

AGRION

NEWSLETTER OF THE WORLDWIDE DRAGONFLY ASSOCIATION

PATRON: Professor Edward O. Wilson FRS, FRSE

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NEWSLETTER OF THE WORLDWIDE DRAGONFLY ASSOCIATION

AGRION is Worldwide Dragonfly Association's (WDA's) newsletter, published twice a year, in January and July. The WDA aims to advance public education and awareness by the promotion of the study and conservation of dragonflies (Odonata) and their natural habitats in all parts of the world. *AGRION* covers all aspects of WDA's activities; it communicates facts and knowledge related to the study and conservation of dragonflies and is a forum for news and information exchange for members. *AGRION* is freely available for downloading from the WDA website at <http://ecoevo.uvigo.es/WDA/dragonfly.htm>. WDA is a Registered Charity (Not-for-Profit Organization), Charity No. 1066039/0.

Editorial

Keith Wilson [kdpwilson@gmail.com]

The 6th WDA International Congress of Odonatology was very successfully held in Xalapa, Veracruz, Mexico 7-12 June 2009 and afterwards a post symposium tour to various locations within Veracruz State was enjoyed by many of the conference delegates from 13-16 June. The principle organisers Rodolfo Novelo-Gutiérrez (Instituto de Ecología A.C.), Enrique González-Soriano (Instituto de Biología UNAM) and Alex Córdoba-Aguilar (Instituto de Ecología UNAM) did a great job in organising and convening the Congress. They must be warmly thanked for the smooth running of all the events despite the very real threats posed by swine flu during the preceding months. They held their nerve and ensured the conference was well attended and provided a full and varied programme. Mike Parr has kindly provided a summary report of the Congress plus the mid- and post-symposium tours for this issue. Following the conference opening ceremony, Mike gave a memorial address in tribute to Philip Corbet, the text of which is provided here. A list of Philip Corbet's Odonata publications is also provided. Other articles included in this July 2009 edition of *AGRION* include three book reviews and various accounts of odonates from many parts of the World including Africa, Australia, China, Malaysia the Neotropics, Oman, Philippines, Sri Lanka, Thailand and Vietnam.

A web-based travel report, which provides a brief summary of the Xalapa conference and the mid- and post-symposium tours has been compiled by Erland R. Nielsen. The report includes many conference photos and many excellent odonate photographs taken during and after the Congress. Erland's report can be accessed from the link provided here: [http://home1.stofanet.dk/erland_refling/danish_dragonflies.htm]. Click the menu located left, under Travel Reports, and select Mexico.

For the next issue of *AGRION*, to be published at the beginning of January 2010, please send me or Graham Reels [gtreels@cyberdude.com] your contributions. All articles, information and news items related to dragonflies or of interest to WDA members are most welcome and will be considered for publication. Please send a Word file by email (preferably) or on disk by post. Please do not forward any original artwork but send a soft copy, ideally in a compressed format e.g. 'jpeg' or 'gif', or as a file on disk if sent by post.

In keeping with the practice adopted for WDA's official organ, the International Journal of Odonatology a dragonfly photo now appears on the front cover of each issue of *AGRION*. If you have a photo illustrating any rarely observed aspect of dragonfly biology, or an unusual species, or simply a stunning dragonfly shot, please submit it for consideration for publication in *AGRION*.

Message from a new member

Colin Adams [colinpauladams@gmail.com]

I am an amateur enthusiast living in Lancashire, England. My wife and I spent holidays in eastern Thailand and Hainan this winter, in my case so as to see dragonflies. So I decided to join the WDA. My website includes a blog of what I see, along with photographs. It is linked from the WDA website.

I have also created a discussion forum there for WDA members. Please email me for permission to view/post messages (you should first register a login-id on the website and then tell me what it is in your email). I hope this will increase communication between WDA members (and allow me to ask pose of questions to the professionals).

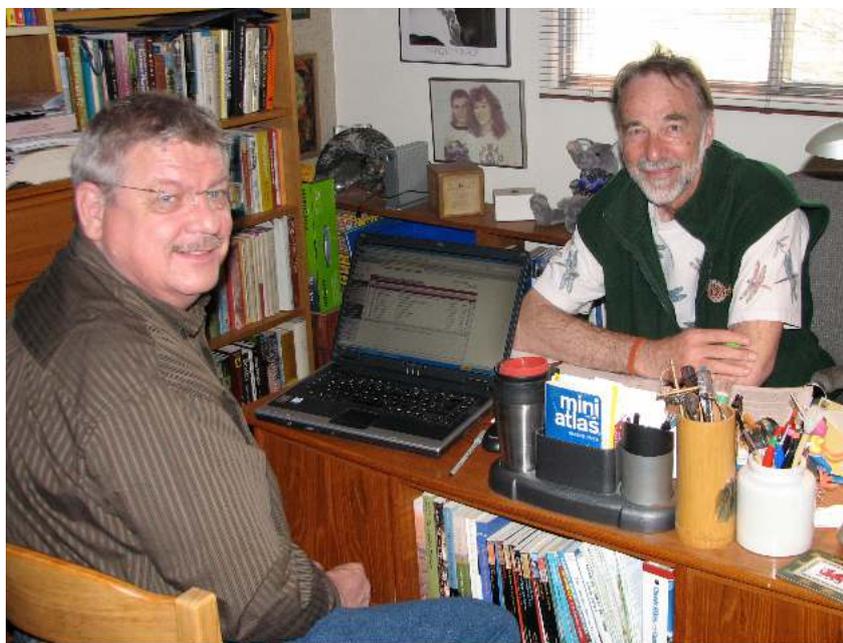
Cover photo: *Platycnemis latipes* group-oviposition, 22 June 2008, Rio Tiétar, Extremadura, Spain, taken by Erland Refling Nielsen; judged to be the winning photo for the Photo Competition held at the 6th WDA International Congress of Odonatology, Xalapa, Mexico, 13-16 June 2009.

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Message from the President

Wolfgang Schneider [wolfgang.schneider@senckenberg.de]



Calgary, May 2009: Gordon Pritchard and Wolfgang Schneider preparing the 6th BGM (Photo: Valerie Pritchard).

Although only a few weeks have passed since the 6th International Congress of Odonatology in Xalapa, Mexico, it is already time for me to address the membership. As there will be a narrative report by WDA's Inaugural President, Mike Parr, on our Mexico experience in this issue of AGRION, I will restrict my remarks to Board matters.

When Gordon Pritchard became President in Namibia in 2007, WDA entered its second decade. Under his Presidency the Board had a number of important topics on the agenda of which the "Merger" of the two international journals and the future of IJO soon became the top priorities.

As holds true for the whole of the WDA, the history of our publication outlet the *International Journal of Odonatology* is one of success: High quality papers on all aspects of odonatology, combined

with a modern layout made it attractive for many internationally recognised experts in the field of odonatology. As already reported by Gordon in his last message, there is now another reason to publish in IJO: Due to the dedication, perseverance, and professionalism of our Editor, Reinhard Jödicke, the journal became ISI listed in 2008. Reinhard's editorial team and the Board of WDA will continue to develop and secure the future of IJO.

Despite the Past President's dedicated efforts, the merger was not realised. But one positive outcome of

the intensive and time consuming negotiations is that in the future there will be only one biennial international meeting and we hope that this agreement will enable many more odonatologists to attend. Our future symposia, starting with the 2011 meeting in Japan will be named by the year only, e.g. "The 2011 International Congress of Odonatology". We shall continue the congresses as we have always done, including the Board and General Biennial Meetings as required by the Constitution.

I am pleased to inform you that for the period after Japan WDA already has two invitations, one for 2013 in Freising, Germany, by Florian Weihrauch, and one for 2015 for Colombia by Catalina Amaya-Perilla. Richard Rowe our Congress Co-ordinator will keep you informed.

I should also mention two other noteworthy upcoming events: In September Elisa Riservato will arrange for a meeting of Italian Odonatologists in Bolzano during which the Italian Society of Odonatology will be founded, and, in 2010 the first European Congress of Odonatology will be organized by Sónia Ferreira in Portugal. Stay tuned to get the latest news!

As far as the administration of the society is concerned, we had an unusual situation in early 2009 in that two members of the Board decided to retire after their names had appeared in the Board's list of nominations in *AGRION* 12(2): Linda Averill as Secretary and Viola Clausnitzer as Trustee for Conservation. Unfortunately there are no provisions in the Constitution for such situations (we have to think about an amendment and I am already working on it). One vacancy could be filled immediately by a decision of the Board following clause G3 of the Constitution: Vincent Kalkman is the successor of Viola Clausnitzer for Conservation issues. Clause G6, would have allowed the new Board to continue without a Secretary but for obvious reasons this seemed not advisable. During a meeting in May this year held in Calgary (see photograph), Gordon and I tried to solve this problem constitutionally. After extensive discussions within the Board, we asked Natalia von Ellenrieder (elected via postal ballot to the Board for 2009-2011) to accept a *pro tem* appointment as Secretary and then have this ratified through a ballot of all members of the WDA. Members present at the BGM in Mexico supported and welcomed this decision, and Natalia is already fulfilling her duties as Secretary. **Please read the enclosed ballot form and make use of your right to vote.**

I would like to avail myself of this opportunity to thank all members of the previous Board for their tremendous support to the WDA, especially to the retiring members: To Hidenori Ubukata, who served the Board for 10 years, to Linda Averill for her hard work and patience as Secretary in the last eight years, and to Viola Clausnitzer for her outstanding achievements in the field of conservation. At the same time I welcome our new Board members, Natalia von Ellenrieder, Vincent Kalkman and Mamoru Watanabe. Very special thanks go to Valerie and Gordon Pritchard for their friendship and hospitality. I spent a busy and very pleasant week at their home in Calgary in preparation for the Mexico meeting.

In his report for the 6th BGM Gordon emphasised the WDA's constitutional aims "to advance public education and awareness by the promotion of the study and conservation of dragonflies (*Odonata*) and their natural habitats in all parts of the world", and I know that I can count on your contributions and support for these aims over the next two years.

Wolfgang Schneider

Details of new members & change of addresses

Colin Adams	14 Colman Court	Preston	PR1 8DL	UK	colin@colina.demon.vo.uk
Nancy van der	17 Monkton Avenue	Toronto	Ontario	Canada M8Z	nmgvdp@netscape.net
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Stanislav Gorb	Dept Functional Morphology & Biomechanics	Zoological Inst. University of Kiel	Am Botanischen Garten 1/9	D24098 Kiel, Germany	

This is important, please read and use your vote!

Worldwide Dragonfly Association Email/Postal Ballot July 2009

Dear members of WDA,

In early 2009 our Secretary Linda Averill decided to retire after her name had appeared in the Board's list of nominations in AGRION 12(2); for details please consult 'Message from the President' in this issue. Clause G6 of the Constitution would have allowed the new Board to continue without a Secretary but this seemed not advisable. After extensive discussions within the Board, we asked Natalia von Ellenrieder (elected via postal ballot to the Board for 2009-2011) to accept a *pro tem* appointment as Secretary and then have this ratified through a ballot of all members of the WDA. **Please make use of your right to vote. If you agree please place an X next to 'YES', otherwise an X next to 'NO'; family members have 2 votes.**

.....
I agree with the Board's decision to appoint the Trustee Natalia von Ellenrieder as Secretary of WDA for the period 2009-2011.

Yes ()

No ()

1. Email your vote to wolfgang.schneider@senckenberg.de

2. For a secret postal ballot completed forms should be returned to the President of WDA (address below) before 31 August 2009.

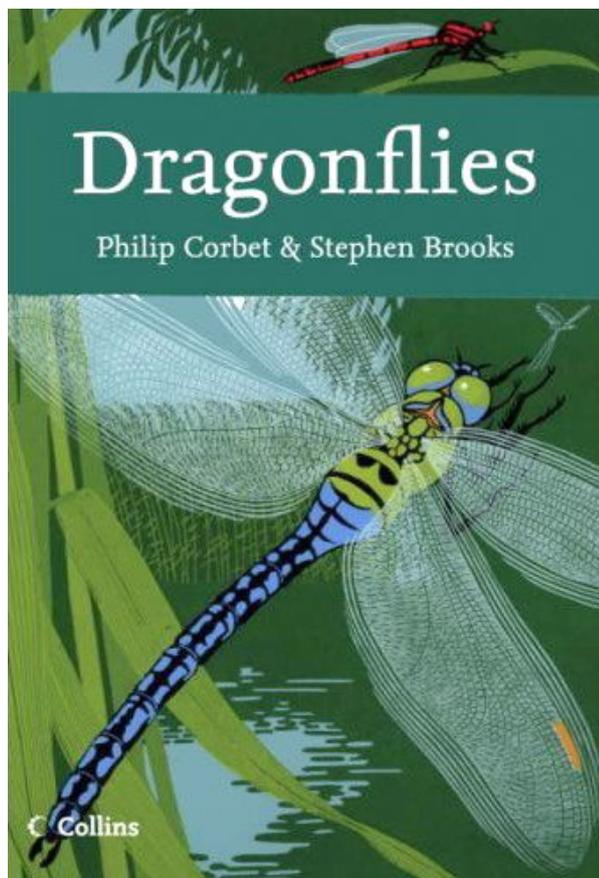
Wolfgang Schneider
Graefstrasse 51
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Germany

Book Reviews

Corbet P.S. and S.J. Brooks, 2008. *Dragonflies*
The New Naturalist Library 106. 454 pp. Harper Collins, Publishers, London.
Hardcover (ISBN-13: 9780007151684) £45, softcover £24.99

Bert Orr [agorr@bigpond.com]

The Collins New Naturalist Library began in 1945 with the publication of '*Butterflies*' by E.B. Ford (Ford, 1945).



