6th WDA International Congress of Odonatology

Xalapa, Veracruz, Mexico
7-12 June 2009

Organizing the 6th WDA Odonatology Congress has been a pleasure and a challenge. On one hand, we were very happy to provide the best academic and friendly environment to our colleagues and friends. However, on the other hand, given the rather unfortunate swine outbreak that occurred in May, 2009 in Mexico, many issues became far more complex. Despite this mixture of feelings, the congress was widely positive for everyone.

There were many institutions and individual people whose support needs to be appreciated. As for the former we would like to thank the Instituto de Ecología, A. C., Instituto de Biología and Instituto de Ecología (both from the Universidad Nacional Autónoma de México), the Consejo Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) and, of course, the World Dragonfly Association. All of them provided both logistic and financial support at all stages. As for the individual people, our most sincere appreciation for: Helga C.P. Barba Medina, Isaac González Santoyo, Leonardo González Valencia, Daniel González Tokman, Jesús Guillermo Jiménez Cortés, Alejandra López Valenzuela, Raúl I. Martínez Becerril, Haydeé Peralta Vázquez, Martín A. Serrano Meneses, Daniela Silva Ruiz and Jesús Wong Muñoz. We are particularly grateful with Julio César Montero Rojas for his altruistic help with the design of the congress and t shirts logos as well as many other aspects of the congress organization. Also our appreciation to those people that while attending the congress diverted their attention to readily provide help whenever this was needed.

The organizing committee

Rodolfo Novelo-Gutiérrez Enrique González-Soriano Alex Córdoba-Aguilar

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OPENING CEREMONY

MIKE PARR
A few words about Phil Corbet</td><td>9:00-10:00 AM

PLENARY:
MARK FORBES
Ecological parasitology of odonates: resistance to understanding</td><td rowspan="11">Midcongress Tour El Tajin Archaeological Site</td><td>9:00-10:00 AM

PLENARY:
ROSSER GARRISON
Diversity of Neotropical Zygoptera</td><td>9:00-11:20 AM

Poster session 2</td><td rowspan="11">Postcongress Tour Tlacotalpan-Los Tuxtlas (evening arrival on Monday 15 to Veracruz city)</td></tr>
<tr><td>10:00-11:00 AM

PLENARY:
MICHAEL SAMWAYS
Conserving dragonflies in a rapidly changing world</td><td>10:00-11:20 AM

Oral contributions</td><td>10:00-11:00 AM

Oral contributions</td></tr>
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Coffee break</td><td>11:20-11:40 AM
Coffee break</td><td>11:00-11:40 AM

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Desk registration Crowne Plaza Hotel, Xalapa</td><td>11:40-2:00 PM

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Oral contributions</td><td>11:40-2:00 PM

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Lunch</td><td>2:00-4:00 PM
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Oral contributions</td><td rowspan="2">4:00-6:00 PM

Oral contributions</td><td>4:00-4:40PM
Oral presentations of posters for session 2</td><td>4:00-5:40 PM

BIENNIAL GENERAL MEETING</td></tr>
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BOARD OF TRUSTEES MEETING</td><td rowspan="2">4:40-6:20 PM

Oral contributions</td><td>5:40-6:20 PM

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Oral presentations of posters for session 1</td><td>6:20-7:20 PM

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Welcome cocktail</td><td></td><td></td><td></td><td>7:00-10:00 PM

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TIME	JUNE 8
9:00-10:00	**OPENING CEREMONY** **MIKE PARR** ***A few words about Phil Corbet***
10:00-11:00	**PLENARY:** **MICHAEL SAMWAYS** ***Conserving dragonflies in a rapidly changing world***
11:00-11:40	**Coffee break**
11:40-14:00	**ORAL CONTRIBUTIONS** **CHAIRMAN: GÖRAN SAHLÉN** FLENNER & SAHLÉN Forestry and climate change: interactions of two disturbance factors of dragonfly communities TERAMOTO & WANATABE Colonization process of the threatened damselfly, *Mortongrion hirosei*, in the artificially established reed community GROENENDIJK & BOUWMAN Finalizing the species protection plan of *Somatochlora arctica* in the Netherlands TERMAAT, GROENENDIJK, BOUWMAN & VAN STRIEN Towards an European dragonfly monitoring scheme: using the results of the Dutch scheme as an example WILSON The odonate recolonization of Hong Kong HOLUSA The analysis of the habitat of *Cordulegaster heros* on its northern area border in Slovakia SÁNCHEZ, REALPE & SALAZAR Evidence of a possible new cryptic species in the genus *Polythore* (Polythoridae: Odonata) in the Colombian Eastern Andes foothills
14:00-16:00	**Lunch**
16:00-17:40	**ORAL CONTRIBUTIONS** **CHAIRMAN: JOHN HAWKING** DIJKSTRA, KALKMAN, STOKVIS & VAN TOL Dawn of the damsels: phylogenetic research on Palaeotropical Zygoptera EGUÍA-LIZ & NOVELO-GUTIÉRREZ Spatial-temporal analysis of the Odonata community structure in three microbasins of the central México HAWKING, COOK, SMITH & MCINERNEY Interpreting changes in temporal patterns of Odonata larval assemblage to ascertain the ecological health of a large inland river

	CORDERO RIVERA, LORENZO-CARBALLA, BEATTY, UTZERI & VIEIRA Parthenogenetic *Ischnura hastata* as an indicator of water quality in the Azores, with notes on ecology
	CONZE Dynamics and continuity in dragonflies – examples from Northrhine-Westfalia, Germany
17:40-18:00	**BOARD OF TRUSTEES MEETING**

TIME	JUNE 9
9:00-10:00	**PLENARY:** **MARK FORBES** ***Ecological parasitology of odonates: resistance to understanding***
10:00-11:20	**ORAL CONTRIBUTIONS** **CHAIRMAN: ALEX CÓRDOBA-AGUILAR** PERALTA-VÁZQUEZ & CÓRDOBA-AGUILAR Do interspecific diferences in immune ability explain parasitism variation in a damselfly community? JIMÉNEZ-CORTÉS & CÓRDOBA-AGUILAR How costly is a costly ornament? Covariation among immune ability, ornament and body size expression in the American rubyspot GONZÁLEZ-SANTOYO & CÓRDOBA-AGUILAR Relationship between the size of the red wing spot and phenoloxidase activity in five *Hetaerina* species GONZÁLEZ-TOKMAN & CÓRDOBA-AGUILAR High ornamentation impairs male "priming" ability in the damselfly *Hetaerina americana* (Odonata: Calopterygidae)
11:20-11:40	**Coffee break**
11:40-14:00	**ORAL CONTRIBUTIONS** **CHAIRMAN: MARTÍN SERRANO-MENESES** GONZÁLEZ-SORIANO, DELGADO-HERNÁNDEZ, & CÓRDOBA-AGUILAR Observations of the reproductive behaviour of *Protoneura cara* Calvert (Zygoptera:Protoneuridae) CORDERO, CONTRERAS-GARDUÑO, LANZ-MENDOZA & CÓRDOBA-AGUILAR Treatment with an analogous of juvenile hormone produces contrasting results in survivorship of two species of *Calopteryx* CÓRDOBA-AGUILAR & MUNGUÍA-STEYER Do individuals in better condition survive for longer? Field survival estimates according to male alternative reproductive tactics and sex SERRANO-MENESES & CÓRDOBA-AGUILAR Sexual selection and the evolution of male wing pigmentation in Odonata ANDERSON & GRETHER Interspecific aggression and character displacement of competitor recognition in *Hetaerina* damselflies BEATTY, CORDERO RIVERA, HARDING, HOFFMANN, SHERRATT & VAN GOSSUM The damselfly genus *Polythore* (Zygoptera: Polythoridae): biogeography, ecology, and the potential for mimetic resemblance in multiple species AMAYA-PERILLA & FAJARDO-MEDINA Dragonflies of Meta Department Colombia: species, inter and intraspecific variation of male genitalia
14:00-16:00	**Lunch**

	ORAL CONTRIBUTIONS **CHAIRMAN: ANDREA WORTHINGTON**
16:00-1720	MARTENS Group oviposition in damselflies: a review GÜNTHER Where is the difference? - comparative study of male reproductive behaviour of different chlorocyphid taxa WORTHINGTON & OLBERG Looming sensitive neurons in the dragonfly predict time to contact with prey WARE, MAY, KOCH & SAHLÉN Dating dragonflies: preliminary odonate divergence times
17:20-19:00	**ORAL PRESENTATIONS OF POSTERS FOR SESSION 1**

TIME	JUNE 11
9:00-10:00	**PLENARY:** **ROSSER GARRISON** ***Diversity of Neotropical Zygoptera***
10:00-11:00	**ORAL CONTRIBUTIONS** **CHAIRMAN: MIKE MAY** MAY, CARLE & KJER Some surprises in the phylogeny of Coenagrionidae CAMPBELL & NOVELO-GUTIÉRREZ Taxonomic distinctness and the assessment of changes in odonate phylogenetic diversity PÉREZ-GUTIÉRREZ Validation of standardized methodology for dragonfly populations and community studies
11:00-11:40	**Coffee break**
11:40-14:00	**POSTER SESSION 1** ALMIRANDA, PÉREZ & GUTIÉRREZ Composition and structure of a dragonfly assemblage in a San Juan Tocagua, Department of Atlantico, Colombia ANGULO, HINOJOSA, DOMÍNGUEZ, BURGOS, MAGAÑA, CONIC & MAY Distribution and phenology of Odonata larvae in southern shallow freshwater systems of the Petenes reserve, Campeche, Mexico ASTUDILLO, NOVELO-GUTIÉRREZ & CAMPBELL Organic enrichment and the phylogenetic diversity of Odonata larvae in the Huehueyapan river, Coatepec, Veracruz, Mexico BOTA-SIERRA & ALTAMIRANDA Preliminary review of the Odonata from Antioquia (Colombia) BARBA-MEDINA, GONZÁLEZ & GONZÁLEZ-SORIANO Odonata diversity from six localities with tropical deciduous forest in Mexico CUEVAS-YÁÑEZ & NOVELO-GUTIÉRREZ Odonata diversity in an elevational gradient in central Mexico GÓMEZ-ANAYA & NOVELO-GUTIÉRREZ A quantitative study of Odonata larvae assemblages from Sierra de Coalcoman mountains, Michoacán, Mexico HOFFMAN, BEATTY, CORDERO, HARDING, SANCHEZ, SHERRATT & VAN GOSSUM Distribution of the genus *Polythore* (Zygoptera: Polythoridae), including notes on habitat preferences within the genus MAGNHEDEN & SAHLÉN Dragonflies vs. fish: interactions between communities in Swedish lakes and ponds
14:00-16:00	**Lunch**

