat@vlinderstichting.nl

In contrast of what may be expected from the name, Dutch Butterfly Conservation is not only involved in the protection of butterflies but also in the protection of dragonflies for already many years. Part of our conviction is that dragonflies are an essential part of our nature and that they should thrive wherever they belong. Dutch Butterfly Conservation informs, advises and encourages people and organisations by devising projects, and, by carrying them out in collaboration with other organisations. The Dutch Dragonfly Monitoring Scheme and a diversity of species protection projects, both nationally and regionally, are amongst the many dragonfly projects carried out at Dutch Butterfly Conservation lately. On our poster we summarise how, in general, our dragonfly projects are carried out. Firstly, we work on public awareness. We are trying to increase support for nature management both by getting more people involved, and by deepening their involvement. Secondly, we invest in ecologically screening. We collect data on occurrence and thus can see changes both in time and space. Furthermore, we look for the causes of such changes in occurrence and also for ways in which a possible decline can be halted. Thirdly, we invest in volunteers. Many of our achievements are due to the work carried out by highly motivated voluntary workers. Our fourth step is that we act upon management and advice and inform policy makers, which puts us into a position to influence nature policy. The fifth step is that we try to influence environmental conservation in giving advices on the best way green spaces and water bodies can be managed. Finally, we aim an active role during the execution of the advices. On our poster we offer examples from our dragonfly projects of all these six steps and in our oral presentations we will outline which of the six steps is involved in the main projects of our talks.
Incidence of egg parasitoids in clutches of *Calopteryx haemorrhoidalis* and *Platycnemis pennipes* in Central Italy

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It is widely known that most insect species are hosts of one or more parasitoids, either in the egg, larval, pupal or adult stage. Egg parasitoids are specialised in localising and parasitise recently laid eggs, and develop using the embryo of their host as the sole source of food, which limit their adult size. Given that the immune system of insect embryos is probably not well developed, eggs are commonly protected from parasitoid attack by scales, hairs, or other specialised structures, or are laid inside vegetal tissues, or even actively protected by the adults (parental care). Surprisingly, very little is known about the incidence of egg parasitoids among odonates, perhaps because Odonata eggs are commonly laid in stems, leaves or other rigid structures, sometimes below water, and might be well protected from parasitoids. In Central Italy (Pontecorvo, Frosinone province) two common species, *Calopteryx haemorrhoidalis* and *Platycnemis pennipes* occur at high densities, and their eggs are attacked by parasitoids (Hymenoptera, Mymaridae, likely *Anagrus* sp.). We collected 30 *Potamogeton* stems (the main egg-laying substrate in the studied locality) and incubated eggs under room temperature (26ºC). Most stems contained odonata eggs (24 of *C. haemorrhoidalis* and 23 of *P. pennipes*). Parasitoids emerged from 12 stems, with a mean parasitism of 2% for *C. haemorrhoidalis* and 6% for *P. pennipes*, and a maximum of 14% and 50%, respectively. We observed egg-laying in 19 females of *C. haemorrhoidalis* and 11 of *P. pennipes*, and marked the stems were oviposition was observed. Clutches remained in the river for 5-7 days and were then collected and incubated. Parasitoids emerged from 11 stems, with an average parasitism of 8% for *C. haemorrhoidalis* and 3% for *P. pennipes* (maximum of 50 and 29% respectively). In the laboratory, parasitoids were observed to submerge and walk on *Potamogeton* stems, apparently searching for odonata eggs. Our data indicate that egg parasitoids might be a significant selective factor in the studied locality, and might affect oviposition substrate selection and behaviour of egg-laying females.
In ectothermic organisms, like insects, the ambient temperature is important in many ways. It affects nearly all physiological and biochemical processes and by that much of a species behaviour and ecology and, hence, also interactions with other organisms in its environment. In dragonflies intraguild predation as well as cannibalism is common - the large larvae simply eat the smaller ones. This makes size structure an important factor affecting the species composition in a community. There are two main different strategies to become successful as species. The first is to show a higher growth rate than other species at the present temperature. Different species show different temperature response of growth, hence, depending on the ambient temperature different species have an advantage. Another strategy may be to enter the habitat earlier, and by that get some extra time for development before the others arrives (priority effect). Total life cycle length as well as ability to enter a habitat early is also connected to a species life cycle strategy. Some are totally unregulated while others show a strict regulation mainly in the egg and/or larval stadia.

We experimentally investigated temperature response of growth of a number of widespread European dragonfly species. The data obtained were used as parameters in a model in which also different types of seasonal regulation patterns could be assigned to the species in order to simulate realistic life cycles. We determined the best fitting life cycle pattern for each species by comparing simulated with naturally recorded phenology patterns (i.e. emergence). Then experimental simulations were made using different environmental parameters (temperature and latitude). This was to investigate how species adopting different life cycle patterns respond to a temperature increase, with respect to direct warming but also taking into account the northwards expanding ranges. The simplified hypothesis was that with rising temperatures the more unregulated species with high optimum temperature and high growth rates should have an advantage. In many cases such species are already proofed to be successful invaders to central and northern Europe during the last decades.
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