This volume, revised in 1975 but not yet superseded, was to establish a new genre in natural history writing. The aim of all New Naturalist books has been to present to the reader an account of a well defined topic relating to the British Isles. The books seldom balk at difficult scientific concepts, but are invariably written in an easy literary style accessible to the generally educated reader. Volumes devoted to Odonata have been number 41, the initial volume titled *Dragonflies* (Corbet *et al*, 1960), and the present volume, number 106. The series has long been a target for collectors; hence the publication of any new volume is guaranteed to meet with considerable interest and brisk sales.

Dragonflies is a substantial, well-produced, octavo volume, arranged in 10 chapters with four supporting appendices, a comprehensive glossary and over 1000 citations. Although its central theme is dragonflies of the British Isles and their biology, there runs through the entire book a strong subtext supporting nature conservation. This feature is one of several which clearly distinguish this book from the original '*Dragonflies*' (Corbet *et al* 1960). However some similarity remains. As in that book, a concise introduction is followed by a long chapter dealing with the 54 species found in the British Isles. Here the entire fauna is first characterised with reference to geographical distribution (5 categories), and habitat preferences (also 5 categories). After this come species accounts, written as continuous text with adults and larvae of representative species depicted photographically. It is a great benefit to be able to write so comprehensively about a fauna as a

whole, including notes on its constituent species, without being unduly troubled by the minutiae of species identification. Several books in print already perform this function perfectly well (e.g. Brooks, 2004) and to these we are directed. Instead, each dragonfly is introduced to us in terms of its general character, its presence, its life history and its relation to the landscape. The reader gains an overview that can seldom be obtained from formulaic field guides.

The core of the book, chapters 3-9, follows almost exactly the same sequence of topics presented in Philip Corbet's encyclopaedic *Dragonflies, Behaviour and Ecology of Odonata* (Corbet, 1999). Approximately half the text is devoted to immature life stages and half to adult biology. However this is in no way a summary or précis of the earlier work. It is restricted in scope, concerning itself primarily with the biology of the species of the British Isles, drawing also on examples from Europe, America and sometimes further afield where appropriate. Therefore much detail relevant only to poorly understood tropical species is omitted, limiting the subject matter to a far more coherent and manageable body of knowledge. Moreover the style in which the information is presented is entirely different. Whereas Corbet (1999) is written in a purely technical style, with numerous subheadings, more suited for convenient reference, the prose of this book reads with fluid continuity.

The final chapter gives us a comprehensive account of odonatology in Britain past and present. This begins with a well-illustrated history, including the contributions of Thomas Mouffet (a contemporary of William Shakespeare), John Ray, Carolus Linnaeus, Moses Harris and others, ending with recent luminaries such as Douglas Kimmins, Cyril Hammond and Cynthia Longfield, all three of whom many readers will still remember personally. There follows a detailed account of the activities of the hugely successful British Dragonfly Society, with a penetrating analysis of dragonfly conservation in the British Isles, (well supported in Appendix 4 by detailed

10X10km grid-based distribution maps).

Above all, *Dragonflies* is a good read. It can and should be read from cover to cover, as much for pleasure as for information, and as with a good novel this pleasure increases with a second or third reading. The prose has a measured, unassuming elegance which is itself a lesson in style. Reading it, one becomes totally immersed in the subject. One senses always an underlying latent enthusiasm, can almost see the gleam in the eyes of the authors as they develop their theme. Occasionally they permit themselves a vivid simile – *Coenagrion* ‘like shards of the sky’ – page 42, or a brief passage of lyrical and evocative beauty – “At the first glimmer of morning light, just before the last bat returns to roost, adults begin to vibrate their wings...” – page 158. Such imagery is used with nicely judged restraint. It reaches the reader almost subliminally and never distracts from the essential factual content.

Although the book covers some difficult concepts, all technicalities are clearly and effectively explained in a series of boxes which are insinuated almost seamlessly into the body of the text. Moreover, although meticulously referenced, citations are identified by a small numeral, which can easily be traced via a key near the end of the book, but in no way impedes the flow of the text. The book is also illustrated throughout by excellent and informative colour photographs, principally by Robert Thompson, placed in close juxtaposition to the text. Also deserving special mention are several stunning shots of dragonflies in flight by Steve Cham. This said, the production is attractive, not lavish, and the colour photographs enhance and support the text, rather than creating a distraction. Importantly and presciently, every chapter is ended by a section on ‘Opportunities for investigation’ suggesting activities likely to produce fruitful research results. This book will inspire and guide useful research for the next generation of odonatologists, especially those with limited access to sophisticated scientific equipment.

The book has a very few typographical and formatting errors, which are unimportant and occur in all books. However one error in the historical account is liable to cause confusion and thus requires clarification: on page 263 William Kirby (1759-1850), ‘the father of entomology’ is credited with describing *Lestes dryas* Kirby 1890. *L. dryas* was in fact described by William Forsell Kirby (1844-1912), independently famous for his work on butterflies, dragonflies, and translation of the Finnish national epic, the Kalevala.

It is a regrettable fact that even amongst the ranks of gentle naturalists, disputes and vehement polemics of one sort or another arise rather frequently. Two current bones of contention in odonatology concern firstly, the proper English naming of the Anisoptera, or ‘true dragonflies’, for which the authors propose the neologism, ‘warriorflies’, and secondly, the morality of capturing and killing specimens for scientific purposes. The authors have chosen to meet these issues head on, discussing both at length in the introduction. My only concern is that this approach may alienate some readers from the outset. More timid authors may have judged it better to postpone a discussion of collecting until the end of the book. It would then be easy to argue, to those opposed to collecting, ‘much of what you have just read would never have been discovered without the considered capture and killing of specimens’.

But these faults, if such they are (do we need timid authors?), are very minor indeed, especially when contrasted with the immensity, the scope, the authority, and the literary skill of what will remain for generations a classic and essential reference work. If you do not approve the term ‘warriorflies’, read on. The term does not appear once in the body of the text. If you do not believe dragonflies should be collected, read on, and you will come to understand the importance of voucher specimens for effective conservation policy. If you are already an expert on the dragonflies of the British Isles, and really do know everything contained within the book, it will still be an inestimable pleasure to revisit this knowledge and see it so concisely, elegantly and masterfully organised and effectively illustrated. Most of us however, no matter how much we think we know about Odonata generally or the British fauna in particular, will find much to learn.

Finally, on a very personal note, I cannot pretend that the task of writing this review has not cost me some sadness. On the one hand, reading the book was a great delight, for everywhere it resounds with the authentic voice of Philip. Yet I cannot help but be grieved by the thought that that voice is at last stilled. Philip was working on this book on the morning of the day of his death. Surely there can be no better testament to a life lived richly and to the full. Although by then the book was nearly finished, it is inevitable that a myriad of small matters would still have had to be addressed. We all surely owe a great debt of gratitude to Steve Brooks, that he was able to bring the book to final publication on time, and in near perfect form. Looking at this volume, I am reminded of Sir Christopher Wren’s epitaph in St Paul’s Cathedral London – LECTOR, SI MONUMENTUM REQUIRIS CIRCUMSPICE (reader, if you seek his monument, look around you) – By direct analogy, I am tempted to inscribe the flyleaf of my personal copy of *Dragonflies* with these words – ‘If you seek his monument, read on’.

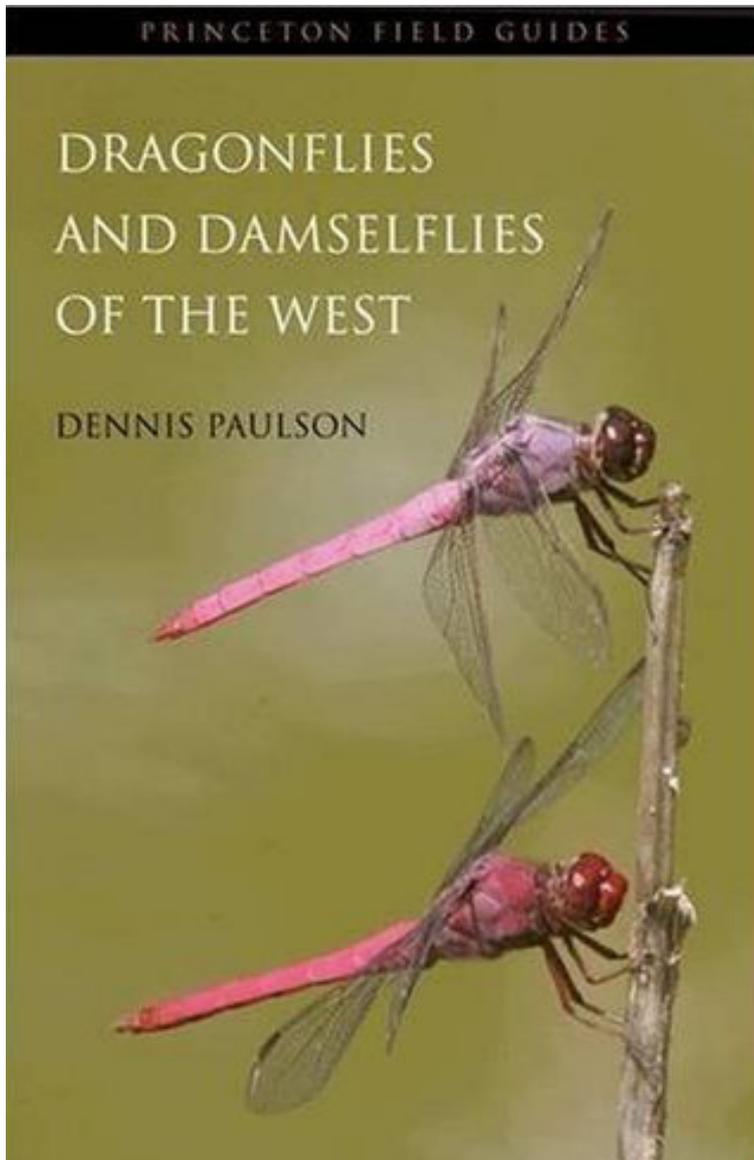
References

- Brooks, S.J., (Ed), 2004. *Field Guide to the Dragonflies and Damselflies of Great Britain and Ireland*. 4th Edition. British Wildlife Publishing: Rotherwick.
- Corbet, P.S., 1999. *Dragonflies, behaviour and ecology of Odonata*. Harley Books: Colchester.
- Corbet, P.S., Longfield, C. & Moore, N.W., 1960. *Dragonflies*. Collins: London.
- Ford, E.B. 1945. *Butterflies*. Collins: London.

Dennis Paulson, 2009. *Dragonflies and Damselflies of the West*
Princeton Field Guides. 535pp. ISBN 978-0-691-12281-6. \$ 29.95

Klaas-Douwe B. Dijkstra [dijkstra@naturalis.nl]

Naturalis, Postbus 9517, 2300 RA Leiden The flow of new odonate field guides is impressive worldwide, but nowhere more so than in North America. However, most of the production has had strong regional or taxonomic



limitations. For instance, possibly the finest (Lam 2004) and certainly the most psychedelic (Acorn 2004; *Flying Neon Toothpicks in the Grass*) odonate guides ever, dealt with Zygoptera only. Also the only comprehensive North American guide so far, the classic *Dragonflies through Binoculars* (Dunkle 2000), treated just a single suborder (Anisoptera). Even a region like Northeast Ohio, smaller than The Netherlands, boasts a sublime fieldguide, uniquely combining stunning photos and plates of all species (Rosche et al 2008). This example shows why the 'field' of so many North American 'guides' is so small: there are 71 Dutch species; this corner of the Midwest is home to the exact double. The guide for Europe, Northwest Africa and western Turkey includes only twenty species more (Dijkstra & Lewington 2006). The majority of European genera are shared with North America, but while Europeans deal with single species of *Enallagma*, *Ophiogomphus* and *Epitheca*, Americans have 37, 19 and ten to learn. Not to mention 38 vs. six *Gomphus*, 26 vs. seven *Somatochlora* and 23 vs. three *Libellula* (s.l.) species. Altogether, North America (north of Mexico) is home to 453 species of Odonata. Imagine acquiring photographs of both sexes of all of them and elaborating on all the distinguishing details...