14:00-16:40	**ORAL PRESENTATIONS OF POSTERS FOR SESSION 2**

ORAL CONTRIBUTIONS
CHAIRMAN: VINCENT KALKMAN

16:40-18:20

KALKMAN
Mapping the dragonflies of the world

DIJKSTRA, CLAUSNITZER & KIPPING
The Odonata database of Africa: putting tropical dragonfly diversity on the map

ABBOTT
Odonata central: a hub for the distribution of New World Odonata

THEISCHINGER
Data basing and distributional patterns of Australian dragonflies

VON ELLENRIEDER
Distribution patterns of dragonflies: State of knowledge in the neotropical region

18:20-19:20	**IUCN MEETING**

TIME	JUNE 12
	POSTER SESSION 2
9:00-11:20	RAMÍREZ, GUTIÉRREZ & SPRINGER The Neotropical damselfly genus *Cora*: new larval descriptions and a comparative analysis of known species (Zygoptera: Polythoridae) RAMOS-HERNÁNDEZ Predation of odonates by the bat *Macrotus warterhousei* minor (Chiroptera: Phyllostomidae) in central Cuba RUIZ-SILVA & CÓRDOBA-AGUILAR The role of the red wing spot on male territorial contests in *Hetaerina americana* THEISCHINGER A peculiar damselfly larva from Australia TORRES-CAMBAS & TRAPERO Oviposition frequency and emergence of *Proteneura capillaris* (Rambur, 1842) (Protoneuridae: Odonata) in Dos Bocas, Santiago de Cuba TORRES-PACHÓN, RINCÓN & REALPE Odonata diversity in four localities of the high Andean forest of Santuario de Fauna y Flora de Iguaque, Boyacá, Colombia TRAPERO, REYES, GÓMEZ & CUELLAR Aquatic plants as emergence substrate for odonata larvae in Las Cuabas, Santiago de Cuba VILLEDA-CALLEJAS, BARRERA-ESCORCIA, DALETH-GUEDEA, RUIZ-PUGA The compound eyes of *Erythrodiplax berenice* (Odonata: Libellulidae) and *Gromphadorrina portentosa* (Blottodea: Blaberidae): a comparative study VON ELLENRIEDER Dragonfly diversity on the Argentinian Chaco
	ORAL CONTRIBUTIONS **CHAIRMAN: ANDREAS MARTNES**
11:20-12:00	SUHLING & RICHTER Temperature dependence on emergence: a model based on long field data WONG & CÓRDOBA-AGUILAR Seasonal changes in body size, sexual size dimorphism and sex ratio in an odonate community
12:00-12:40	**Coffee break**
	ORAL CONTRIBUTIONS **CHAIRMAN: ANDREAS MARTNES**
12:40-14:00	MARTENS Searching for the limits of Odonata biology: a first comparison with Ephemeroptera HOLUSA The diurnal activity of adults of *Cordulegaster bidentata* in the flight period

	SAHLÉN Branched setae on larval feet - where, why and how come? TRAPERO & REYES The last instar larva and emergency pattern of *Erythrodiplax fervida* (Erichson, 1848) (Odonata: Libellulidae) in Las Cuabas, Santiago de Cuba
14:00-16:00	**Lunch**
16:00-17:40	**BIENNIAL GENERAL MEETING**
17:40-18:20	**CLOSING CEREMONY**
18:20-19:00	
19:00-22:00	**CONGRESS DINNER**

Monday 8 June, 2009

WELCOME CEREMOMY

FOREWORD IN MEMORY TO CORBET

M. Parr

Plenary Talk – Monday 8 June, 2009

CONSERVING DRAGONFLIES IN A RAPIDLY-CHANGING WORLD

M. J. Samways

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The Anthropocene is seeing one of the largest mass extinctions of species since the Cretaceous. Possibly a quarter of all insect species will go extinct over the next few decades. As many freshwater systems are highly threatened, it is not surprising that some dragonfly species are also threatened, especially narrow-range specialists. Yet some other species are remarkably tolerant of change, even benefiting from altered habitat conditions. Dragonflies, unlike many other invertebrate taxa, appear to be remarkably positively responsive to restored conditions. They are also highly responsive to climate change, with some species showing fast adaptation to warmed conditions, while others, particularly some montane species, being very sensitive, jeopardizing their future. By and large, it is only the widespread generalists which benefit from artificial water bodies. Considering all these threats and responses of dragonfly species, we are able to instigate progressive conservation strategies. The charismatic nature of dragonflies means that there is enthusiastic support of the public. Clearly, it is important to conserve natural areas in the first place, and then aim to restore conditions around these core habitats, as dragonflies, even rare endemic species, tend to be ready colonists of suitable habitat conditions. This approach can also engage use of large-scale ecological networks, which not only increase the area of occupancy and extent of occurrence of species, but also put in place a buffer against climate change. When these large-scale and positive approaches are taken, the dragonflies act as umbrella surrogates for other biotic components, emphasizing how dragonflies are mainstream in global conservation strategies.

FORESTRY AND CLIMATE CHANGE: INTERACTIONS OF TWO DISTURBANCE FACTORS ON DRAGONFLY COMMUNITIES

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Forestry has, up to now, been regarded the major disturbance factor in Swedish forests. This landscape consists of a mosaic of forest mixed with wetlands; consequently, the conditions of surrounding forest also affect the close-by wetlands. Results from a recent study of ours imply that another factor now has become of significance: climate change. Here we compare dragonfly community data from two areas in central Sweden at similar latitudes but with different pressure of forestry. The first area is used for commercial forestry, while the second is situated in a big nature reserve area only exposed to gentler and smaller scale forestry. Data regarding species occurrence and forestry activities close to the lakes were collected at two occasions in and around each lake (1996/97 and 2006/08 respectively), and changes in species ecology, species pools and diversity is compared between years. Our results imply that dragonfly community reactions to climate change in the two areas are different. There seems to be fewer changes in the communities in the nature reserve area than in the area used for forestry, even though species have disappeared and others have been added in both areas. The results and their implications will be discussed further.

COLONIZATION PROCESS OF THE THREATENED DAMSELFLY, *MORTONAGRION HIROSEI*, IN THE ARTIFICIALLY ESTABLISHED REED COMMUNITY

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For the habitat of the threatened damselfly, *Mortonagrion hirosei*, a reed community ($2100m^2$) was artificially established adjacent to the natural habitat ($500m^2$) by transplanting reed rhizome. Because both sexes have low flight activity throughout their lifetime (which results in low dispersion ability), few adults immigrated to the new reed community during the 1st year of the establishment. They tended to remain near the natural habitat. However, the distribution of the larvae in the established habitat was rather wide, when compared to that of the adults. In the second year of the established habitat, adults emerged from the whole reed community. The daily number of emerging adults was estimated using line transect method, which was comparable with that estimated from the mark-and-recapture method. Adult population size in the natural habitat was calculated at approximately 20,000 individuals per year for a period of 6 years (that is approximately 20 adults per square meter). The number of adults in the established habitat has increased, and it has reached a similar density to that of the natural habitat. Therefore, the colonization of *M. hirosei* in the established habitat was considered successful.

FINALIZING THE SPECIES PROTECTION PLAN OF *SOMATOCHLORA ARCTICA* IN THE NETHERLANDS

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Northern Emerald (*Somatochlora arctica*) is a typical species of bogs and wet heaths and an example of an arctic-alpine fauna element. It is rare in the western parts of its range. In the Netherlands, it severely declined during the last century. Therefore, the species is listed as endangered on the national Red List and a Species Protection Plan was published in 2005. During the time allotted to this plan (2006-2010), the aims are 1) to know more about the ecology and the measures required for its conservation; 2) to convey this knowledge to those concerned with nature conservation in the field; and 3) to integrate this knowledge into hydrological parts of peat restoration projects. During the first two years, the research focused on identifying the precise location of the reproduction sites within each population. Furthermore, a list was made of all local threats, and the measures required for the conservation of each population were formulated. This information, together with detailed distribution maps, was presented to local conservation managers and follow-ups were planned. These mainly consisted of short-term measures, such as coppicing trees and bushes, creating new peat pits where *Sphagnum* can grow, and blocking drains to stop local run-off. The last step in the Species Protection Plan will be to formulate long-term measures. This, in order to maintain healthy peat bogs and ensure habitats for *S. arctica* and many other species for the future.

TOWARDS A EUROPEAN DRAGONFLY MONITORING SCHEME: USING THE RESULTS OF THE DUTCH SCHEME AS AN EXAMPLE

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The possibilities for a European Dragonfly Monitoring Scheme have been studied, during a symposium in June 2008, in the Netherlands. Participants from 11 different countries shared their experiences and opinions on this subject. Success stories, encountered obstacles and methodological issues were discussed. Three alternative methods can be used for dragonfly monitoring, which differ with respect to statistical power and trend bias. If no standardisation of field method is prescribed, the data can be used for comparing distribution maps between periods. But this alternative suffers from low statistical power and the risk of bias due to increased sampling effort is considerable. If a strong standardisation is prescribed and count data are being collected, such as for the monitoring scheme in the Netherlands, the power is high and the bias can be minimized. However, the sampling effort for this alternative is too high for most countries, with only few people collecting data. If an intermediate level of standardisation is prescribed and presence-absence data are being collected, the power is rather low but bias can be minimized. The needed sampling effort will be acceptable for most countries. Combining the latter two methods seems to be most promising in order to compose supra-national trends in Europe.