But change is coming, and Dennis Paulson is making it happen. Even Paulson has had to split the continent in two to handle all species, but the areas covered and their species overlap is so great, that his *Dragonflies and Damselflies of the West* is the first truly comprehensive North American

guide. It treats all 348 species occurring from Texas to California and Alaska, between Hudson Bay and the Pacific. *Dragonflies and Damselflies of the East* will cover 334 species. That Paulson's West has almost double the area of his East stems from the East's much greater diversity and the desire to produce two similarly thick volumes. The present book has 535 pages and the maximum weight one wishes to carry: a continent-wide book would approach 700 pages. The book has forty pages of introductory chapters. Highlights are the sections on anatomy, explained with annotated photographs, and collecting. In Europe, collectors are increasingly treated as sadistic freaks - a trend that may develop in America also. Paulson argues that our current knowledge would not exist without collections and that much remains to be learnt. He therefore provides the guidelines to responsibly collect, preserve, label and store dragonflies: a rare but commendable feature for a field guide.

The remaining nine-tenths of the book is devoted to the species texts: just under three pages for every two species. There are short family and genus texts, introducing their diversity and main characteristics, but no tools (such as keys) are provided to guide the user to them. Instead, a more organic (and probably more popular) identification process is anticipated. Flipping through the pages, users will recognise their candidates by their

general appearance and distribution. This is facilitated by two or three excellent photographs of each species, crystal-clear maps and the strongly comparative texts. Each species has a brief description, but more important is the section that indicates exactly which species are most similar and how those should be separated. For the larger complexes, summary tables of key features and detailed line-drawings of important structures (like appendages) are given. The drawings by Natalia von Ellenrieder and Rosser Garrison are renowned for their accuracy, as demonstrated in their indispensable handbook (Garrison et al 2006). Most photographs show the animals in natural poses, which is remarkable considering the over 800 images used. Some individuals were posed, but this is indicated, and while their posture may not be natural, coloration is.

For a European, it is intriguing to compare the Holarctic faunas. Not everything is 'bigger and better' in America! For instance, while there are twice as many American *Aeshna* species, it strikes me how homogeneous they appear. None have the startling coloration of such distinctive Eurasian species as *A. cyanea*, *A. grandis*, *A. isoceles* and *A. viridis*. Species like *Lestes dryas*, *Aeshna juncea* and *Sympetrum danae* have long been known to occur on both sides of the Atlantic, but looking in this guide I wondered if 'their' *Coenagrion angulatum* and *Leucorrhinia hudsonica* differed much from 'our' *C. lunulatum* and *L. dubia*. A synonym of the former is even *C. luniferum*! For the sake of widening your odonatological horizon alone, I recommend this book, but its real impact will be in accelerating the already growing North American interest for Odonata. Knowing what to expect, we may now eagerly await *The East*. Only the almost surreal prospect of a guide for all North American Odonata, painted by Ed Lam, can trump this!

References

- Acorn, J., 2004. *Damselflies of Alberta, Flying Neon Toothpicks in the Grass*. University of Alberta Press, Edmonton.
- Dijkstra, K.-D.B., & R. Lewington, 2006. *Field guide to the Dragonflies of Britain and Europe*. British Wildlife Publishing, Milton on Stour.
- Dunkle, S., 2000. *Dragonflies through Binoculars*. Oxford University Press, New York.
- Lam, E., 2004. *Damselflies of the Northeast*. Biodiversity Books, Forest Hills.
- Garrison, R., N. von Ellenrieder & J. Louton, 2006. *Dragonfly Genera of the New World*. Johns Hopkins University Press, Baltimore.
- Rosche, L.O., J.M. Semroc & L.K. Gilbert, 2008. *Dragonflies and Damselflies of Northeast Ohio*, Second Edition. Cleveland Museum of Natural History.

Note: Discount available from Princeton (see advertisement page 97)

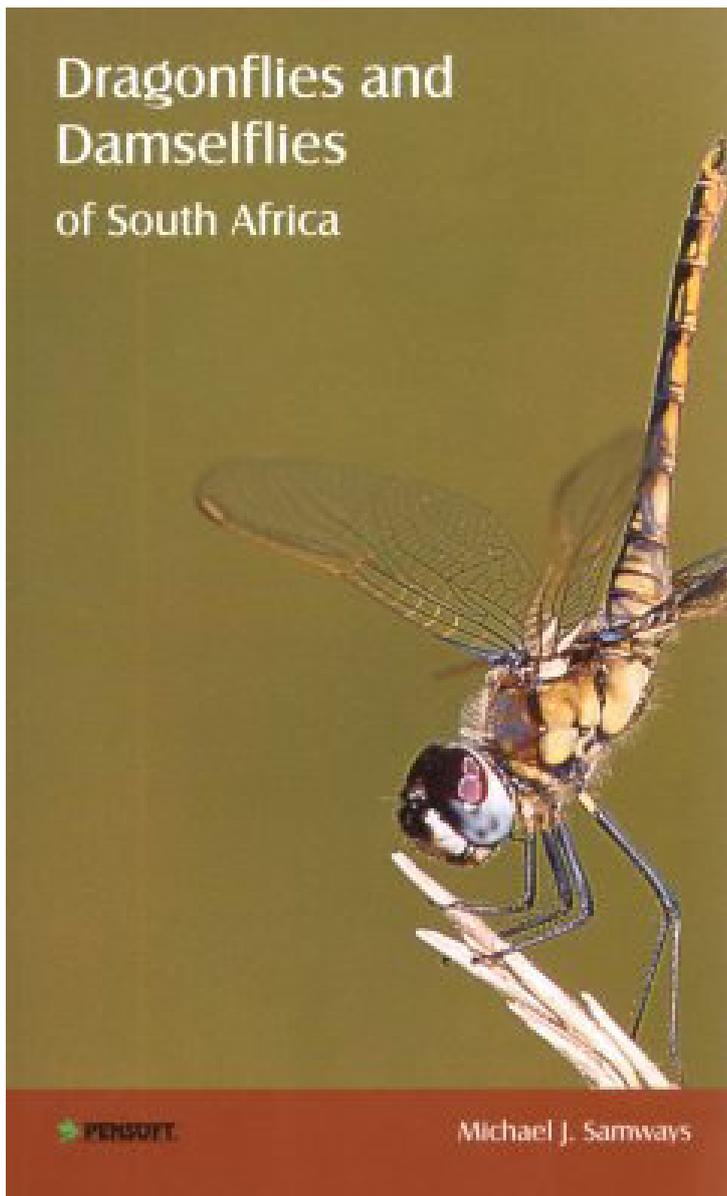
Michael J. Samways, 2008. Dragonflies and Damselflies of South Africa. Pensoft Publishers, Sofia-Moscow. 297pp. ISBN 978-954-642-330-6. € 39

Klaas-Douwe B. Dijkstra [dijkstra@naturalis.nl]

As Odonata gain in popularity with a broad public, new field guides appear like mushrooms all over the globe. After the dragonfly and damselfly volumes by Tarboton & Tarboton (2002, 2005), this is the second publication to deal with all the Odonata of South Africa. Mike Samways has been the foremost authority for the past two decades, aside from his numerous contributions to conservation biology (e.g. Samways 1995, 2005). South Africa harbours about 160 species, including almost thirty endemics. The latter are concentrated in the Cape Floristic Region - of fynbos fame - and includes nine malachite damselflies (*Chlorolestes*, *Ecchlorolestes*) and four presba dragonflies (*Syncordulia*) that appear 'Australian' rather than 'African' in their affinities. Other groups, such as the six endemic sprites (*Pseudagrion*) are part of larger Afrotropical radiations. Indeed the unique southern fauna is very different from that of the north-east (e.g. Kruger National Park) where about sixty widespread tropical species just penetrate the country. Thanks to this tropical augmentation, a book on South African dragonflies can also be useful in open areas elsewhere in Africa.

Although the book includes a checklist, glossary and brief introductions to ecology, morphology, habitats, conservation and observation of Odonata, 85% of the pages are devoted to identification. This is done with no less than three approaches: a 'quick-key', species texts and a species key. The quick-key is intended as a simple field-tool, using mainly colour characters to get on the right track. After several queries, a list of similar species is provided with two-line diagnoses and reference to the appropriate text. While this key intends to characterise the groups and relies strongly on their general appearance, it consists of fourteen pages of boxed small-print texts with just six line-drawings. Thus, while the concept is user-friendly, a more pictorial emphasis seems logical.

Next is a full page for every species chock-full of information. Each page features the vernacular and scientific names, a brief characterisation of the species, compact descriptions of appearance, habitat, distribution,



flight season and behaviour, a discussion of similar species, a dot-map of the South African range, two colour photographs (ideally one of each sex) and two line-drawings of appendages, secondary genitalia and/or wing venation. Three graphics show the Dragonfly Biotic Index (an environmental indicator scale developed by the author), flight season and size (with bars representing total and hind wing length) of every species. Understandably, such a concentration of information requires a strict and logical layout. This has been achieved, although the many headings and coloured boxes may be too lavish for some tastes. The information is accurate and succinct; some identification pointers are shown on the photos and drawings. This is useful, although it adds to the plethora of information.

Almost all photographs show the species in natural poses: a remarkable achievement considering the 320 (160 species x 2 sexes) images that ideally requires. In some cases dead, often discoloured and damaged, individuals have had to be portrayed, which have sometimes been 'posed' on a natural perch. This is not indicated and gives rather surreal results. Because of the stringent format, and in agreement with the book's tendency to profusion, seventy extra photos have been inserted after the species texts, i.e. about one for every second species (references are provided in the species text). One error has sneaked in here: what should be *Syncordulia legator* actually shows *Hemicordulia africana*. The species key, finally, is based mainly on wing venation and male genitalia. This is illustrated with scanned wings that are elaborately annotated to explain the technical characters. Also most line-drawings are reused. These, of

the author's own hand, are generally excellent, although the hamule of the pictured *Orthetrum stemmale* is distorted, concealing the hook and thus not showing the relaxed condition in that species. This may induce misidentification of a nationally scarce species of this difficult genus.

This book is an obvious labour of love, of the author as well as his collaborators. Consequently, the book has a slightly overdone feel: so much information presented in so many and such compact ways. It is therefore a great pity that such passion has been so poorly produced: the paperback is not very field-resistant and the printing is dark and blurred. To include all other information, the photographs have been kept quite small. With good print quality this would have been fine, but now many images have lost the liveliness of the subject portrayed. Samways' devotion deserved better. Hopefully the book will sell well with South Africa's booming eco-tourism (nine million tourist arrivals in 2007!) and a more luxurious edition will follow soon!

References

- Samways, M.J., 1995. *Insect Conservation Biology*. Kluwer Academic Publishers.
 Samways, M.J., 2005. *Insect Diversity Conservation*. Cambridge University Press.
 Tarboton, W., & M. Tarboton, 2002. *A Field Guide to the Dragonflies of South Africa*. Privately published.
 Tarboton, W., & M. Tarboton, 2005. *A Field Guide to the Damselflies of South Africa*. Privately published.

Additional records for Oman

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Over the past seven years that I have been living in Al Ain, United Arab Emirates, I have developed a passion for dragonflies. When I arrived, what I enjoyed most out of doors was doing macro photography of plants. I joined the Al Ain Chapter of the Emirates Natural History Group and was soon doing tramps around the oases and wadis of the Buraimi District of Oman each weekend. Buraimi and Al Ain are twin cities and, when we arrived, there was a large area of Oman that could be visited with no border formalities. Occasionally an insect of some kind would spoil my photograph of a flower, but the two resident entomologists in the group, Dr. Mike Gillett and Dr. Brigitte Howarth, would tell me what it was and something of its behaviour. After a while it became more interesting and challenging to photograph insects with the knowledge I was gleaming from my fellow members. Eventually, I settled on learning dragonflies and damselflies as a group that was relatively easy to observe and learn with a comparative wealth of information available. Vincent Kalkman's visit to Al Ain in 2007 reported in *Agrion* 12.2 raised my interest to a new level.



Photo 1: *Paragomphus sinaiticus* male at Ayn Hamran, Dhofar, Oman

wife had obtained some nice pictures of a male and female dragonfly I hadn't spotted at a coastal inlet in the east between Hadbeen and Hasik. With the resources I had at the time, the closest I could come as a species identification was *Pantala flavescens* although they were perching horizontally not vertically. The publication of *Agrion* 12.2 with Michiel van der Weide and Vincent Kalkman's records from Oman solved the problem as the photo of a *Macrodiplox cora* matched up with my wife's photographs.