THE ODONATE RECOLONISATION OF HONG KONG

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There is strong evidence to suggest Hong Kong has been gradually recolonised by specialist forest dragonflies over the past twenty years. Historically Hong Kong has been devoid of woodland for several hundred years but over the past sixty years, extensive areas of woodland have gradually returned to Hong Kong. Since the nineteen-eighties many Guangdong forest bird species have colonised the territory after many years of absence. The same pattern has also been observed in odonate populations but hitherto the increase in numbers of species discovered has been attributed to increased survey effort. Recent discoveries of many new species records indicate that odonates, especially forest specialists, are actively recolonising from south Guangdong. Supporting evidence is provided by comparing the Hong Kong fauna with neighbouring Guangdong. The potential for odonates to further recolonise Hong Kong both by natural and man-assisted means is considered.

THE ANALYSIS OF THE HABITAT OF *CORDULEGASTER HEROS* ON ITS NORTHERN AREA BORDER IN SLOVAKIA

O. Holuša

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Cordulegaster heros Theischinger 1979 is Eastmediterranean species occurring in insular areas within the Balkan Peninsula in Europe. Its habitat is smaller meandering streams, mostly overshaded by tree vegetation in hilly landscape. Northern area border is still unclear – a larger unbroken area is known from eastern Austria, Slovenia and western Hungary. An independent isolated area is at present known from western Slovakia. The running waters of streamlets and streams (totally at 30 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 Vihorlat Mts. and Popričný Hills but also in the Bílé Karpaty Mts. in the Czech Republic. Data concerning morphology of stream basin, pedological composition of sediments, water quality, state of vegetation and landscape etc. were collected. The occurrence of C. heros (majority of larvae) was confirmed only in the Borská nížina lowland and the Malé Karpaty Mts. in Slovakia. Its habitats are there natural streams and streamlets with clear water with the width of basin from 20 to 160 cm with the depth of 3 to 10 cm. All localities lie in the forest complexes. The important factor appears to be the absence of any settlement above the localities. The occurrence was found in the southernmost part of the Malé Karpaty Mts., in very narrow steep streamlets (habitat type of *C. bidentata*) in a forest complex of beech forests. The highest found density of larvae (majority last larval instar - 14) was 25 per 0,25 m^2. The occurrence of species ends in the MK Mts. northwards, where the parent rocks of Mts. changes from crystalline into the limestone.

EVIDENCE OF A POSSIBLE NEW CRYPTIC SPECIES IN THE GENUS *POLYTHORE* (POLYTHORIDAE: ODONATA) IN THE COLOMBIAN EASTERN ANDES FOOTHILLS.

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The Neotropical damselfly genus *Polythore* consists of nineteen described morphospecies and most of them show sexual dimorphism in wing color compositions. However, their evolutionary history and speciation are unknown. We used COI locus (799bp), male genitalia, wing venation, and geometrical pattern variation to clarify specific status in four *Polythore procera* populations in the Colombian Andes foothills. Morphological data corroborates that all populations are *Polythore procera*, but a molecular approach suggests two well supported reciprocal monophyletic clades; one composed of Chirajara (clade A) and the other of La Catira, Cementerio and Bavaria (clade B). A high genetic divergence (~3%) was observed and different degrees of gene flow were estimated by MDIV among populations. Gene flow was $N_f m=0.18$ between clades, and was consistent with two Chirajara haplotypes related to clade B in mtDNA genealogy. Male genitalia and wing venation suggest that Chirajara population morphology fits within clade B. Moreover, clade B color pattern measurements and mtDNA shared haplotypes advocate ancestral shared polymorphism or high gene flow throughout its history. Since morphometrical genitalia variation analysis exhibited great overlapping among populations, mechanical isolation could be ruled out as a factor in maintaining the present clade A integrity. Nevertheless, our results support a recent (1.4 mya) possible rapid cryptic speciation in which other intrinsic, extrinsic, or both reproductive mechanisms may be involved.

DAWN OF THE DAMSELS: PHYLOGENETIC RESEARCH ON PALAEOTROPICAL ZYGOPTERA

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With historic (D. Geijskes, J. Belle and especially M. Lieftinck) and present-day workers, Naturalis has a tradition in odonatological research, with one of the best dragonfly collections and libraries in the world. Current molecular research by the Damselfly Workers at Naturalis (DAWN) focuses on the phylogeny of families of the Zygoptera with their greatest diversity in the Old World tropics that have received rather little attention so far, e.g. Chlorocyphidae, 'Megapodagrionidae' s.l., Platycnemididae, Platystictidae and the Old World 'Protoneuridae'. Many of these groups have an enigmatic biogeography, with 'relict' distributions in regions like the African Cape, Madagascar, Seychelles, India, China, New Guinea and Australia. Some preliminary results are presented, with a focus on the Chlorocyphidae and Platycnemididae, including the classic problem of *Platycnemis* and *Copera*.

SPATIAL-TEMPORAL ANALYSIS OF THE ODONATA COMMUNITY STRUCTURE IN THREE MICROBASINS OF CENTRAL MÉXICO

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Odonata communities were described and compared at eight sites in San Juan, Tula, and Moctezuma microcatchments, The physico-chemical, biotic and environmental characteristics were determined in each habitat. To describe ecological associations in terms of life cycles (voltinism) and frequency of annual appearance, both adults and naiads were considered. Only naiads were used for community structure (richness, abundance and diversity) and classified according to the development of mesothoracic wings. It was found that species abundances might be explained by the four most common distributions. Co-existence among dominant species appears to result from temporal shifts in the synchrony of development. Beta diversity showed a replacement rate of 38%, suggesting that naiads respond to the regional heterogeneity of the system. Species richness could be partially explained by conductivity and type of habitat (lotic or lentic). The regional mosaic includes six sites with natural variations and two with important physical perturbations. The Odonata communities showed to be sensitive to habitat disturb.

INTERPRETING CHANGES IN TEMPORAL PATTERNS OF ODONATA LARVAL ASSEMBLAGE STRUCTURE TO ASCERTAIN THE ECOLOGICAL HEALTH OF A LARGE INLAND RIVER

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A long term macroinvertebrate survey was conducted on Australia's largest river, the Murray, in south-eastern Australia from 1986-2009. The project assessed the health of the river system by monitoring the macroinvertebrate assemblages in each of the major faunal zones along the river's length. Investigation of the trophic structure identified the major predator group, the Odonata, as of ecological importance. The Odonata were represented by 26 species, of which 10 species were zygopterans and 16 species anisopterans. The Odonata also contributed up to 10 percent of the total macroinvertebrate richness at many sites. The greatest species richness occurred in the upland section, with 15 species, dominated by the Anisoptera, which contributed 10 species. The lowest richness occurred in the most lowland reach, with the occurrence of eight species. However, in this reach there was a suborder reversal and the Zygoptera became dominant with five species. The greatest Odonata abundances were found predominantly in the mid reach and the abundances were attributed to four species of Zygoptera. At an upper midland reach site the zygopteran, *Nososticta solida,* contributed over 10 percent of the total abundance of all the invertebrate fauna. The temporal distribution of these zygopteran species and the other Odonata appears to be linked to the abundance of available habitat. This change in habitat can be attributed to river modification and regulation, which in the last five years been compounded by extreme drought conditions.

PARTHENOGENETIC *ISCHNURA HASTATA* AS AN INDICATOR OF WATER QUALITY IN THE AZORES, WITH NOTES ON ECOLOGY

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Populations of the New-World damselfly *Ischnura hastata* in the Azores islands represent the only known example of parthenogenesis in the order Odonata. Despite its widespread distribution, little is known about its biology and reproductive behaviour in either its sexual or asexual forms. Here, we present data on distribution, population density and habitat preferences from several island locations within the Azores, as well as results of studies of behaviour, survivorship and fertility rates of parthenogenetic females. We found *I. hastata* in high densities at oligotrophic ponds, but it was absent from eutrophic ponds, many of which have been impacted by cattle grazing and water extraction by humans, indicating the importance of this species as a bioindicator of water quality. The life expectancy of adult *I. hastata* females is estimated at less than one week, but their high fecundity and fertility could be the explanation for the high numbers of individuals observed in some of the studied sites. This work represents a first approach to the ecology and population biology of the parthenogenetic populations of this species, and may help us to begin to understand the unique conditions under which these parthenogenetic populations evolved, and how best to insure their conservation.

DYNAMICS AND CONTINUITY IN DRAGONFLIES – EXAMPLES FROM NORTHRHINE-WESTFALIA, GERMANY

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The German federal state of Northrhine-Westfalia is not only one of the highest populated parts of Europe; it has also a 150 years old history of dragonfly observation. These last 150 years are characterized by parallel developments: the growing number of people including their enormous infrastructure, the well documented changing in the landscape (i.e. to be analyzed by a continued set of historical maps covering the whole country) and the comparably growing knowledge about plants and animals which includes the dragonflies. Analyzing the database of more than 150.000 observations of dragonfly examples for the dynamics but also for the continuity of dragonfly-populations and assemblages are given. Similar to the high potential of changing life-cycles by birds where in many species populations can change from resting to migrating ones in a few generations this capacity from high fidelity to the place of birth to obligate migration seems even better evolved in many dragonfly species.

Plenary Talk – Tuesday 9 June, 2009

ECOLOGICAL PARASITOLOGY OF ODONATES: RESISTANCE TO UNDERSTANDING

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Recently, there has been much interest in how immune systems of insects are organized and whether we can learn anything about how insects cope with parasites and pathogens that assail them. Dragonflies and damsefllies have been centre stage for such investigations along with other groups such as crickets, mosquitoes, beetles, bees, and fruit flies. In this talk, I demonstrate that parasitic mites and gregarines exact fitness costs on their host odonates and, as such, hosts should resist them. I will show what resistance to parasites looks like and argue that innate components of resistance are variable within an between species in relation to a number of factors including emergence timing, temperature, estimates of condition, age and sex of hosts and whether the host dragonfly is a common or less common species. Trying to understand how resistance evolves and what constrains it requires a firm understanding of the natural history of both the hosts and its parasites. I will present also what I think are exciting avenues for future research based on that understanding and emerging theoretical issues.

DO INTERSPECIFIC DIFERENCES IN IMMUNE ABILITY EXPLAIN PARASITISM VARIATION IN A DAMSELFLY COMMUNITY?

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There are few studies that have explored the relationship between immune system and parasitism, specifically how immune variation is related to parasitism variation. In this study we investigated how immune variation measured as nitric oxide in ten species of damselflies is related to parasitism variation by two different parasites; gregarines and water mites. Our objective was to investigate whether differences in parasitism prevalence were related to immune system differences. We found that there was parasitism variation in three aspects: between species for each year, between years for each species, and within sexes. This suggests that the host-parasite relation is not a stable one. On the other hand, the species with the highest parasitism prevalence, had the less nitric oxide concentration. This suggests that parasite resistance is possibly so costly, that the host does not invest any resources to defence. This is in agreement with current models of host immune investment.

HOW COSTLY IS A COSTLY ORNAMENT ? COVARIATION AMONG IMMUNE ABILITY, ORNAMENT AND BODY SIZE EXPRESSION IN THE AMERICAN RUBYSPOT

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Recent advances in the field of ecological immunity have documented that production of courtship characters negatively impair immune function and vice versa. This has been used as evidence of trade-offs between both character types, although such relationship does not necessarily mean that these traits are directly coupled. We have tested whether such relationship holds in a population in which both the ornament and immune ability vary seasonally in expression. We monitored the relationship between a pigmented wing spot (a sexual ornament) and phenoloxidase (a component of immune activity) in males of the territorial damselfly *Hetaerina americana* in central Mexico for 10 months. In this species, previous results have suggested positive correlations between both traits. This has been interpreted as an indicative of sexual selection favoring both ornament expression and immune ability. Results showed that in certain months there is a positive linear relationship between both variables, which becomes negative at times. This provides partial support to the hypothesis that there is a trade-off between both characters types.

RELATIONSHIP BETWEEN THE SIZE OF THE RED WING SPOT AND PHENOLOXIDASE ACTIVITY IN FIVE *HETAERINA* SPECIES

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Secondary sexual traits have been proposed to be indicators of male condition. In Odonata, one morphological feature recently uncovered to be an indicator of condition is wing pigmentation, as it reflects immunocompetence. For example, in *Hetaerina americana*, the size of the red wing spot positive correlates with immune capacity. In this work, we have investigated such finding to other *Hetaerina* species including *H. americana* itself: *H. cruentata*, *H. occisa*, *H. titia* and *H. vulnerata*. Pigmented wing areas were measured which was correlated with phenoloxidase activity, a key indicator of insect immune response. Our results showed a negative relation between spot size and PO activity in all species studied, in contrast with the previous results obtained in *H. americana*. Although these results are in accordance with the idea that secondary sexual traits trade-off immune ability, they contradict the idea that males with better immune condition have highly developed sexual traits.

HIGH ORNAMENTATION IMPAIRS MALE "PRIMING" ABILITY IN THE DAMSELFLY *HETAERINA AMERICANA* (ODONATA: CALOPTERYGIDAE)

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Trade-off theory predicts that two traits that share costly resources cannot be maximized. This could be the case for immune response and reproduction. According to theory, only individuals in good condition will be able to afford the cost of producing elaborated ornaments and an efficient immune system. In this study we tested the relationship between the expression of a condition-dependent ornament (wing pigmentation) and one component of immune response ("priming") in males of the damselfly *Hetaerina americana*. Since immune priming allows an animal to prepare against repeated infections with a pathogen, and its occurrence has not been explored in odonates, we carried out an experiment to determine its presence and condition-dependence. We immunized a group of males with inactive bacteria prior to exposure to the same, active bacteria, and compared their survival with that of males that were infected but not previously immunized. Our results show that immunization reduced male mortality. However, less pigmented males showed higher survival rates than more pigmented males. No relationship between survival and pigmentation was detected in males that were not immunized. We suggest that immune priming and wing pigmentation are a traded-off, but our results contradict the general idea that male ornamentation reflects immune ability.

OBSERVATIONS ON THE REPRODUCTIVE BEHAVIOUR OF *PROTONEURA CARA* CALVERT (ZYGOPTERA: PROTONEURIDAE)

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The Protoneuridae comprises the third most diverse family of zygopterans in the world. Nevertheless, the reproductive behavior of these tiny damselflies is only known for not more than a dozen of species. *Protoneura cara* is a slightly sexually dimorphic species which inhabits a wide array of water bodies in Mexico. Here we present the results of our observations on the reproductive biology of this species in two contrasting lotic habitats. The first habitat is a wide open permanent river at El Estudiante (EE), Morelos (Mexico) and the second one is a small temporal forested stream at Chamela (CH), Jalisco (Mexico). At EE, males exhibit two tactics in order to contact receptive females: (i) they patrol above the water surface and (ii) they search among nearby vegetation. At CH, besides patrolling, males congregate in aerial mating aggregations to which females are attracted to. In all the tactics employed, the males invest a huge proportion of their time at flight, a very unusual situation for the suborder Zygoptera. Copulations were rarely observed at both sites and when they occurred at the water bodies, most females were already in tandem. Details of diurnal activity, copulation, oviposition and postcopulatory behaviour are given. A new function for postcopulatory guarding behavior of males is proposed.

TREATMENT WITH AN ANALOGOUS OF JUVENILE HORMONE PRODUCES CONTRASTING RESULTS IN SURVIVORSHIP OF TWO SPECIES OF *CALOPTERYX*

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Recently it has been shown that male *Calopteryx virgo* administrated with methoprene acid, an analogous of the juvenile hormone, increased their aggressive behaviour and occupation time of territories. To test the generality of these results, we realized two mark-recapture experiments with males of *C. haemorrhoidalis* (125 males in 2006 and 224 males in 2008) and *C. splendens* (114 males in 2008). We predicted that if methoprene increases aggressive behaviour, then survivorship should be reduced as a trade-off. One third of the males received methoprene acid diluted in acetone (treated males), one third received only acetone (control for diluent) and the final third remained untreated (Control). The analysis of recapture histories of marked animals was done with the program Mark, using information theory methods (AIC) to select between models. For *C. hameorrhoidalis* in 2006, the most supported model included time effects in survivorship and recapture rates [Phi(t) p(t)], but did not include the effect of treatment. In 2008, with a larger sample size and better meteorological conditions for territorial behaviour, the most supported model included groups on recapture rates but not in survivorship [Phi(.) p(g)], but the second model was Phi(g) p(g), i.e., the effect of groups (treatment) on both parameters. In any case this model suggested almost identical survivorship between groups. For *C. splendens*, the most supported model was also Phi(.) p(g), but model Phi(g) p(g) was among the three most supported. This model suggested reduced survivorship for treated males (0.859±0.029) compared to both controls (acetone: 0.913±0.022, control: 0.910±0.024). We discuss why the contrasting aggressive behavior of both species might explain the difference.

DO INDIVIDUALS IN BETTER CONDITION SURVIVE FOR LONGER? FIELD SURVIVAL ESTIMATES ACCORDING TO MALE ALTERNATIVE REPRODUCTIVE TACTICS AND SEX

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There is a gap in the supposed survival differences recorded in the field among individuals according to their condition. This is partly due to our inability to assess survival in the wild. We applied modern statistical techniques to field-gathered data in two damselfly species with alternative reproductive tactics (ARTs). In *Paraphlebia zoe*, there are two ART: a larger black-winged (BW) territorial male and a smaller hyaline-winged (HW) nonterritorial male. In this species, condition is thus indicated by body size. In *Calopteryx haemorrhoidalis*, males follow tactics according to their condition with males in better condition practicing a territorial ART. In this species, condition correlates positively with wing pigmentation in both sexes. We predicted that territorial males will survive less than nonterritorial males, and larger or more pigmented animals will survive for longer. In *P. zoe*, BW males survived less, but not necessarily larger individuals survived for longer. In fact, size affected survival but only when group identity was analyzed, showing a positive relationship in females and a negative relationship in both male morphs. For *C. haemorrhoidalis*, survival was larger for more pigmented males and females (in the case of males, likely the territorial tactic), but size was not a good survival predictor.

SEXUAL SELECTION AND THE EVOLUTION OF MALE WING PIGMENTATION IN ODONATA

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Males of certain dragon- and damselfly species (Insecta: Odonata) exhibit conspicuous wing pigmentation patterns that have inspired several theories to understand its occurrence. Some of these theories concentrate on the ecological processes that may maintain wing pigmentation (i.e. sexual segregation, predator warning, ecological character displacement); however, a growing number of single-species studies suggest that sexual selection is most likely to drive the evolution of this trait. Nonetheless, no study to date has tested whether sexual selection first promoted the evolution of wing pigmentation from a wide, comparative perspective. Here we used a directional phylogenetic comparative method to test whether territoriality (a *proxy* for sexual selection) predicts the evolution of male wing pigmentation in odonates. First, we show that territoriality and wing pigmentation evolved in a correlated fashion. Second, the evolution of wing pigmentation depends on the presence of territoriality: wing pigmentation is likely to evolve only if territoriality has been acquired first. Finally, once wing pigmentation has been acquired, it may be retained even if territoriality is lost. Taken together, these results suggest that sexual selection is likely to be a first promoter of wing pigmentation; however, other selective processes that may maintain this trait are still to be tested.

INTERSPECIFIC AGGRESSION AND CHARACTER DISPLACMENT OF COMPETITOR RECOGNTION IN *HETAERINA* DAMSELFLIES

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Sexually selected or secondary sexual characters can be favored by either one of two processes: mate choice and/or mate competition. When interacting individuals include closely related species, species recognition may additionally influence secondary sexual character evolution. The interplay between species recognition and mate choice has received much attention in the form of research on reproductive character displacement. Here, I focus on the interplay between species recognition and mate competition using Rubyspot damselflies (*Hetaerina* spp.) as a model system. I predict that *Hetaerina* males should be under selection to reduce aggressive interspecific territorial flights. In sympatry, territorial males show reduced territorial aggression towards conspecific males that have been manipulated (with ink) to resemble sympatric congeners, relative to sham-manipulated conspecific controls. Allopatric populations fail to show reduced aggression to experimental males relative to controls.