With the *Agrion* article in hand and the knowledge that the wet season in Dhofar would just be completed, we headed back to Salalah at the end of the holy month of Ramadan for the Eid holiday. We were able to have a good internet connection during this visit, so each night I sent a short report with pictures of species we hadn't seen before to Vincent Kalkman and K-D Dijkstra who kindly sent back identifications. On our first day we visited Ayn Hamran and Khor Taqah. At Ayn Hamran we were able to see two species new to us and one old friend that had not been recorded in Dhofar before to the best of my knowledge. The *Agrion* pictures of *Pseudagrion sublacteum* made that damselfly easy to recognize. I also managed to net a heavy dragonfly that was foraging along the irrigation channel which K-D identified as *Tramea limbata*. A *Paragomphus sinaiticus* also showed up and was photographed (Photo 1). This may be the most southerly record of this species in Arabia. Later in the day we visited Khor Taqah. I saw a couple dragonflies I couldn't get great pictures of but the pictures were good enough for K-D to identify as *Rhyothemis semihyalina*. The most interesting find was a small red damselfly in short grass in the marsh. Since I couldn't see ovipositors on three of them, I assumed I had 3 males and 1 female. From the male and female pictures I sent, K-D sent this response: "Agriocnemis sp. both seem females to me. Schneider & Dumont (1997) report just one species from Oman: a single female *A. pygmaea* from al-Ansab lagoons, Muscat [Photo 2]. So your find is interesting. Try to find some males for the voucher. They're equally small and will also be reddish when fresh, but turn dark and eventually pruinose."

Progress in UAE and Oman has brought a border fence and new border controls, but it has also brought a much improved highway to the south of Oman and the relatively poorly explored Dhofar region. It is now possible to make the 1200 km journey from Al Ain to Salalah, the main city in Dhofar, in a day rather than the 2 or 3 days that were necessary when we arrived. My wife, Barbara, and I took advantage to that twice in 2008, first during our University break in January (12-16 Jan 2008) and then at Eid at the end of September just after the end of the *Khareef* or monsoon season (29 Sep-2 Oct 2008).

During our first trip in January, we only recognized one species as new to us, *Lindenia tetraphylla*, which Abu Dhabi ENHG member Dick Hornby had photographed in the same location, Wadi Darbat, a year earlier. There was also a red dragonfly that was seen foraging along a beach at dusk near Al Mugsayl that I couldn't identify. My

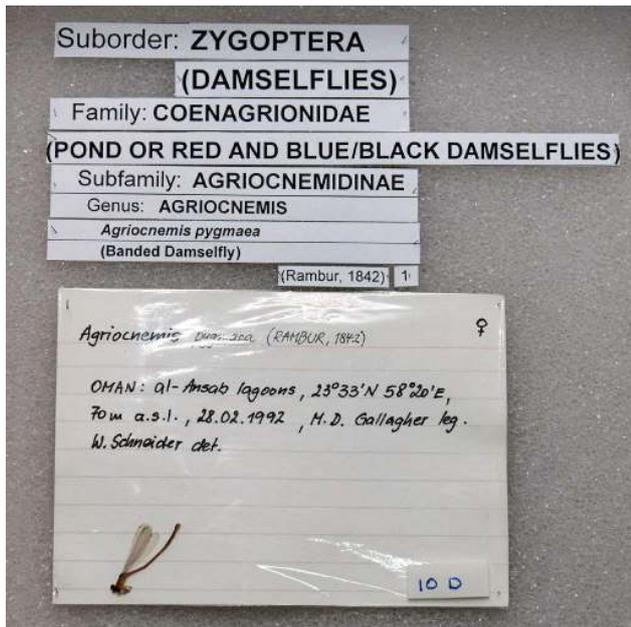


Photo 2: The only previously known record of *Agriocnemis pygmaea* from the collection of the Oman Natural History Museum



Photo 3: *Agriocnemis* cf. *pygmaea* male at Khor Taqah, Dhofar, Oman



Photo 4: *Agriocnemis* cf. *pygmaea* female at Khor Taqah, Dhofar, Oman

Our second day, we surveyed the section of Wadi Darbat reported in the *Agrion* article. Barbara quickly spotted *Nesciothemis farinosa*. While I was photographing a *N. farinosa* which we collected as a voucher, the smallest damselfly wheel I had ever seen appeared on a floating plastic bag. Unfortunately it blew away before I was able to switch lenses to photograph it. I suspect this was our *Agriocnemis* sp. Further down the lake, we also saw *Azuragrion nigradorsum* and collected a tandem pair as a voucher.

The third day, we drove to the end of the road to the east. At the time, we didn't think we'd got anything new but did get good views of *Rhyothemis semihyalina* and what turned out to be *Macrodiplax cora* mating and ovipositing in tandem in flight. The following day we visited Khor Rawri at the mouth of Wadi Darbat and returned to Khor Taqah to look harder for the *Agriocnemis* sp. We found about 6 males and 10 females within 100 m of where I had found them the first time. I collected two males and a female as voucher specimens (Photos 3 and 4).

When we returned to Al Ain, another ENHG member, Dr. Gerald Buzzell, was able to help me use the Faculty of Medicine and Health Sciences' research microscope to view one of the male *Agriocnemis* sp. Those pictures were duly forwarded to K-D and Vincent who responded that it did indeed look like *A. pygmaea*. Since Mike Gillett was visiting the UAE at that time, he set the voucher specimens from Dhofar for me and they have been added to the ENHG collection. The male *Agriocnemis* used for microscopic examination was sent to K-D for the Naturalis collection. Between my visit to Salalah and when K-D received the specimen, K-D had the opportunity to collect in Egypt and had obtained specimens of *Agriocnemis sania*. He wondered if perhaps the population in Dhofar might be *A. sania*. His opinion is that the specimen he received is *A. cf. pygmaea*. It agrees in many features with the assumed *sania* from Egypt and this implies that, once more, if populations between North Africa and tropical Asia are studied, the two might prove to be synonymous (pers. comm. K.-D.B. Dijkstra).

The beginning of December meant we had another break for UAE National Day and Eid al Fitr. We spent a few days at Sawadi Beach near Muscat and visited the Oman Natural History Museum in Muscat where I was allowed to view their Odonata collection. It was nice to be able to see almost all of the dragonflies and damselflies recorded in Oman represented in the drawers. As a result of seeing *Urothemis edwardsi* "in the flesh" with its locality information, I reviewed my photographs and believe I have some pictures of one from Dhofar that I had previously thought might be *Diplacodes lefebvreii* (Photo 6). While at Sawadi Beach, there were several dragonflies foraging around the swimming pool that appeared to be behaving the same way as the ones I saw in January in Dhofar. While I couldn't take a picture, I did get a good look at one flying around my knees and believe it was *Macrodiplax*



Photo 6: *Urothemis edwardsi* female from Khor Rawri, Dhofar, October 2008

photographed in Northern Oman keyed out as *Ischnura fountaineae*, which had not been previously recognized in Oman. A later, more detailed review of my photographs led to the discovery of earlier pictures of the species at other locations nearby in Northern Oman. Waterson and Pittaway (1991) have previously recorded *I. fountaineae* for Qatar.

I'd like to thank the Emirates Natural History Group and in particular Al Ain members Dr. Mike Gillett, Dr. Brigitte Howarth (the curator of the ENHG arthropod collection) and Dr. Gerald Buzzell, Dubai chairman, Gary Feulner and Abu Dhabi member, Dr. Dick Hornby for their help and encouragement in my study of dragonflies. Thanks to Siddiqah Ramadhan, director of the Oman Natural History Museum, and Azza Al Jabri, the keeper of the arthropod collection, for their permission to view the Oman Natural History Museum Odonata collection. K-D Dijkstra, Vincent Kalkman and Wolfgang Schneider have all been very generous with their time and sharing in-depth knowledge of Odonata for which I am very grateful.

References

- Babu, B.S., 2002. Description of Territoriality and Reproduction of *Agriocnemis pygmaea* (Rambur, 1842) (Zygoptera: Coenagrionidae) in *Current Trends in Odonatology*, A. Kumar, ed. Daya Publishing House, Delhi, India. pp. 255-272.
- Dijkstra, K-D.B. and R. Lewington, 2006. *Field Guide to the Dragonflies of Britain and Europe*. British Wildlife Publishing, Dorset. 320 pp.
- Dumont, H.J., 1974. *Agriocnemis sania* Nielsen, 1959 (Odonata: Zygoptera) from Israel and Sinai, with a redescription of the species and distributional and ecological notes. *Israel Journal of Zoology* 23: 125-134.
- Dumont, H.J., 1991. *Fauna Palaestina. Insecta V. Odonata of the Levant*. Israel Academy of Sciences & Humanities, Jerusalem. 297 pp.
- Feulner, G.R., R.W. Reimer and R.J. Hornby, 2007. Updated and Illustrated Checklist of Dragonflies of the UAE. *Tribulus* 17: 37-62. <http://www.enhg.org/trib/v17/tribulusv17P037-062.pdf>
- Schneider, W. and H.J. Dumont, 1997. The dragonflies and damselflies (Insecta: Odonata) of Oman. An updated and annotated checklist. *Fauna of Saudi Arabia* 16: 89-110.
- van der Weide, M.J.T. and V.J. Kalkman, 2008. Some new records of dragonflies from Oman. *Agrion* 12.2: 52-54.
- Waterston, A.R. and A.R. Pittaway, 1991. The Odonata or Dragonflies of Oman and neighbouring territories. *Journal of Oman Studies* 10 (for 1989): 131-168.

cora. If correct, this observation would bring the presence of that species much closer to the UAE.

Ischnura have been a problematic genus for UAE observers as for many years we only recognized *Ischnura evansi*. As a result of our discussions when we recognized *I. senegalensis* and the acquisition of more reference material, I have been paying particular attention to these damselflies especially when we realized that they could not be separated by location. I photographed several specimens that did not appear to fit in either species during March, 2009 (Photo 8). A planned trip to Frankfurt, Germany, created the opportunity to visit Dr. Wolfgang Schneider. Dr. Schneider very kindly spent many hours with us over three days, showing us specimens of Odonata that were present or expected in Arabia under the microscope, reviewing some of the literature for Arabia that wasn't available in the UAE and reviewing our photographs to confirm my identifications. The aberrant *Ischnura* that I had

Red-veined dropwings: how long do they live?

Warwick & Michèle Tarboton [wtarbotn@iafrica.com]



Photo 1: *Trithemis arteriosa* fresh male

The Red-veined Dropwing *Trithemis arteriosa* is a common and characteristic African savanna dragonfly, and virtually any sedge-fringed pond in this region will have males of this species in attendance in the summer months. Until recently, we lived on a farm in this savanna environment, 200 km north of Johannesburg, in South Africa, and in 2001, after reading about how to go about it on the British Dragonfly Society web-site, we were inspired to build a 40 m² dragonfly pond in our garden. It was planted with a selection of locally-occurring sedges, and within days these iconic dragonflies moved in, quickly becoming, and remaining, the dominant odonate on the pond. In the 2005/06 summer we decided to mark and monitor this population, and over the eight-month period (Sept-April) we caught and

numbered virtually every male that made an appearance on the pond. The number of territorial males varied monthly, peaking at about 20 individuals in February and, as a result of the steady replacement of older males by younger males, we marked 407 individuals in total, plus 25 females that came to the pond to oviposit.

When caught, each male's left hindwing was marked with a small 2- or 3-digit number, the numbers written in reverse so they appeared normal when viewed through the wing from above. The numbers were painted onto the wing using a tooth-pick dipped into quick-drying, red nail varnish (Revlon Swift-set #032), the red colour selected to match the male's abdomen colour. After being held in this way for about a minute (for the varnish to dry) the marked dragonfly



Photo 2: *Trithemis arteriosa* showing progressive wing damage compared with photo 1.



Photo 3: *Trithemis arteriosa* male showing significant wing damage

was released onto a branch next to the pond.

The perch sites used by the males (about 100) were all numbered, and we did daily, and often hourly, roll-calls of all the marked individuals in attendance, which perches they were using, and what they were doing. We had 7,766 re-sightings of marked males, recorded 122 copulations involving marked males, and we witnessed many, many territorial skirmishes. We also collected, throughout the eight months, hourly weather readings using an automatic, on-site weather station. Here we simply want to report on how long the territorial males occupied sites on the pond and what became of them.

Nearly half of the males caught (42% of 407) flew off and never returned to the pond. A few of these were subsequently sighted at other

ponds in the area but, because none of these other sites were systematically monitored, further history on these individuals' movements was not obtained. Of the 227 males that returned to the pond for at least one day after being caught, 47% continued to take up daily positions on the pond for at least 10 days after being marked, 16% survived for at least 20 days, and 4% survived for at least 30 days. Five males survived for at least 40 days, and the longest-lived males on the pond survived for 47, 48 and 50 days respectively; all these individuals were present on the pond on a daily basis. Based on age when caught, these males would have had life-spans of 54, 52 and 55 days respectively. Six of the 25 marked females were resighted on the pond, these sightings being 3, 7, 11, 14, 24 and 29 days after they were marked.

The eventual fate of males was seldom witnessed. A couple were found dead or dying on the pond, but the great majority were present one day and gone the next. What we did witness was a progressive deterioration of their wings as the males got older, and some examples of this are shown in photos 1-3. No males reached 30-35 days of age without significant wing damage (photo 3) and males older than this, although still living, were to a greater or lesser extent incapacitated and effectively excluded from the desired parts of the pond by the aggressive behaviour of younger males. Our counts showed that copulation frequency in males diminished significantly with age, and that males older than 32 days did not achieve any copulations at all. So, from a reproductive perspective, how long their lives extended beyond this age was of no consequence.

What caused the wear and tear in their wings? We witnessed literally hundreds of territorial interactions which, in the Red-veined Drowwing, takes the form of an aerial skirmish in which the two (or less often three) competitors fly rapidly around each other in tight circles ("spinning"), the defender apparently seeking to drive the intruder/s upwards (photo 5). In some instances the pair of combatants disappeared high into the air out of view and, in a few cases, males continued this energetic activity for 20 minutes or more. We also observed the fact that males frequently came out of such skirmishes with damaged wings which, prior to the conflict, were intact (photo 4). During these skirmishes it looked as if the combatants lowered their legs while spinning - were they using their legs in this way, perhaps, to inflict wing damage on the opponent?

Our conclusion from watching this charming little dragonfly is that wing wear-and-tear progresses with age, and it is largely inflicted during territorial skirmishes. Also, as males get older and more wing-damaged, they become progressively more handicapped in such contests and, even if they survive, they are eventually side-lined from the mating arena by younger males. Almost certainly the added disadvantage of deteriorating wings is a diminishing ability to both avoid predators and hunt successfully.



Photo 4: Wings observed damaged following aerial conflict



Photo 5: Defender apparently seeking to drive intruder upwards

Rediscovery of *Austrocordulia leonardi* (Sydney Hawk) in the suburbia of Sydney

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Abstract. A report is given of the rediscovery in suburban Sydney of *Austrocordulia leonardi*, a species considered as one of Australia's rarest dragonflies. Ecological information accumulated during the recent search for the species is presented and discussed.

Introduction

Austrocordulia leonardi, better known as "Sydney Hawk" (Hawking & Theischinger 2002) was described from Woronora River near Heathcote, New South Wales (Theischinger 1973). The type habitat was a river dam used for some time in the 1960-1980s as a bathing site. Several years after its discovery the species, a medium-sized (wing span 60-70 mm, body length 50-55 mm), black and yellow dragonfly, at that time considered to belong in the family Corduliidae, was found along Kangaroo Creek near Audley in the Royal National Park (Theischinger 1973; Theischinger & Watson 1978) and in the Nepean River at Maldon Bridge near Wilton where it appeared to be quite common (Theischinger & Watson 1984). Because it represented a traffic-hazard (parked cars along the busy Heathcote-Liverpool Road), the Woronora River bathing site was eliminated in 1986 by taking down the man-made weir that had provided deep cool water beneficial for swimming - and apparently crucial for the existence there of *A. leonardi*. After that the species was no longer observed at its type locality, and not much later it apparently disappeared from the Nepean River site leaving the site near Audley as the only locality where the regular observation of fresh final instar larval exuviae along the steep high bedrock banks continued to prove its survival, even though adults were never observed. A record of *A. leonardi* from near Rockhampton (Theischinger 2001) probably resulted from mislabelled material.

After a few surveys aimed at the discovery of *A. leonardi* in other locations in the larger Sydney region failed, *A. leonardi* was considered to be one of Australia's rarest dragonflies. In 2007, based on the extremely limited distribution, rarity, recent lack of detection and threats to its survival, it was listed as an Endangered Species in Part 1 of Schedule 4 of the NSW Fisheries Management Act 1994. It is also included in the category B1+2c (Critically Endangered) in the IUCN Red List of Threatened Species.

Only in recent years have a few scientific papers (e.g. Hawking & Theischinger 2004; Theischinger & Hawking 2006; Theischinger & Jacobs 2008) and popular articles (e.g. Bertola 2008) drawn attention to the seemingly disappearing *A. leonardi*. These articles, the listing of the species, and proposed developments that could impact the waterways of the region, made the present authors very determined to find if there were other sites where the species survived, and they set out to survey areas of potential *A. leonardi* habitat.

Methods and results

With the available habitat descriptions ["breite, sehr langsam fließende Flüsse und große, tiefe Tümpel in Küstennähe" (= wide, slow-flowing streams and large, deep pools near the coast) (Theischinger 1973) respectively "rivers, particularly dams" (Theischinger & Hawking 2006) and Gunther Theischinger's thorough instruction on how to best find and distinguish final instar larval exuviae of *A. refracta* and *A. leonardi* and other dragonfly species (the most effective recording method, at least for the strongly sclerotized exuviae of *Austrocordulia* species) as a basis, JM, RM and MK - walking and swimming - explored territory much of which was familiar particularly to Rob Miller from extensive flora surveys in the region. Topographic maps were used to identify deep pools with suitable aspect, orientation and slope which would provide suitable habitat for the occurrence of *A. leonardi*. Surprisingly JM and RM were able to establish that *A. leonardi* tenuously survives in the Nepean River, and JM, RM, and GT finally succeeded in finding clear evidence of the species at three new sites along the Georges River near Campbelltown in Western Sydney.

In detail the results of the *A. leonardi* surveys are as follows (identification of material by GT, conducted in the lab):

Localities and dates and collectors:

A: Australia, New South Wales, Waratah Rivulet, Pool S and marginal habitats nearby, 34.18545S/150.94689E, 27/11/2008, M. Krogh, J. Miller, G. Theischinger.

B: Australia, New South Wales, O'Hare's Creek, waterholes, 34.181956S/150.857627E, 25/12/2008, M. Krogh, J. & R. Miller.

C: Australia, New South Wales, Nepean River, Maldon Bridge, 34.20204S/150.631608E, 29/12/2008, J. & R. Miller.

D:Australia, New South Wales, Georges River, near Campbelltown, pool 1, 34.078480S/150.854880E, 03/01/2009, J. & R. Miller.
 E:Australia, New South Wales, Georges River, near Campbelltown, pool 2, 34.083978S/150.853744E, 03/01/2009, J. & R. Miller.
 F:Australia, New South Wales, O’Hare’s Creek, Pool 1, 34.19285S/150.85743E, 23/01/2009, M. Krogh, J. & R. Miller.
 G:Australia, New South Wales, O’Hare’s Creek, between Xing and Pool 2, 34.19287S/150.86065E, 23/01/2009, M. Krogh, J. & R. Miller.
 H:Australia, New South Wales, O’Hare’s Creek, Pool 2, 34.19377S/150.85888E, 23/01/2009, M. Krogh, J. & R. Miller.
 I:Australia, New South Wales, O’Hare’s Creek, pool at and near 34.164052S/150.837416E, 03/02/2009, J. & R. Miller, G. Theischinger.
 J:Australia, New South Wales, Georges River, near Campbelltown, Freres Crossing, 34.060936S/150.879248E, 03/02/2009, J. & R. Miller, G. Theischinger.

Presence/absence of species and numbers of specimens collected at localities/sites A-J

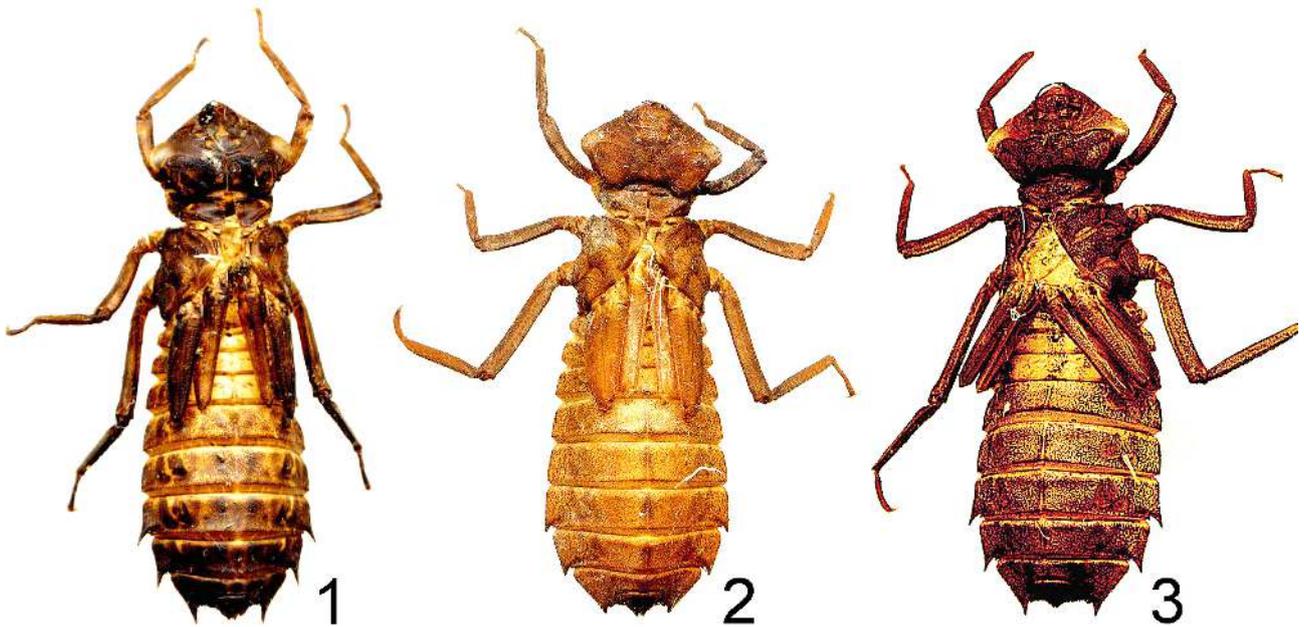
Species	Localities/sites and exuviae numbers									
	A	B	C	D	E	F	G	H	I	J
<i>Austrolestes cingulatus</i>						10	8	5		
<i>Synlestes weyersii</i>	3					4	2	8	3	
<i>Austroargiolestes ?icteromelas</i>	1			15	4	1	4		6	2
<i>Diphlebia ?lestoides</i>	2	2				1			2	2
<i>Nososticta solida</i>			3	1						
<i>Neosticta canescens</i>		7			1	2	4	2	1	
<i>Rhadinosticta simplex</i>			2	4	8		1	1	3	1
<i>Austroagrion watsoni</i>	1		2							
<i>Caliagrion billinghursti</i>			*	3	22					3
<i>Pseudagrion</i> sp.			1							
<i>Ischnura</i> sp.			1		1					
<i>Xanthagrion erythroneurum</i>							1			
<i>Austroaeschna unicornis</i>	2	2				5		11	11	1
<i>Notoaeschna sagittata</i>	8								2	
<i>Adversaeschna brevistyla</i>								1		1
<i>Austrogomphus amphiclitus</i>			35	52	76					13
<i>Austrog. ochraceus/guerini</i>	6	25		48	70	5	7	2	16	13
<i>Hemigomphus ?gouldii</i>	6	30	3	8	17	10	7	3	23	6
<i>Choristhemis flavoterminata</i>						2				
<i>Synthemistidae</i> sp.				1				2		
<i>Austrocordulia leonardi</i>			2	20	12					20
<i>Austrocordulia refracta</i>	80	30	*	21	4	42	11	15	19	31
<i>Cordulephya ?montana</i>	6	9	3	56	15	12	11	11	32	11
<i>Hemicordulia australiae</i>			7	18	82					46
<i>Hemicordulia superba</i>			1							
<i>Hemicordulia tau</i>			4	1	2			1	1	1
<i>Diplacodes bipunctata</i>	1			1						
<i>Diplacodes haematodes</i>	1		2		4				1	6
<i>Nannophlebia risi</i>	1	1	14		1	6		16	11	2
<i>Orthetrum caledonicum</i>	1								1	
<i>Orthetrum villosovittatum</i>	1				1					
Total number of species other than <i>A. leonardi</i>	14	8	15	13	15	12	10	13	15	15
Stream order	4	4	7	5	5	4	4	4	5	5
Altitude of locality (m asl)	180	200	80	50	45	220	240	240	150	40

* = known from previous collecting of GT

Discussion

The new findings of *A. leonardi* confirm some of its known/suspected ecological requirements and present at least initial and anecdotal observations on its synecology.