THE DAMSELFLY GENUS *POLYTHORE* (ZYGOPTERA: POLYTHORIDAE): BIOGEOGRAPHY, ECOLOGY AND THE POTENTIAL FOR MIMETIC RESEMBLANCE IN MULTIPLE SPECIES

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The damselfly genus *Polythore* consists of 20 described species distributed in the Andean lowlands from Colombia to Bolivia. The most striking morphological difference between species in this group is in wing coloration, with significant differences in colour and pattern between, and sometimes within, species. It has previously been suggested that the wing colours of some *Polythore* offer protection from predation due to their mimetic resemblance to co-occuring toxic butterflies. We here present initial results of studies to assess this putative mimicry. We collected individuals of 5 species of *Polythore* from a number of locations in central Peru, and compare distributions of these species with the most common forms of butterflies with which they are encountered: We will also assess similarities in colour and form between the damsels and co-occuring butterflies, in both visible and ultraviolet spectra. Further we present results of experiments with free-ranging chickens on their initial avoidance of *Polythore* damsels, and whether they can learn to associate these damsels with butterflies under experimental conditions. Through this work and further research on flight similarities between damsels and butterflies, and phylogenetic assessment of *Polythore* species, we hope to better understand the selective forces behind wing coloration in this damselfly group.

DRAGONFLIES (LIBELLULIDAE: ANISOPTERA) OF META DEPARTMENT, COLOMBIA: SPECIES, INTER AND INTRASPECIFIC VARIATION OF MALE GENITALIA

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One of the most general trends in animals with internal fertilization is the rapid divergent evolution of male genitalia. Knowledge about genitalia in the suborder Zygoptera is greater than in Anisoptera since the latter are very difficult to capture and mark. Few investigations about Anisoptera genitalia suggest the presence of a rapid divergence in the morphology of male genitalia, like in other polyandrous insects, which corroborates Eberhard's postcopula sexual selection hypothesis. The purpose of this study is to corroborate the information about the variation of the genitalia for the suborder Anisoptera offered by Córdoba-Aguilar (high variation on segment 4 of the penis). We sampled 12 areas between Villavicencio and Puerto Gaitan (Meta department of Colombia) in two different seasons from 2003 to 2008. We explored the variation of the genitalia among the specimens collected with morphometric analysis and compared it with a general trait (hind wings). We found a total of 330 males distributed in 27 species of Libellulidae. The male genitalia studied showed inter and intraspecific variation. These differences could be used as tools for the evolutionary relationships among the genitalia of the group.

GROUP OVIPOSITION IN DAMSELFLIES: A REVIEW

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In many damselflies females, alone or in tandem, oviposit in conspecific groups. In several cases there is an experimental proof that groups develop because arrivers prefer to land close to conspecifics. It can be assumed that social attraction during oviposition is more distributed among the Zygoptera. On the other hand egg-laying groups may also result from limited and patchy oviposition sites.

This contribution deals with the design and results of field experiments to test social attraction at the oviposition site. Finally I will discuss mechanisms and advantages of group oviposition. There is a wide spectrum of options, the protection against interference, the reduction of predation risk to adults, the location of suitable oviposition sites or the protection of eggs against parasitoids or secondary metabolites of plants.

WHERE IS THE DIFFERENCE? - COMPARATIVE STUDY OF MALE REPRODUCTIVE BEHAVIOUR OF DIFFERENT CHLOROCYPHID TAXA

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Many species of Chlorocyphidae exhibit highly complex and specialized reproductive behaviour. Males display specialized, species-specific agonistic behaviour, and in most species mating is preceded by ritualized courtship of females by males. In both cases visual communication involving ritualised display of ornamentation is of great importance. Inter- and intra-sexual signals are potentially part of mate recognition systems, which have evolved within communities of syntopic species. Based on own results for a total of 20 taxa and a review of the data published hitherto the display of ornamentation will be classified for taxa of the genera *Disparocypha*, *Libellago*, *Platycypha* and *Rhinocypha* (including *Aristocypha* and *Heliocypha*). Together with the knowledge of the historical biogeography the results gave new aspects to reconstruct their phylogenetic relationships.

LOOMING-SENSITIVE NEURONS IN THE DRAGONFLY PREDICT TIME TO CONTACT WITH PREY

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To catch a flying insect, the dragonfly must not only fly towards the correct location to intercept the prey's flight path but also grasp the prey at the right time. We use high-speed video analysis of prey capture flights and neurophysiology to understand this behavior. The dragonfly aims its flight trajectory at a point in front of the flying prey, anticipating where the prey will be. As it approaches the point of interception, it thrusts its legs forward to grab the prey. This final maneuver reflects an accurate collision-time calculation, with the leg thrust beginning about 20 ms before time-to-contact. We found neural correlates of this time-to-contact calculation and behavior.

Eight pairs of target-selective descending neurons (TSDNs) appear to control prey capture. Whereas 6 of the neuron pairs are strongly directionally selective (in 2 dimensions), two (DIT3 and MDT3) show maximal responses to looming objects. The timing of their bursting activity, about 100 ms before contact, is best explained as a time-to-contact response. We hypothesize that these neurons are involved both in initiating the final leg thrust and in guiding a final flight correction to capture the prey. (Supported by the Air Force Office of Scientific Research)

DATING DRAGONFLIES: PRELIMINARY ODONATE DIVERGENCE ESTIMATES

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Divergence time estimation allows researchers to evaluate evolutionary hypotheses about ecological processes. We use Bayesian molecular results to estimate both divergence times and diversification rates in Anisoptera. Dating estimates are recovered using different methodologies (BEAST and r8s), datasets and taxon samples to evaluate the robustness of odonate divergence time estimates. Phylogenetic hypotheses and divergence estimates are discussed in relation to the success of Libelluloidea, with a focus on the evolution of exophytic oviposition and burrowing behavior.

Plenary talk – Thursday 11 June, 2009

DIVERSITY OF NEOTROPICAL ZYGOPTERA

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Knowledge of the Neotropical fauna of Odonata has arguably lagged behind those of other faunal regions. However, this region possesses the highest diversity of odonate species in the world and basic information on their taxonomy, life history, and biology is still fragmentary. In my presentation I will review the diversity of the Zygoptera in this region, showing basic characteristics and distribution for each family and discussing the state of knowledge of their genera and species.

SOME SURPRISES IN PHYLOGENY OF COENAGRIONOIDEA

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Several molecular and morphological analyses now suggest that Lestoidea forms a clade sister to other Zygoptera. The Calopterygoidea, even if defined to include Amphipterygidae and Megapodagrionidae, may be polyphyletic, however, and in some analyses it includes, very unexpectedly, Isostictidae. At the very least, relationships among the families remains uncertain. In any case, Isostictidae itself is monophyletic and not closely related to Protoneuridae. Coenagrionoidea, excluding Isotictidae is also monophyletic. Within Coenagrionoidea, several novel relationships appear to be well supported. First, the Old World disparoneurine "protoneurids" are nested within Platycnemididae and well separated from the protoneurine, *Neoneura*. The remaining coenagrionids are divided into two well-supported subdivisions. The first includes Pseudostigmatinae, *stat. nov.*, Protoneurinae, a group of coenagrionids mostly characterized by having an angulate frons, and *Argia*. The second division includes typical Coenagrionidae. Although our taxon sampling within the last group is too sparse to provide clear conclusions, neither ours nor other recent phylogenies support any of Fraser's subfamilies except possibly Argiinae and Ischnurinae.

TAXONOMIC DISTINCTNESS AND THE ASSESSMENT OF CHANGES IN ODONATE PHYLOGENETIC DIVERSITY

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Taxonomic distinctness is a robust index that combines species richness and taxonomic relatedness, and has been successfully used to assess the effect of environmental impacts on the taxonomic composition of floral and faunal assemblages in aquatic and terrestrial ecosystems. Here we assess the results from three separate studies on odonate assemblages in Mexico that span the effects from the creation of a hydroelectric impoundment, to changes along an elevation transect, and to local nutrient enrichment. Odonate phylogenetic diversity, as measured by taxonomic distinctness, was negatively associated with the proportions of plant-dependent species relative to those that were not plant-dependent. Changes in these relative proportions were directly influenced by taxonomic suborder (Zygoptera or Anisoptera), and by changes in water flow (e.g. from flooding, or changes in river gradient with elevation) which affected the retention of aquatic vegetation relative to inorganic benthic substrates without aquatic vegetation. The balance of higher taxonomic structure between the suborders within the Odonata appears driven by the negative relationship between water flow and the maintenance of habitat for aquatic vegetation over large spatial scales, while species richness may be more affected by changes in variables such as nutrient enrichment occurring at local scales.

VALIDATION OF STANDARDIZED METHODOLOGY FOR DRAGONFLY POPULATION AND COMMUNITY STUDIES

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A new methodology was implemented with the aim of standardizing sample designs for quantitative and unmanipulated experiments with dragonfly populations and communities. To validate the methodology, data obtained with the use of linear transects and triangular plots was analyzed and examined simultaneously in order to compare the effectiveness, efficiency and representativeness of both designs especially with the purpose of comparison and reproducibility between studies. The obtained results indicated that the triangular plots represented a geometric figure recommendable for community studies, with the purpose of providing representativeness, major diversity, and independence between samples and experimental units. Results suggest that community studies require that data collection is obtained using *a priori* spatial heterogeneity in the area of interest while population studies require homogeneity. Preliminary results of this comparison study, between methodologies for collecting and sampling dragonflies, suggest that it is possible to test hypotheses of habitat association of euritopic and estenotopic species as well as to monitor for short, medium and long term dragonfly populations using geometric plots.

MAPPING THE DRAGONFLIES OF THE WORLD

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For the last two years the Dragonfly Specialist Group has been working together with the International Union for Conservation of Nature (IUCN) and Conservation International (CI) on the Global Dragonfly Assessment (GDA). These projects aim at assessing the threat status of all of the 6000+ dragonfly species in the world. In addition, dragonfly distribution databases of large parts of the world are being constructed. Thanks to the large effort made by members of the Dragonfly Specialist Group much has already been achieved. Red List assessments have been made for over one third of the world's species as part of the Red List Species Index (Clausnitzer et al., submitted) and the African Freshwater Assessment. Distribution databases have been constructed for large parts of Africa, Europe, North America, Australia and the Indonesian Archipelago. Current projects and future plans for the GDA are presented.