The detected species numbers did not differ significantly between sites where *A. leonardi* was found previously and in this study and similar localities where it was not detected. The only clearly detected difference appears to be altitudinal. Whereas the *A. leonardi* site at Audley is practically at sea level, the Woronora River site at Heathcote-Liverpool Rd is only a few m higher and Maldon Bridge bridges the Nepean River at about 80 m asl, the visited site at Waratah Rivulet is approximately 240 m asl and the sites at O'Hare's Creek are between 150 and 240 m asl. Altitude, however, does certainly not strongly affect the closely related *A. refracta* which species is known from sea level up to 1100 m (Theischinger, unpublished). It may, however, in this context be of some significance that the black and yellow *A. leonardi* is a strictly diurnal dragonfly that seems to need open sunlit space, whereas the drab *A. refracta* is crepuscular and able to do just as well in overgrown and narrow situations. It also appears that *A. leonardi* can only survive in sites with permanent rather deep and cool water whereas *A. refracta* is also able to live at least in some temporal streams. The stream orders range from 4 to 7.



Figs 1-3. Final instar larval exuviae of: 1) *Austrocordulia leonardi* Theischinger, from Georges River (34.060936S / 150.879248E); 2) *A. refracta refracta* Tillyard, from Karuah River (32.27445S / 151.90099E); 3) *A. refracta jurzitzai* Theischinger, from Georges River (34.060936S / 150.879248E). (The transversely evenly arched abdomen of *A. leonardi* and the pitched abdomen of *A. refracta* make distinguishing of the two species clear and easy, even in the field.)

It is probably significant that *A. leonardi* has as yet not been found in sites where *A. refracta* was missing, and it may be worth mentioning that *A. leonardi* was hitherto only found to coexist with the southern subspecies of *A. refracta*, *A. r. jurzitzai* (Theischinger 1999). Only typical *A. refracta*, however, is known from Karuah River (ca 60 m asl) where a small larva, most probably of *A. leonardi*, was recently collected (Theischinger unpublished; Theischinger & Endersby in press).

It can be seen from the table that the only dragonfly species found in the new *A. leonardi* sites and not in similar sites where the species was not found are *Caliagrion billinghursti* (Martin) and *Austrogomphus* (*Pleiogomphus*) *amphiclitus* (Selys). These two species are known to GT also from the original Woronora River site and the site along Kangaroo Creek. The observed negative associations between *Austrolestes cingulatus* and *Xanthagrion erythronurum* with *A. leonardi* did not come as a surprise but are most probably due to small sample size.

Conclusion

The great news about the rediscovery of *A. leonardi* in suburban Sydney does not represent a reason for complacency or for easing up on its conservation status. The Georges River habitat pools are located close to an area of Sydney

that is experiencing renewed urban development. Some of the potential consequences of this development on the *A. leonardi* habitat are increased urban runoff and increased controlled burning for new houses that adjoin the bushland areas. The habitat pools are also at risk from the potential of altered hydrology and water quality that can result from longwall mining upstream from the sites.

While the discovery of a new location for *A. leonardi* is good news, it does not in any way diminish the need for vigilance in the conservation of the habitat for this species, which is still very rare and at risk of extinction.



Photo 1: *Austrocordulia leonardi* (male). Credit: L. Müller

References

- Bertola, V. (2008). It's a rare sight. *MacArthur Chronicle* October 28: 3.
- Hawking, J.H. & G. Theischinger (2002). Vernacular names for the Australian dragonflies (Odonata). *Austrolestes*, Suppl. to No: 4, autumn 2002: 1-6.
- Hawking, J. & G. Theischinger (2004). Critical species of Odonata in Australia. *International Journal of Odonatology* 79(2): 113-132.
- IUCN (2003). Red list of threatened species. www.redlist.org.
- Theischinger, G. (1973). Eine zweite Art der Gattung *Austrocordulia* Tillyard (Odonata, Anisoptera). *Ann. Naturhistor. Mus. Wien* 77: 387-397.
- Theischinger, G. (1999). Regions of taxonomic disjunction in Australian Odonata and other freshwater insects: first addendum, with the description of *Austrocordulia refracta juritzsai* ssp. nov.

(Anisoptera: Corduliidae). *Odonatologica* 28(4): 377-384.

Theischinger, G. (2001). *Preliminary keys for the identification of larvae of the Australian Synthemistidae, Gomphomacromiidae, Pseudocorduliidae, Macromiidae and Austrocorduliidae (Odonata)*. Cooperative Research Centre for Freshwater Ecology, Thurgoona (NSW) pp. i-iv; 1-88.

Theischinger, G. & I. Endersby (in press). *Identification Guide to the Australian Odonata*. Department of Environment and Climate Change NSW.

Theischinger, G. & J.H. Hawking (2006). *The Complete Field Guide to Dragonflies of Australia*. 366 pp. CSIRO Publishing.

Theischinger, G. & S. Jacobs (2008). Fossicking for dragonflies and connections with an endangered species. *Agrion* 12(2): 50-51.

Theischinger, G. & J.A.L. Watson (1978). The Australian Gomphomacromiinae (Odonata: Corduliidae). *Aust. J. Zool.* 26: 399-431.

Theischinger, G. & J.A.L. Watson (1984). Larvae of Australian Gomphomacromiinae and their bearing on the status of the Synthemis group of genera (Odonata: Corduliidae). *Aust. J. Zool.* 32: 67-95.

Viridithemis viridula Fraser, 1960 – discovery of the first known male

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Discovery

On the 8 November 2007, on a Limosa Holidays bird and wildlife visit to Madagascar led by CC of Birding Africa, we visited Zombitse Forest, part of the Zombitse-Vohibasia National Park. This relatively small remnant patch of deciduous dry forest has similar characteristics to the more extensive and better-studied forests of Kirindy, further to the north near Morondava. Zombitse is situated in the south-west of the island, approximately 130 km east of Toliara and 10 kilometres west of Sakaraha, and access details to the trail that we explored on the northern side of the main Ihoisy-Toliara road (the RN7) are provided in Cohen et al. (2006). During our walk in the forest, MDC noticed a particularly colourful dragonfly perched close to ground level in the forest understorey on the edge of a small open area, which we were able to photograph. The GPS location was S 22.88339 E 44.69447 and the altitude was 800 metres above seal level. The timing of our visit was just at the start of the main rain season.

Identification

On returning home to the UK, MDC was unable to identify the specimen to species, having worked his way through all the likely species listed by Donnelly & Parr (2003) and researched them on the internet, so the photographs were left unlabelled. By coincidence, in January 2009, he received an email from Dr. Florian Weihrauch of Germany, requesting information on some odonata records he had reported for the Canary Islands; in the course of a number of emails that followed, he emailed Dr Weihrauch one of the pictures. The answer came back pretty quickly from Andreas Martens that the photos were of *Viridithemis viridula* Fraser, 1960, a species known only from a single museum specimen and from pictures of three further individuals, photographed in the field (K-D Dijkstra pers. comm.); all previous known individuals were female. K-D Dijkstra further confirmed the identity and the fact that it was a male.

Photo 1: Male *Viridithemis viridis*, Madagascar. Photo credit Callan Cohen



Descriptive remarks

Photographs of the Zombitse Forest individual show it to be a male by virtue of the genital appendages, while comparison of the wing venation (and general structure and shape) with a photograph by K. Karkow in Collen et al. (2008) confirms the Zombitse Forest individual as *V. viridula* and this therefore represents the first discovery of a male of this species. In comparison with the female, the male shows the same blue and purple eyes and bright, apple-green head, thorax and proximal part of the abdomen, while the lower abdomen is flushed with orange, becoming a brighter and richer red towards the distal end. The pterostigmata on both fore and hind wings have a yellowish-green colour, again like those of the known females. The femora and tibiae are a dull orange, becoming black on the tarsus.

It has previously been suggested that the failure of researchers to find a male *V. viridula* may well be due to the males being difficult to pick out amongst males of other, similarly-coloured species (K-D Dijkstra pers comm.). All-green libellulids are certainly unusual and, in the one genus where this colour is frequent (the New World *Erythemis* species), a proportion of mature males attain a bluish pruinescence; if males of *V. viridula* did this, they would be difficult to spot amongst pruinose blue males of several other Madagascan species. This has certainly proven not to be the case, with the extensive bright red colouration of the abdomen on the Zombitse individual going against this idea – though it is, of course, not yet known to what extent this may vary.

References

- Collen, B., M. Ram, N. Dewhurst, V. Clausnitzer, V. Kalkman, N. Cumberlidge & J.E.M. Baillie, 2008. Broadening the coverage of biodiversity assessments. In: J.-C. Vié, C. Hilton-Taylor and S.N. Stuart (eds). *The 2008 Review of the IUCN Red List of Threatened Species*. IUCN Gland, Switzerland.
- Cohen, C., C. Spottiwoode & J. Rossouw, 2006. *The Southern African Birdfinder - where to find 1400 species in southern Africa and Madagascar*. Struik New Holland Publishers, Cape Town, South Africa.
- Donnelly, T. W. and M.J. Parr, 2003. *Odonata, Dragonflies and Damselflies*. In: Goodman, S. M. and Benstead, J. P. (eds.) 2003. *The Natural History of Madagascar*. The University of Chicago Press, Chicago.

Photo 2: Male *Viridithemis viridis*, Madagascar. Photo credit Callan Cohen



Additional records of *Lyriothemis defonsekai* van der Poorten 2009 in Sri Lanka

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Lyriothemis defonsekai was first identified in 2007: one female was seen on 18 June and one male and one female were seen on 3 July near Kudawe, Sri Lanka (van der Poorten, 2009). Additional sightings have since been confirmed, with photographic evidence, from a small section of the Sinharaja Forest Reserve near the type locality.

L. defonsekai is easily distinguished from all other dragonflies in Sri Lanka (Fig. 1-2). These additional recordings have all been made along the edge of a walking trail near the Kudawe entry point that is bordered by

1. At the Kudawe entry point, 100 m from the entrance gate:

Date & time	Number & Sex	Observer(s)	Reference
October 7, 2007	1 ♀	K. Conniff	Pers. comm.
May 12, 2009, 9:30 am	1 ♂	K. Conniff	Pers. comm.

2. At the Kudawe entry point, 400 m from the entrance gate, near the start of the Moulawella Nature Trail:

Date & time	Number & Sex	Observer(s)	Reference
25 July 2007	1 ♀	G. de Silva Wijeyeratne	Pers. comm.
8 September 2007, 12:30 pm	3 fresh ♀♀, 2 fresh ♂♂	K. Conniff and G. van der Poorten	Pers. comm.
9 September 2007, 10 am	1 ♀	K. Conniff and G. van der Poorten	Pers. comm.
17 April 2008, 10:47 am	1 ♀	N. and G. van der Poorten	Pers. comm.
4 May 2008, 8:30 am	1 ♀, 1 ♂	N. and G. van der Poorten	Pers. comm.
6 Aug 2008	1 ♀	A. Salgado	Database for Bedjanič et al., 2009
30 Sept 2008	1 ♂	G. de Silva Wijeyeratne	Pers. comm.

3. At the Kudawe entry point, 2 km from the entrance gate, near the Research Station:

Date & time	Number & Sex	Observer(s)	Reference
14 July 2006	1 ♂	A. Salgado	Database for Bedjanič et al., 2009
2 May 2007	1 ♂	S. Gunasinghe	Pers. comm.
14 Aug 2007	1 ♂, 1 ♀	A. Salgado	Database for Bedjanič et al., 2009

a perennial stream (500 m asl). The vegetation here consists mainly of dipterocarps with tree ferns, bamboo and pitcher plants. Females were seen perched on vegetation at a height of 1 to 5 m above ground. Males were seen perched 3 to 7 m above ground, usually on a bare twig. No behaviour other than perching and no interactions between males and females have been reported.

The Sinharaja Forest Reserve is located in the south-west of the island and is a National Heritage and Wilderness Area administered by the Forest Department. UNESCO designated it as a Man and Biosphere Reserve in 1978 and a World Heritage Site in 1988. It is hilly terrain, about 8,800 hectares in extent, ranging from 300 to 1200 m asl. It receives 3500-5500 mm of rainfall annually with no pronounced dry spell. Sri Lanka and the Western Ghats in India are one of 25 global biodiversity hot spots (Myers et al., 2000). The hill forests in south-western Sri Lanka, of which the Sinharaja Forest Reserve is a part, are the only aseasonal, ever-wet region in South Asia, between Malesia and Madagascar (Ashton & Gunatilleke, 1987). The Sinharaja Forest Reserve in particular has a high endemism of plants, birds, reptiles, amphibians and insects. About seventy species of dragonflies have been recorded from this forest (Bedjanic et al., 2009) including the following endemics—*Hylaeothemis fruhstorferi*, *Tetrathemis yerburii*, *Elatoneura oculata*, *E. caesia*, *E. centralis*, *Heliogomphus walli*, *Gomphidia pearsoni*, *Microgomphus wijaya*, *Macrogomphus lankanensis*, and several species of *Platysticta* and *Drepanosticta*. In addition, several other species found in this forest are in the process of description (N. van der Poorten, in press; M. Bedjanic, pers. comm.).

Since the trail from the Kudawe entry point through the Sinharaja Forest Reserve is well traveled, it is likely that more records of *L. defonsekai* will be made. The park is a protected area but the stream along which the records of *L. defonsekai* have been made is a sensitive, and now important, habitat and needs to be protected from any changes. Since the rest of the Sinharaja Forest Reserve is not as accessible and is rarely visited, it remains to be seen whether or not *L. defonsekai* is found in other locations.

Lyriothemis defonsekai male. Credit: George van der Poorten



References

- Bedjanic, M., K. Conniff, N. van der Poorten & A. Šalamun, 2009. Preliminary results of the work on the odonatological database: Distribution Atlas of the Dragonflies of Sri Lanka, Version 2.0, April 2009. 72 pp, 138 figs. <draft .pdf document distributed by the authors>
- Ashton, P. S. & C. V. S. Gunatilleke, 1987. New light on the plant geography of Ceylon. I. Historical Plant Geography. *Journal of Biogeography* 14: 249-285.
- Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. B. da Fonseca & J. Kent, 2000. Biodiversity hotspots for conservation priorities. *Nature* 403: 853-858.
- van der Poorten, N., 2009. *Lyriothemis defonsekai* spec. nov. from Sri Lanka, with a review of the known species of the genus (Anisoptera: Libellulidae). *Odonatologica* 38(1): 15-27.

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Lyriothemis defonsekai female. Credit: George van der Poorten



Databasing dragonflies: State of knowledge in the Neotropical region

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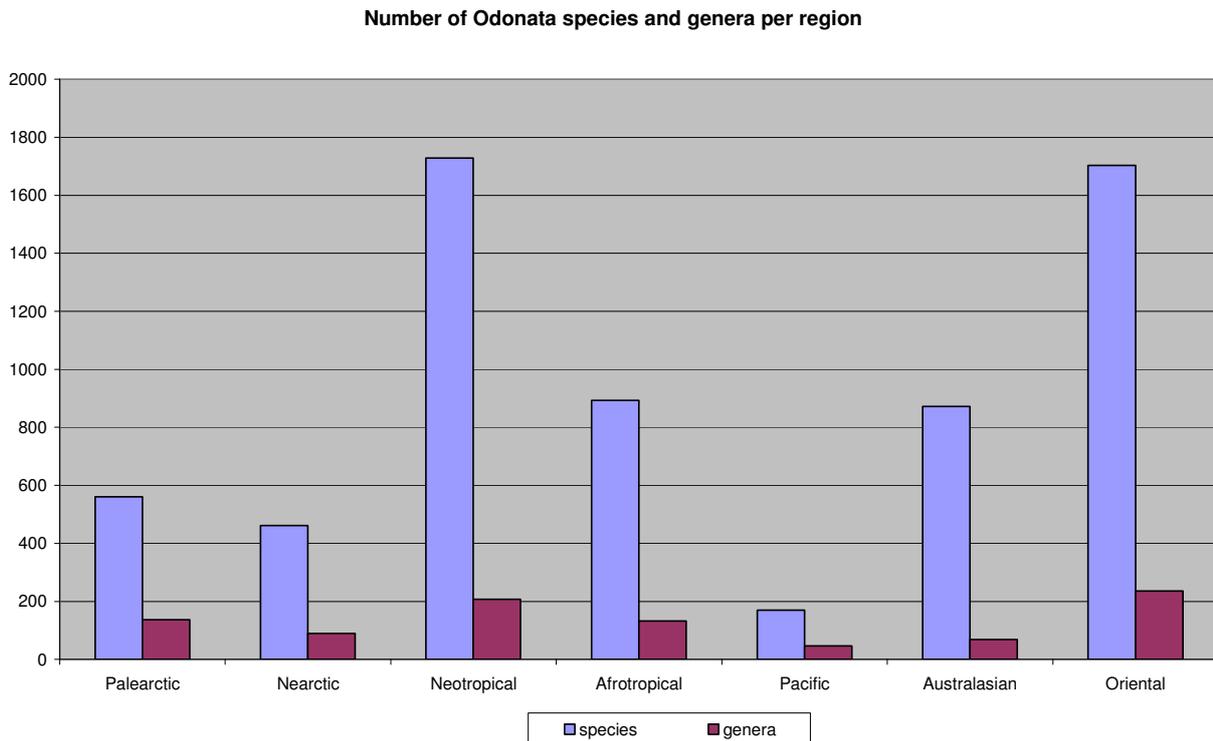
Taxonomy

The Neotropical region extends from the lowlands of Mexico to central Argentina. The fauna from the highlands of N Mexico belongs to the Nearctic region, and that of temperate forests of SW Argentina and Chile to the Austral region (Morrone 2001). However, in order to simplify the analysis and to allow for comparison with previous studies (Paulson 2004; Kalkman *et al.* 2008), the entire area extending from all of Mexico to S South America will be here referred to as Neotropical region.

Thus defined, the Neotropical region is currently the richest in described species of Odonata (1,727), closely followed by the Oriental region (1,703 species), housing almost a third of the world total number of described species (Fig. 1). However, knowledge of the order in this region is still poor and lags behind other regions of the World. New species continue to be found and many are awaiting description in collections; systematics within some families, especially within Zygoptera, has not been properly settled yet, and larvae of two thirds of the described species and of a fourth of the genera are still unknown. The main causes for this are twofold: 1) a regional shortage of trained taxonomic specialists relative to the high diversity of the area, and until recently, 2) lack of a comprehensive literature base covering the entire region. No treatises exist to allow for the identification of all the odonates of this amazingly biodiverse region. This has severely hampered studies in many countries as the literature necessary to identify all known species is scattered and not easy to gather.

This is currently changing, as several identification guides have recently been published for the Neotropical

Figure 1. Comparison of number of species and genera of Odonata between different regions of the world (updated from Kalkman *et al.* 2008).



region: keys to species for Central America (Förster 2001), generic keys for adults of Brazilian Zygoptera (Lencioni 2005, 2006), generic keys for larvae of Brazilian Odonata (Costa *et al.* 2004), generic keys for the New World Anisoptera (Garrison *et al.* 2006), and generic keys for South American Odonata (von Ellenrieder & Garrison 2009). Two volumes authored by Heckman (2006, 2008) treat all species of Odonata described from South America; although the keys they include will not allow for reliable identifications, the compilation of references to specialized papers dealing with each taxon can be useful.

During the last five years (2004-2009) 93 new species (Table 1) and 11 new genera, and the larval stage of 90 species (Table 2) have been described from this region, doubling the number of new species described

in the previous five year period (Paulson 2004). Revisions were published during this period for some genera of Austropetaliidae (von Ellenrieder 2005), Corduliidae (von Ellenrieder & Garrison 2005), Calopterygidae (Garrison 2006), Protoneuridae (Pessacq & Costa 2007; von Ellenrieder & Garrison 2008b), and especially for the diverse family Coenagrionidae (von Ellenrieder & Muzón 2006; De Marmels 2007b; von Ellenrieder 2008a, b; von Ellenrieder & Garrison 2008a; Garrison 2009; Garrison & von Ellenrieder 2009; Machado 2009). Two field guides (Esquivel 2005 for Central America and von Ellenrieder & Garrison 2007a for the cloud forest in Argentina) and several faunal studies including distribution data of Odonata assemblages for particular areas (Table 3) have also been published.

Researchers and Collections

The early stages of Odonatology in this region were the result of the work of several European entomologists; among them Burmeister (1839), Rambur (1842), Selys-Longchamps (including more than 30 contributions from 1853 through 1889, with synopses for families of Zygoptera, and Aeshnidae, Corduliidae, and Gomphidae), Brauer (1865), Mc Lachlan (1878, 1881, 1897), Martin (1907, 1908, 1909a, b, 1911, 1914, 1921, including synopses for Aeshnidae and Corduliidae, and lists for Argentina and Chile), Karsch (1890, 1891a, b, c, d), and Hagen (1860; 1861; 1868), all of which included numerous descriptions of new species. Navás published numerous listings and descriptions between 1911 and 1936, but his descriptions were extremely brief and include numerous synonymies, with the additional problem of most of his types being lost. A similar situation is encountered with Förster's contributions (1903, 1905, 1906, 1907, 1909, 1914). Kirby's illustrated revision of the subfamily Libellulinae (1889) and synonymic catalogue of the Odonata of the world (1890) are still used by students of the order, as is Ris' revision of the Libellulinae (1909-1919), which is still the most comprehensive reference available for some Neotropical genera. Ris (1904, 1908, 1913, 1918) also published listings and descriptions for Argentina and the Andean region. Fraser published monographs on the Austropetaliidae and Petaluridae (Fraser 1933), and described several new species from Peru (Fraser 1946) and Argentina (Fraser 1947, 1948).

Starting in the first half of the Twentieth century several entomologists from North America contributed to the study of the region. Calvert, whose most valuable contribution among his more than 250 publications dealing with Neotropical Odonata was a treatise of all odonate species from Central America (1901-1908, the *Biologia Centrali Americana*), Borrer, who provided important revisions and a key to Libellulinae genera (1931, 1942, 1945), and Gloyd, Kennedy, Montgomery, and Williamson among others with many important contributions.

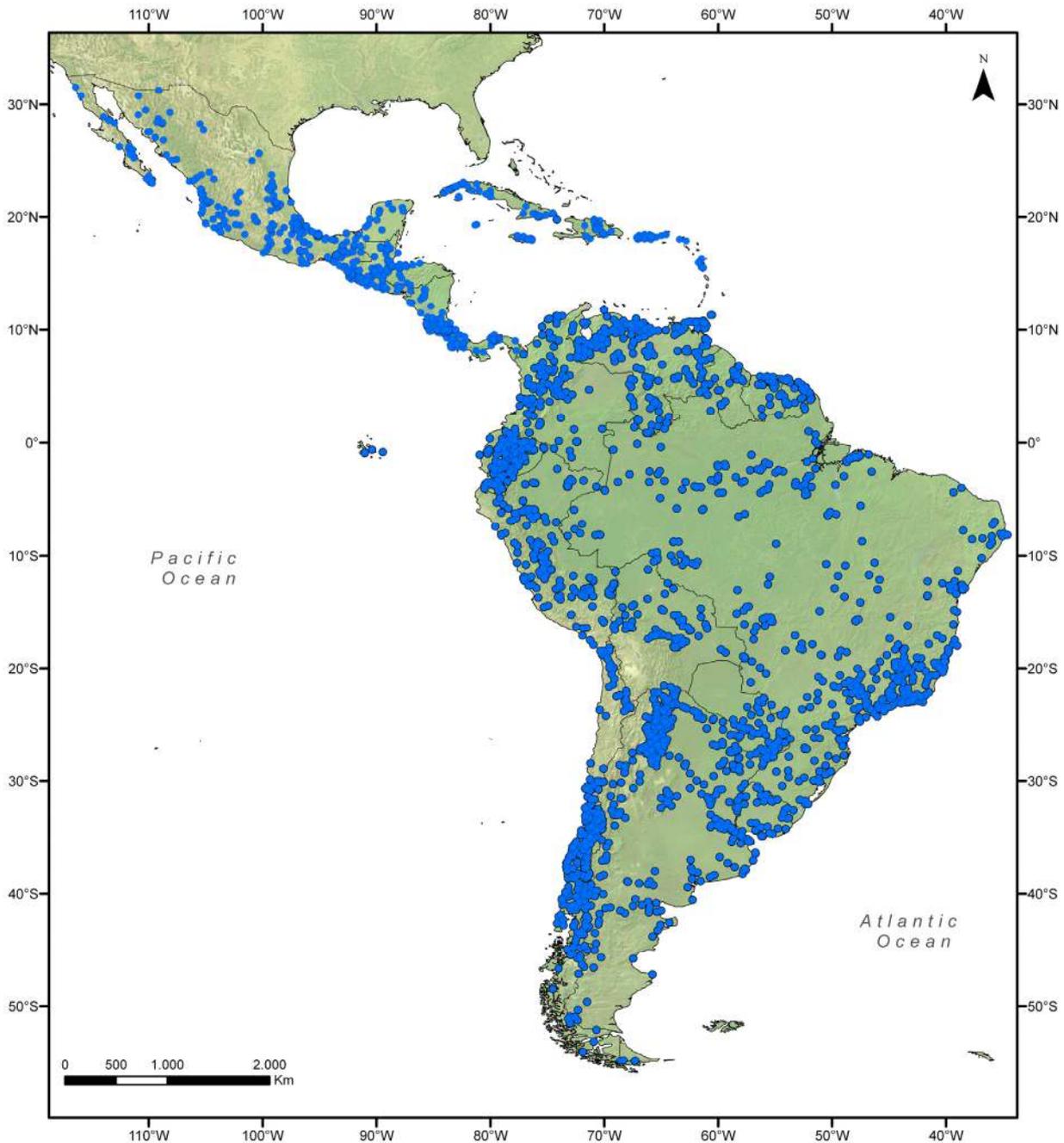
Only during the second half of the Twentieth century did resident entomologists begin to study odonates in the Neotropical region, with Santos in Brazil, Rácenis in Venezuela, and Geijskes and Belle in Suriname. During the last thirty years research teams developed and are now active in Mexico (under the direction of Enrique González-Soriano, Rodolfo Novelo-Gutiérrez, Alejandro Córdoba-Aguilar), Costa Rica (Carlos Esquivel), Venezuela (Jürg De Marmels), Brazil (Angelo Machado, Janira Costa, Frederico Lencioni, Alcimar Carvalho), and Argentina (Javier Muzón, Natalia von Ellenrieder, Pablo Pessacq, Federico Lozano). Several visiting researchers from the USA and Europe (Jerrell Daigle, Nick Donnelly, Sid Dunkle, Bill Mauffray, Mike May, Dennis Paulson, Rosser Garrison, Ken Tennessen and Steve Valley among others) have conducted research in several countries and greatly contributed to the advancement of the knowledge of Odonata in this region.