THE ODONATA DATABASE OF AFRICA: PUTTING TROPICAL DRAGONFLY DIVERSITY ON THE MAP

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The Odonata Database of Africa (ODA) is the first continent-wide, high-resolution, taxonomically-verified database of a group of tropical freshwater insects, including some 70,000 records for more than 700 odonate taxa. It thus provides the first demonstration at the scale of an entire (tropical!) continent of what the Global Dragonfly Assessment can be worldwide: a tool to determine freshwater biodiversity hot-spots and knowledge gaps, threats and responses to change, etc. Therefore analysis of the data is the first priority. The data and analyses should also be presented in a distributional checklist or atlas, facilitating further taxonomic and biogeographic advances in African odonatology.

ODONATA CENTRAL, A HUB FOR THE DISTRIBUTION OF NEW WORLD ODONATA

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Odonata Central (http://www.odonatacentral.org) is a web site sponsored by the Texas Natural Science Center at the University of Texas at Austin that relies on the novel incorporation of existing World Wide Web, database, and geographic information system (GIS) technologies to produce a truly dynamic, set of distribution maps, interactive field guide and web site for the dragonflies and damselflies of North America. At the heart of OdonataCentral lies the North American Dot Map Project. Started in 1994, the project involved the efforts of more than 100 contributors from the Odonata community to accurately document and amalgamate the distributions of all North American odonate species through 2004. The result was more than 124,000 county-level records for the United States and Canada. The original OdonataCentral, a field guide to the odonates of the south-central United States, was integrated with the Dot Map Project data and re-launched. We are now actively pursuing funding to expand the primary coverage to all of the New World as part of the on-going Global Dragonfly Assessment project. I will discuss the history of OdonataCentral, the current plans to incorporate the New World Tropics and how the website will ultimately fit into the Global Dragonfly Assessment.

DATA-BASING AND DISTRIBUTION PATTERNS OF AUSTRALIAN DRAGONFLIES

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Lists are given of the Australian dragonfly collections that have been made available electronically and of those yet to be data-based. Distributions of Australian dragonflies are discussed. There are f. e. widespread Asian species largely confined to the north, a limited number of these and some other species colonizing the dry interior, and endemics with south-western or eastern distribution, many of the latter confined to higher altitude areas (mountain ranges) of various sizes and often separated from their nearest allies by lower altitude areas. Examples for these common distribution patterns are given from several families. A few small and unusual areas of endemism are pointed out.

DISTRIBUTION PATTERNS OF DRAGONFLIES: STATE OF KNOWLEDGE IN THE NEOTROPICAL REGION

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The Neotropical region is the richest in Odonata housing almost a third of the world's total number of described species. The state of knowledge of the taxonomy of the order, literature, researchers, and collections in the region is summarized, and information from an existing database is outlined. During the last five years 93 new species and 11 new genera, and the larval stage of 90 species have been described from this region, and several revisions and identification guides have been published. The existing database currently contains over 15,500 entries including 1,150 species, which represent 66% of the described species for this area. It includes complete distributional data for a third of the total number of its described species. From these, 70% are known from 10 or less localities, and only a few are widely distributed. Steps needed to complete the database are discussed.

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TEMPERATURE DEPENDENCE OF EMERGENCE: A MODEL BASED ON LONG-TERM FIELD DATA

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Precise models for the phenology of different species are essential for predicting the potential effects of any temporal mismatch of life cycles with environmental parameters under different climate change scenarios. In Odonata the emergence is a sensible part of phenology. We investigated the effects of ambient water temperature on the onset and synchrony of emergence for a widespread European riverine dragonfly, *Gomphus vulgatissimus*. Long-term field data on the annual emergence from two rivers in northern Germany, and additional data from a laboratory experiment with different temperature regimes, were the basis to develop a model that predicted the onset of emergence by using mainly the temperature sum as a parameter. Model predictions fitted the observations and could be transferred between localities. This was particularly so when weighting early winter temperature data by using a day length and a temperature-response function, implying potential additional control mechanisms for the onset of emergence. We simulated the effects of different winter temperatures on the emergence curves in order to predict the effects of climate change using an accelerated life model. These indicated an acceleration of emergence by 6–7 days per 1°C temperature rise and it is comparable to most phenology data published for dragonflies so far.

SEASONAL CHANGES IN BODY SIZE, SEXUAL SIZE DIMORPHISM AND SEX RATIO IN AN ODONATE COMMUNITY

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In a community of territorial and non-territorial odonates we tracked changes in emergency time and body size of both sexes at emergence, both along the season. Our predictions were that a) size would decrease along with the season, b) there would be a trade-off between size and early emergence, c) males would be larger than females in territorial zygopterans; the reverse would occur in non-territorial zygopterans, while no sexual size dimorphism (SSD) would be found in anisopterans, and d) there would be more females than males in territorial species, whereas in nonterritorial species the sex ratio will be biased towards males. For this, we studied 14 odonate species located in the Columbia National Wildlife Refuge (USA) in 1999. Body size in nonterritorial species decreased in both sexes, which was not the case for territorial species. In non-territorial species, females were larger than males, but there was no such difference for territorial species. SSD did not decrease along with the time season in all species, except for *Erythemis collocata* in which this trait increased. Finally, in the majority of the species they did not show biases in sex ratio. These results indicate different selective regimes according to mating system.

SEARCHING THE LIMITS OF ODONATA BIOLOGY: A FIRST COMPARISON WITH EPHEMEROPTERA

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The insect orders are marked by general morphological as well as biological characteristics. Therefore, research in the different orders often follows very different lines and traditions. A comparison with other insects may help for a better understanding of the Odonata themselves.

My approach is to define general differences between Odonata and Ephemeroptera, and to find similarities between them. This comparison may help to think about principles and adaptations previously unknown to be realized in odonates. An example: Many mayflies emerge floating from the water surface. Dragonflies emerge from substrates at or above the water surface. So far, some gomphids are known to have a characteristic which is not far away: they emerge half-floating, fixed to a stone with one or two legs. Is there any dragonfly able to emerge from nothing else than the pure water surface.

THE DIURNAL ACTIVITY OF ADULTS OF *CORDULEGASTER BIDENTATA* IN THE FLIGHT PERIOD

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Cordulegaster bidentata Sélys, 1843 is a European species occurring in the hills, where it inhabits forest spring areas and very small streamlets. In the Czech Republic, the centre of occurrence of the species is in the Western Carpathian Mts. The study area lies in the Moravskoslezské Beskydy Mts. (Ostravice village - valley of Mazák, altitude 680 m a.s.l.) in the eastern part of the Czech Republic. The spring area and contiguous streamlet (with total length of 70 m) are in a small valley in a large complex of forests (stemwoods). The population – the course of eclosion and abundance of imagoes - was noted from 18.V. to 5.IX in approximately 10-day-intervals. Daily observations took place from 9.00 till 19.00 (CET). All exuviae were collected on observation day, imagoes were marked and released during flight days. Totally there were 12 control days with 10 positive (with finding of exuviae or imago). The eclosion was found from 1.VI. to 22.VI. Totally there were found 58 exuviae during 29 days. The most numerous exuviae were noted during first June days. The flight of imagoes was observed from 22.VI till 19.VIII. Totally there were found 63 males and 14 females (during the individual control days we marked 12-8-18-11-12-1-1 males and 3-1-3-5-1-1-0 females respectively). Diurnal activity of males was recorded from 9.45 until 18.50, when the locality was shaded or their flight was ended by a sudden change of weather. Rapid decrease of imagoes abundance after the occurrence of first autumn night (in 9.VIII.) was an interesting find, when the temperature decreased to 4ºC during night.

BRANCHED SETAE ON LARVAL FEET - WHERE, WHY AND HOW COME?

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Branched setae are described from larvae of a number of genera both in Zygoptera and Anisoptera. They are mostly present on tibiae and feet; their numbers and shape varying between species. Also their numbers and morphology differ between front, mid and hind legs. They have different morphology; the three-tipped variety seems most common, but two tipped, multi-tipped and feather-shaped branched setae are described. I surveyed the presence of branched setae against known phylogeny and ecology using both literature and SEM-studies of larval material from Europe, Africa and Central America. The higher number of branched setae in species originating or living in muddy or otherwise particle rich environments indicates their origin as an improved cleaning device (in relation to normal, one-tipped setae). In a few species with special habitat choice (container or phytothelmata dwellers) evolution has favoured the formation of highly specialised eye-cleaners.

THE LAST INSTAR LARVA AND EMERGENCY PATTERN OF *ERYTHRODIPLAX FERVIDA* (ERICHSON, 1848) (ODONATA: LIBELLULIDAE) IN LAS CUABAS, SANTIAGO DE CUBA

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The last instar larva of *Erythrodiplax fervida* is described for the first time and illustrated from individuals collected in a pond at Las Cuabas, Santiago de Cuba. The emergency pattern of the larva is also characterized, along with the substrate, position and distance from the water. The emergency period was detected between May and September, most commonly between May and June. The most used macrophytes as emergency substrate were *Eichhornia crassipes* (Mart.) Solms and *Paspalum distachyon* Poir. The most frequently used plant organ was the underside of leaves, in vertical position (75.5 % of individuals). The average distance from the water where the exuviae were found was 10 cm, although some individuals were found floating on the water (N=4). Females were more frequently observed than male specimens.

Posters

Abstracts

Session 1

COMPOSITION AND STRUCTURE OF A DRAGONFLY ASSEMBLAGE IN A MARSH IN SAN JUAN TOCAGUA, DEPARTMENT OF ATLANTICO, COLOMBIA

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The composition and structure of an odonate assemblage was studied in the San Juan de Tocagua marsh, Departament of Atlántico, Colombia. Collection of imagos was carried out from September 2006 to March 2007 in three transects (500 m length each) located along the marsh shore. The assemblage was constituted by 38 species from 26 genera and four families. 15 species were present during both, the dry and the wet seasons. Species richness was constant during the sampling period; however, there was a slight increase during the drought period (36 spp). This, although unexpected, is probably due to the intense drought that affected most neighboring fresh water habitats during throughout the season. Thus, the San Juan marsh could act as a "refuge" for at least some species.

DISTRIBUTION AND PHENOLOGY OF ODONATA LARVAE IN SOUTHERN SHALLOW FRESHWATER SYSTEMS OF THE PETENES RESERVE, CAMPECHE, MEXICO

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The present study was carried out during the dry (February-May) and raining (June-September) seasons, 2008 in permanent and semi-permanent freshwater (≤ 1.5 ‰) wetlands of the Petenes reserve. Odonata larvae were collected using dip nets in the rifle areas delimitated by a throw trap that was randomly diploid (1 m^2 sampling area). At the same time physicochemical variables were recorded (pH, temperature, salinity, turbidity, conductivity, STD, speed flow and depth) and macrophyte coverage. We collect a total of 236 larvae representing 8 families and 24 generous, from which 18 belong to Anisoptera and 6 to Zygoptera. The highest diversity was recorded in the permanent/lotic systems during the dry season, decreasing during the flooding months. Libelullidae and Coenagrionidae were the most diverse families while *Argia* (12 ind./m^2), *Dythemis* (8 ind./m^2) and *Erythemis* (4 ind./m^2) were the most abundant genera. Multivariate analysis by CANOCO determined that variables such as speed flow, turbidity, depth and substrate composition (muddy, rocky and leaf litter) strongly influence larvae distribution. The present study analyzed Odonata larvae in water bodies of the Petenes reserve for the first time. However, further research is necessary to describe species composition and distribution in the entire reserve as well as to design conservation strategies.

Session 1

ORGANIC ENRICHMENT AND THE PHYLOGENETIC DIVERSITY OF ODONATA LARVAE IN THE HUEHUEYAPAN RIVER, COATEPEC, VERACRUZ, MÉXICO

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Two sites on the Huehueyapan River, La Marina (low enrichment) and Las Puentes (high enrichment), with different degrees of organic enrichment were compared over a one-year period. Twenty physicochemical parameters were evaluated at each site. The majority of parameters at Las Puentes showed a larger variation range, although only five parameters (dissolved oxygen, conductivity, orthophosphates, ammonium, and turbidity) showed significant differences (Mann-Whitney U-test, $p \leq 0.05$). Most of the values, with the exception of dissolved oxygen, were highest at Las Puentes. Odonate larvae were sampled from riffles, runs, and pools, and from select habitats such as rocks, cobble, gravel, sand, silt, aquatic macrophytes, root mats, and leaf packs. A total of 12 species and one morphospecies were identified. Twelve and 11 species were collected at La Marina and Las Puentes, respectively. No difference in the number of species per month between sites was found ($t=-0.49$, $p=0.63$). Examination of Taxonomic Distinctness (Δ^+) and its variation (Λ^+) showed no differences between sites, indicating that the chosen water quality parameters were not of sufficient magnitude to affect odonate phylogenetic diversity (as measured by taxonomic distinctness) in this stream.

PRELIMINARY REVIEW OF THE ODONATA FROM ANTIOQUIA (COLOMBIA)

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The Antioquia department is located at the northern Central Andes of Colombia, and it has an extension of 63612 km^2. Its territory comprises three biogeographical subregions that cover altitudinal zones from 0 to 4080 meters above sea level: the Andean, the Choco and the Magdalena. For this department, as well as for the most part of Colombia, the Order Odonata is poorly known, with very few studies about its diversity. This work is one of the first attempts to know the richness of this group of insects in Antioquia. Adults of dragonfly and damselfly deposited in the entomological museums MEFLG, MEPB and CEUA, were taxonomically revised. Specimens collected since 1945, were identified. Those were distributed in 63 genera and 13 families: Aeshnidae, Gomphidae, Corduliidae, Libellulidae, Polythoridae, Calopterygidae, Lestidae, Perilestidae, Megapodagrionidae, Coenagrionidae, Pseudostigmatidae, Protoneuridae and Platysticitidae. Distributional maps for the genera are provided.

Session 1

ODONATA DIVERSITY FROM SIX LOCALITIES WITH TROPICAL DECIDUOUS FOREST IN MEXICO

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The Tropical Deciduous Forest (TDF) is one of the most diverse ecosystems in America, but also one of the most endangered. In Mexico, it covers almost 8% of the country's surface with many endemic species included in it. As part of a project to study the insects associated to the TDF in Mexico, odonates were collected in these habitats since 1997. Here we present the results of a study of the Odonata assemblages associated with six TDF habitats at different localities of Mexico. The study sites are located in the states of Sonora (San Javier), Jalisco (Chamela), Colima (Ixtlahuacan), Morelos (Huautla) and Oaxaca (Dominguillo and Huatulco). The number of species recorded for the six sites was 123. 18 spp. (14.6%) were present in all localities while 33 (26.8%) were exclusive to one single locality. Chamela was the richest (79 spp.) and most diverse locality (H': 1.677) while Dominguillo was the poorest (45 spp) and least diverse locality (H':1.238). No endemic taxa were found in any of the individual localities nor in the whole portion of the TDF habitats studied. The total richness recorded for the six sites is lower than that recorded for one site covered with Tropical Rain Forest (Los Tuxtlas). A cluster analysis for the six odonate communities is presented.

ODONATA DIVERSITY IN AN ELEVATIONAL GRADIENT IN CENTRAL MEXICO

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Odonata survey was conducted along an elevation gradient (351-1960 m asl) in Estado de México, in Central Mexico (18°40'4''N, 100°34'48''W; 19°2'7''N, 99°59'47''W). Sampling was made in nine streams comprising three periods: dry, rainy and post rainy seasons, during five collecting trips by two people along 2008. The study area comprised tropical deciduous forest, oak-pine forest and pine forest. Specific richness (as species number, α diversity) for each site was obtained, and species accumulation curves for each locality and the whole landscape were generated using Estimates 8.0 software. The species turnover was assessed by Whittaker's beta diversity index (βw). All the study area yielded 1257 specimens belonging to 75 species, 35 genera and 10 families. The highest richness (α diversity) was found in both Los Cuervos and Acamuchitlán localities (37 each one), while the lowest richness corresponded to Real de Arriba (11 spp.). The lowest turnover (beta diversity) was found between Los Cuervos and Acamuchitlán (βw= 1.3), and the highest one between Río San Felipe and Real de Arriba (βw= 2.14). We report 61 new records for Estado de México, increasing the previous report from 26 species to 74 species for this state. We concluded species diversity was higher at middle altitudes, while maximum turnover occurred between tropical deciduous forest and pine-oak forest.

Session 1

A QUANTITATIVE STUDY OF ODONATA LARVAE ASEMBLAGES FROM SIERRA DE COALCOMAN, MOUNTAINS, MICHOACÁN, MEXICO

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Five Odonata larvae assemblages from Coalcomán Mountains (CM), Michoacán, Mexico, were studied. Two samplings for each year's season were carried out. Simultaneously, pH, temperature, dissolved oxygen and conductivity was recorded, as well as gradient, width, depth, velocity and discharge. Sampling was stratified in shores, riffles, runs and eddies. All the larvae were identified and quantified to the species level. Richness and composition were used to describe and compare the assemblages through several indexes. Theoretical richness using non-parametric and parametric methods was estimated. A total of 12,245 larvae belonging to 75 species 28 genera and 8 families were recorded from 380 samples. At large scale, the dominant species at CM were *Erpetogomphus elaps* (24.8%), *Macrothemis pseudimitans* (12.2%), and *Argia pulla* (10.2%), with a high number of rare species (76%). Whitaker's equation showed beta diversity is an important component of gamma diversity in CM. The CM larvae assemblage represents the largest one reported for Mexico up to now. These results support some previous proposals on the CM as a high rich area for conservation.

DISTRIBUTION OF THE GENUS *POLYTHORE* (ZYGOPTERA: POLYTHORIDAE), INCLUDING NOTES ON HABITAT PREFERENCES WITHIN THE GENUS

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The genus *Polythore* belongs to the super-family Calopterygoidea and is a recent genus of dragonflies in South America. The genus comprises a total of 21 species (with at least one other species description pending), the distribution of which is confined to the north-west of South America.

All species occur in Peru on the eastern slopes of the Andes with 16 species in the central region, 8 in the northern area (however, of these only 4 are found north of the equator), 3 species on the Andean slopes between 15 and 20 degrees south, 9 species in the Upper Amazon area as well as 4 species in the central region. *P. gigantea* and possibly also *P. procera* are special cases as the two are also found west of the Andes in Ecuador.

Six biogeographical assemblages can be distinguished on the basis of these distributions. The highest diversity of species is found between 72.5 and 76 degrees W and 9 and 13.5 degrees S which appears to indicate this area as a centre of differentiation. This region of the Andes adjoins the Sira Mountain area, which is a region of high endemism and is considered by many as an evolutionary refuge. Thus, it is possible that this area is the centre of origin from which the genus radiated.

Present observations indicate that all species of *Polythore* are forest-dwelling. Most of the species prefer shaded rivulets or forest creeks as reproductive habitat. Some species are also found in vertical trickles of water with a permanent "film" of flowing water at the edge of waterfalls and in forested seeps.

Session 1

ALLOMETRY AND SEXUAL SELECTION: SEASONAL CHANGES IN TWO SEXUAL TRAITS IN THE AMERICAN RUBYSPOT

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Static allometry is a useful tool to study the processes of selection behind the expression of a sexual trait. According to this tool, it has been hypothesized that pre-copulatory sexual characters should show positive allometry unlike post-copulatory sexual traits which should show negative allometry. We have investigated whether these ideas apply to two sexual traits in the American rubyspot, a species that exhibits a lek mating system: the wing spot (a trait that is selected via male-male territorial competition: males with larger spots are more likely to win disputes) and aedeagal width (a trait that is selected during copulation: the wider the aedeagus, the higher the sperm competition success). Previous studies in this population have indicated that both traits show seasonal changes. When expression of both traits was larger, we detected positive allometry (4.489) for the spot and negative allometry (0.368) for aedeagal width; when expression was lower, there was extremely low negative allometry (-16.896) for the spot and negative allometry (0.301) for aedeagal width. Thus, the spot was a more variable character as it probably relies more on the animal condition, a situation that is unlikely to apply to aedeagal width. These results are congruent with sexual selection models.

DRAGONFLIES VS. FISH: INTERACTIONS BETWEEN COMMUNITIES IN SWEDISH LAKES AND PONDS

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Some fish-free waters are known to harbour high numbers of dragonfly species. The presence of fish, on the other hand, affects the dragonfly community, changing abundance, survival rates and niche availability of dragonfly species. But fish are not simply “fish” - there are many fish species co-occurring with dragonflies, each one with a specific ecology; living on different trophic levels in the lake foodweb. We explored the dragonfly community composition in a dataset of 134 lakes and ponds from south to north in Sweden, for which the fish community was known. Using discriminant analysis we could distinguish three clear groups of dragonfly communities, equivalent to lakes with zero, three and four trophic levels of fish. There were very few lakes with only one or two trophic levels of fish in our material for any pattern to occur. Further analyses revealed dragonfly species indicative for each of the three groups, e.g. *Lestes dryas* and *Sympetrum flaveolum* in fish-free waters; several species of *Leucorrhinia* in lakes with three or four trophic levels. Dragonfly species composition in lakes is discussed in relation to their ecological preferences and the presence or absence of 22 species of fish.

Session 2

THE NEOTROPICAL DAMSEFLY GENUS *CORA*: NEW LARVAL DESCRIPTIONS AND A COMPARATIVE ANALYSIS OF KNOWN SPECIES (ZYGOPTERA: POLYTHORIDAE)

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The damselfly genus *Cora* has 23 Neotropical species, making it the largest genus in the family Polythoridae. The largest species diversity is found in South America and only 6 species have been reported for Central America and Mexico. *Cora* is a forest-dwelling group; most species appear to prefer small streams with dense riparian vegetation and shaded channels. Larvae can be found in well-oxygenated habitats (e.g., riffles and runs), where they tend to prefer rocky substrates. The larval stages of *Cora* are poorly known, only three species are known as larvae: *C. chirripa chirripa* Calvert, *C. cyane* Selys, and *C. marina* Selys. In this study, we present the description of the larvae of *C. skinneri* and *C. semiopaca*. All known species in the genus have scaly bodies, lateroventral gills in the abdomen and large, sack-like caudal gills that are connected to the abdomen by a small petiole. Larval stages can be identified to species using characters present in their caudal gills. Gill shape and the form and number of protuberances on them are all useful characters for species identification. Variability on gill characters was assessed using specimens of *Cora* collected at different locations in Costa Rica, but not reared to adult.

PREDATION OF ODONATES BY THE BAT *MACROTUS WARTERHOUSEI MINOR* (CHIROPTERA: PHYLLOSTOMIDAE) IN CENTRAL CUBA

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The current paper aims to review and to increase the knowledge about the predation of dragonflies by the bat *Macrotus waterhousei minor* in Central Cuba. I also want to demonstrate that in Cuba, as in other West Indian islands, this insectivorous bat consumes many species of odonates. The samples were obtained in the nocturnal resting sites and diurnal roosts of this bat species, located in eleven caves of the Sancti Spíritus province. I collected all the wings of odonates (entire or fragmental) found in these sites. We detected 20 species of odonates that are consumed by *M. waterhousei minor*; all species except one were anisopterans, and from these, 75% were libellulids. Two species, *Orthemis ferruginea* and *Pantala flavescens*, were present in 90% of the sampling sites, while *Gynacantha nervosa* were present in 70% of the sites. A fourth species, *Erythrodiplax umbrata*, very common in Cuba, was found in 50% of the sites. The fact that up to 90% of the dragonflies consumed by this bat are diurnal, suggests that they were captured while they were resting on vegetation.

Session 2

THE ROLE OF THE RED WING SPOT ON MALE TERRITORIAL CONTESTS IN *HETAERINA AMERICANA*

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Adult males of *Hetaerina americana* bear red wing spots at the base of the wings. Individuals with larger spots are more successful in territorial competition and obtain more copulations. The territories, for which males compete, are leks where females arrive to copulate and its possession is decided by aerial contests. Previous works have hypothesized that the expression of wing spots may be used to settle contests. In this work we tested this hypothesis. Our predictions were that (1) males with larger spots will win more contests than males with smaller spots and (2) the greater the difference in spot size between contesting males, the shorter the contest duration. Male contests were observed in the Amacuzac River in Tehuixtla, Morelos, Mexico. Individuals were marked and photographed, and contests among these individuals were recorded. We found that males with larger spots won more contests that those with smaller spots. We also found that when the differences between spot areas were small, contests lasted longer than when spot differences were larger. These results support the hypothesis that the spots are a communication mean to settle territorial disputes in this species.

A PECULIAR DAMSELFLY LARVA FROM AUSTRALIA

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Damselfly larvae recently discovered in Queensland, Australia, were found unidentifiable by using the relevant keys. Discussed are their morphological characters, reason for peculiarity, identification, affinities, ecology and the prospects for collecting the adult. The available material is listed and maps of the known localities are presented.

OVIPOSITION FREQUENCY AND EMERGENCE OF *PROTONEURA CAPILLARIS* (RAMBUR, 1842) (PROTONEURIDAE: ODONATA) IN DOS BOCAS, SANTIAGO DE CUBA

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The flying season of *Protoneura capillaris* at Dos Bocas stream, Santiago de Cuba is described. The presence of couples ovipositing was recorded once a month from June 2005 to May 2006. Seven days of observations were carried out in both February 2006 (dry season) and May 2006 (rainy season). There was sexual activity all the year along. However, the number of couples and teneral individuals was higher in May than in February. These results suggest that variation in population abundance may be related to seasonal changes.

ODONATA DIVERSITY IN FOUR LOCALITIES OF THE HIGH ANDEAN FOREST OF SANTUARIO DE FAUNA Y FLORA DE IGUAQUE, BOYACÁ, COLOMBIA

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Alpha and beta diversity were surveyed in four localities of the Santuario de Fauna y Flora de Iguaque, Boyacá, Colombia, between an altitudinal gradient of 2500 to 2900 MASL. Collections were made during three months covering a transitional period between drought-precipitation, high precipitation-drought, during September, November 2008 and February 2009, respectively. Collections were made from 10:00 to 16:00 h using aerial nets and D-net for adults and larvae respectively. A total of 56 adults and 11 larvae were captured, distributed in four families, six genera and seven species. *Hetaerina fuscoguttata* and *Ischnura chingaza* were reported as new records for the zone. Locality and period samples with higher diversity was La Colorada stream (Locality 2) with H'=1.39305 and was transition with H'=1.54660, respectively. The localities with more similarity were La Colorada stream (Locality 1) and Chaina stream (Locality 3) with 66%. *Cyanallagma ovigerum* was predominant with 32.14% and *Ischnura chingaza* was rare with 1.78% in all localities. Odonate fauna of high Andean forest is an important contribution to the knowledge of the species for Colombia, because it represent a 20% to the genus level, for this reason, is very important to continue with studies on the diversity and ecology of odonates in this area for future conservational plans.

AQUATIC PLANTS AS EMERGENCE SUBSTRATE FOR ODONATE LARVAE IN LAS CUABAS, SANTIAGO DE CUBA

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Odonate larvae use several substrates for emergence, among which aquatic plants play an important role. A list of such plants from a permanent pond at Las Cuabas, north Santiago de Cuba is presented here. A one year survey between August 2007 and August 2008 yielded 288 exuviae. The distance from the water, position and location of the exuviae on every plant was recorded. Twenty species of aquatic macrophytes were found in the pond, classified as submerged (2), floating (5) and rooted emergent (13). Twelve of these species are used as emergence substrates among which *Eichhornia crassipes* (Mart.) Solms and *Typha dominguensis* (Pers) Kunth are the most frequently used. Of the 31 species of odonates flying at Las Cuabas, 28 develop their larval cycle in the pond. The most abundant species are *Tramea abdominalis* (Rambur, 1842), *Telebasis dominicanum* (Selys, 1857), *Crocothemis servilia* (Drury, 1770) and *Coryphaeshna adnexa* (Hagen, 1861). The most used part of the plant was beneath the leaves and mostly on vertical position (63.5 %). The distance from the water varied in both suborders, being the anisopterans the ones which emerge further out.

THE COMPOUND EYES OF *ERYTHRODIPLAX BERENICE* (ODONATA: LIBELLULIDAE) AND *GROMPHADORRINA PORTENTOSA* (BLATTODEA: BLABERIDAE): A COMPARATIVE STUDY

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This comparative study assesses the differences between the compound eyes of *Erythrodiplax berenice* (captured in Zihuatanejo, Mexico) and *Gromphadorrina portentosa* (from the FES Iztacala's vivarium). The heads of certain individuals were fixed in formaldehyde at 4% dilution for their treatment using a conventional histological technique. The rest of the heads were processed for their analysis using scanning electron microscopy. The eyes of *E. berenice*, (a species with stereoscopic vision), were more developed and covered a larger area of the head than those of *G. portentosa.* In the former species, there was a larger amount of omatides, while the facets showed a well defined hexagonal shape –the larger ones located in the core of the cornea and the smaller ones on the periphery. Histologically, the omatides looked fully developed and all had the cellular elements known: in a transverse section it was possible to observe eight retinal cells. Conversely, in *G. portentosa*, an organism with no stereoscopic vision, the eyes are not fully developed and constituted a smaller proportion of the head. The omatides are scarcer and even though their facets are hexagonal it was not possible to find a good definition, due to the slightly less concave shape of the cornea. *E. berenice* is a predator that feeds on the wing and it therefore requires better sight for hunting. In contrast, *G. portentosa* is an omnivore in which highly efficient vision is not essential; this species has silk structures useful for detecting food.

DRAGONFLY DIVERSITY OF THE ARGENTINEAN CHACO

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Odonates of temporary pools, permanent ponds, and rivers were sampled in the Chaco biome of NW Argentina. Presence/absence information of species from samples and from examination of collections and literature was recorded in a spatial-relational database. Alpha, beta, and gamma diversity and total species richness expected for the area were estimated. Similarity in composition of Chaco odonate assemblages was analyzed using multivariate cluster analysis. Odonate composition of the Chaco was compared with that of neighboring Yungas and Paranense biomes. Information from 95 localities yielded 88 species, from which five are new records for the country and 31 are new records for four provinces. Species composition was found to be related to both longitudinal sector and type of environment, with eastern assemblages mostly segregated from western ones, and assemblages from large permanent lentic water bodies (oxbow lakes and dams) segregated from those of rivers. Percent complementarity values show Chaco odonate composition to be slightly more dissimilar to that of the Paranense than to the Yungas adjacent areas. Odonate species found in the Chaco are more widely distributed in the Neotropical region, with only three potential endemisms.

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