Several collections house Neotropical Odonata, both in Europe (collected mainly around 1800-1900, and including many types) and in the New World.

European Collections:

- BMNH: British Museum of Natural History, Dept. of Entomology, British Museum (Natural History), Cromwell Road, London SW7 5BD, ENGLAND, UK. Large collection, mostly pinned and of old material, but containing type material described by Calvert (1901-1908) in the *Biologia Centrali Americana*, and by other authorities. Type catalogs: Kimmins, 1966; 1969a; 1969b; 1970. No electronic database including locality data available.
- FNS: Forschungsinstitut und Naturmuseum Senckenberg, Senckenberganlage 25, D-60326, Frankfurt-am-Main, GERMANY. Contains the papered collection of Friedrich Ris who worked on Odonata from the Andes (Ris, 1918). No electronic database including locality data available.
- IRSN: Institut Royal des Sciences Naturelles de Belgique, 29, rue Vautier, B-1000 Bruxelles, BELGIUM. Very old collection containing the Odonata of Baron Edmund de Selys-Longchamps, considered the "Father of Odonatology" who described approximately one-fifth of the world's Odonata. Almost all of the collection is pinned and is rich in type material although no listing has ever been made. No electronic database including locality data available.
- RNHL: Rijksmuseum van Natuurlijke Historie, Department of Entomology, Rijksmuseum van Natuurlijke Historie, Raamsteeg 2, Postbus 9517, NL 2300 RA Leiden, THE NETHERLANDS. Contains the collections of Jean Belle and Dirk Geijskes who collected for many years in Surinam. The collection is especially rich in neotropical Gomphidae. Type catalog: Lieftinck, 1971. Electronic database including locality data currently under construction (Wasscher & van t' Bosch, 2009).

Figure 2. Localities in the Neotropical region with databased Odonata records.



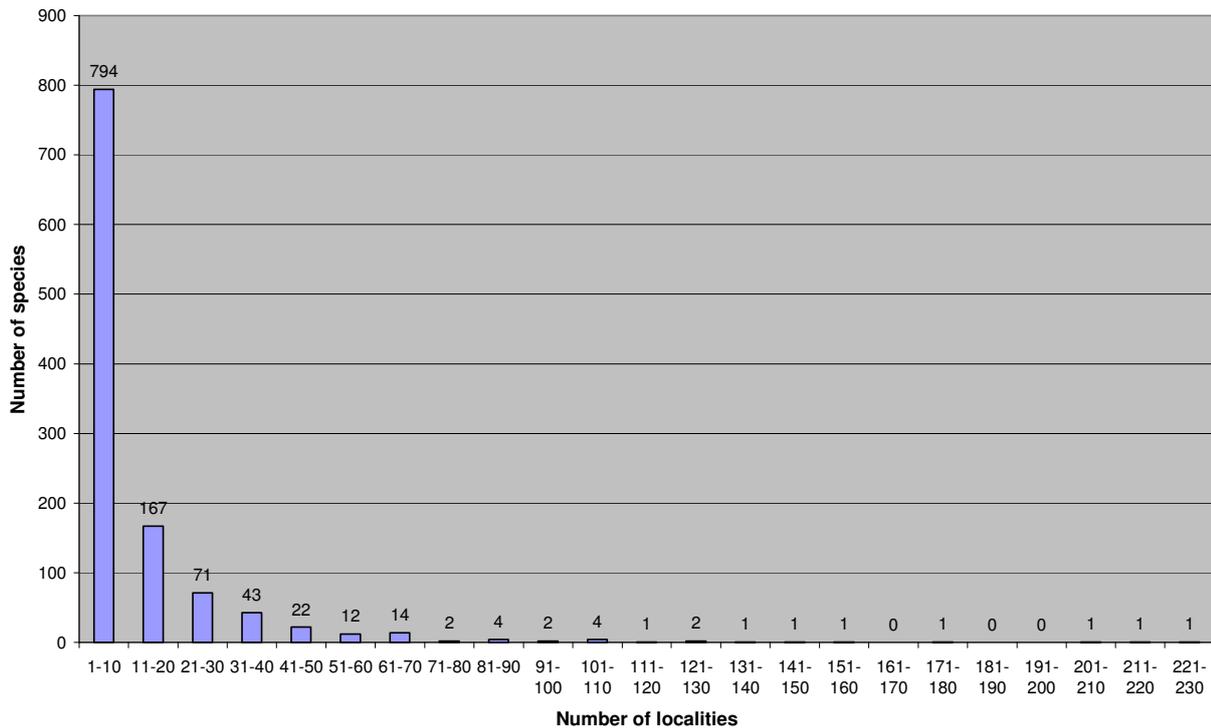
New World Collections:

DRP (registered with FSCA): Dennis R. Paulson personal collection, Slater Museum of Natural History, University of Puget Sound, 1500 North Warner, Tacoma, WA, 98416, USA. Large well-curated collection of Odonata especially rich in New World specimens. Electronic database including locality data; not georeferenced.

FSCA: Florida State Collection of Arthropods, 1911 SW 34th Street, Gainesville, FL 32608-1268, USA. One of the largest holdings of New World Odonata in the United States, containing over 330,000 specimens (including 130,000 immatures in vials) collected over the last sixty years. Collection includes over 150 primary types, listed on line at: < <http://www.iodonata.net/> >. A list of all species is also provided on-line. No electronic database including locality data available.

MCZ: Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts 02138, USA. Very rich, old, pinned collection containing type material of Herman Burmeister, Toussaint de Charpentier, Herman Hagen, and others. Listing of over 550 types (some with images) on line at: < <http://insects.oeb.harvard.edu/mcz/> >. No electronic database including locality data available.

Figure 3. Number of databased species from the Neotropical region that occur in n number of localities in ranges of 10.



RWG (registered with USNM): Plant Pest Diagnostics, California Department of Food and Agriculture, 3294 Meadowview Road, Sacramento, CA 95832-1448, USA. Well-curated collection, especially rich in New World material with emphasis on neotropical fauna. Electronic database including locality data available; georeferenced.

TWD (registered with FSCA): 2091 Partridge Lane, Binghamton NY 13903, USA. Well-curated, world-wide collection containing numerous New World specimens collected over the last 50 years. No electronic database including locality data available.

UMMZ: University of Michigan, Museum of Zoology, 1109 Geddes Avenue, Ann Arbor, MI, 48109-1079, USA. One of the largest holdings of Odonata in the world, containing the collections of F. Förster, C.H. Kennedy, E.B. Williamson, and others. Particularly rich in neotropical material though vast amounts of this material await study. Type catalog: Garrison *et al.*, 2003. No electronic database including locality data available.

UNAM: Instituto de Biología, Departamento de Zoología, Apartado Postal 70-153, MX-04510, D. F. Large, well-curated, papered collection of Odonata from Mexico put together mostly by E. González-Soriano. No electronic database including locality data available.

USNM: National Museum of Natural History, Smithsonian Institution, Washington, D.C., 20560, USA. A large well-curated world-wide collection containing numerous neotropical specimens collected mostly by Oliver S. Flint, Jr. over the past 40 years. Type catalog: Flint, 1991. No electronic database including locality data available.

ABMM, Angelo B.M. Machado personal collection, Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Caixa Postal 486, BR-31270-901, Belo Horizonte - Minas Gerais, BRAZIL. Private collection including types of Brazilian material. No electronic database including locality data available.

IEUM: Instituto de Entomología “Prof. José Herrera G.”, Universidad Metropolitana de Ciencias de la Educación, Casilla 147, Santiago, CHILE. Collection including numerous unidentified odonates, including some collected in N Chile. No electronic database including locality data available.

MIZA: Museo del Instituto de Zoología Agrícola “Francisco Fernández Yépez”, Maracay, VENEZUELA. Particularly rich collection of papered Venezuelan Odonata including collected material by the late J. Rácenis and by Jürg De Marmels. No electronic database including locality data available.

MLP: Museo de Ciencias Naturales de La Plata, Departamento de Entomología, Paseo del Bosque s/n, 1900 La Plata, ARGENTINA. Rich collection including types of Argentine species. Type catalog: Muzón *et al.*, 2007. Electronic database including locality data currently under construction.

Figure 4. Recorded number of genera from the Neotropical region compared to their representation in database.

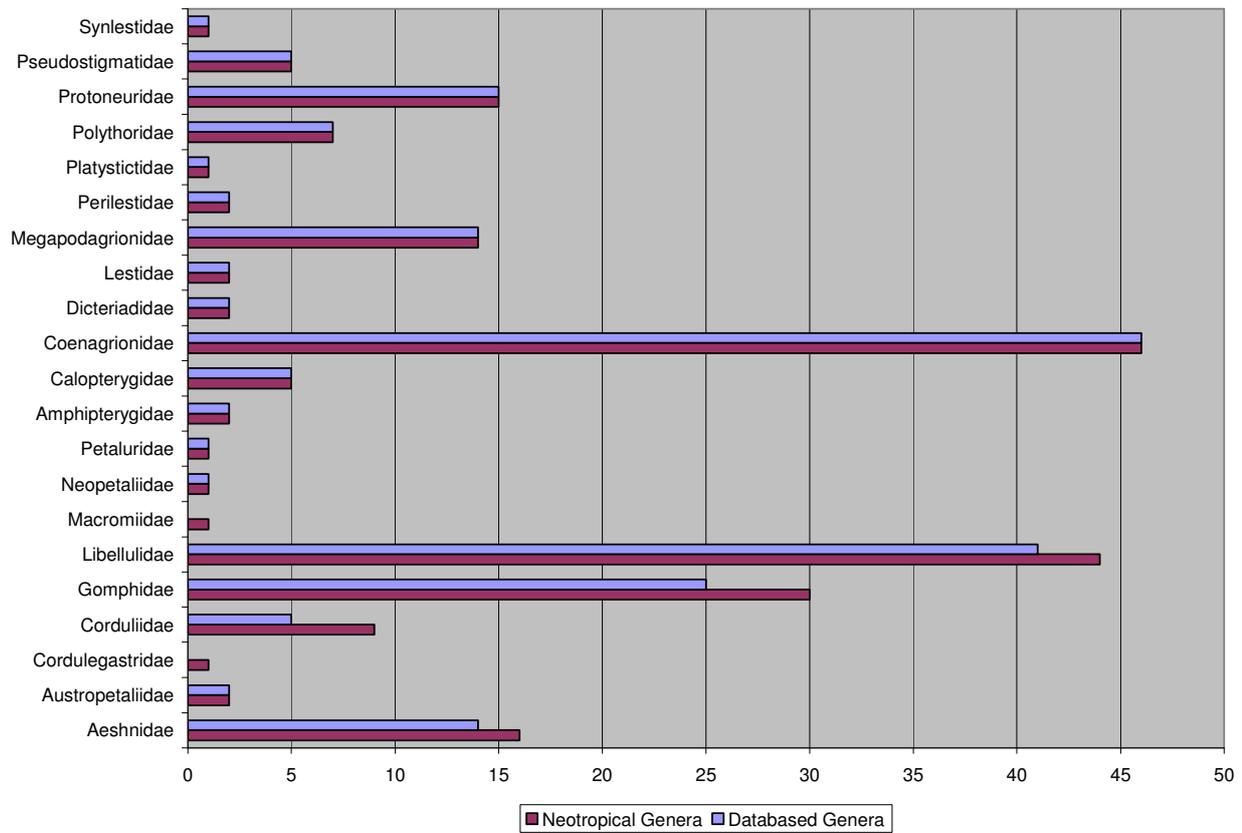


Figure 5. Recorded number of species from the Neotropical region compared to their representation in database.

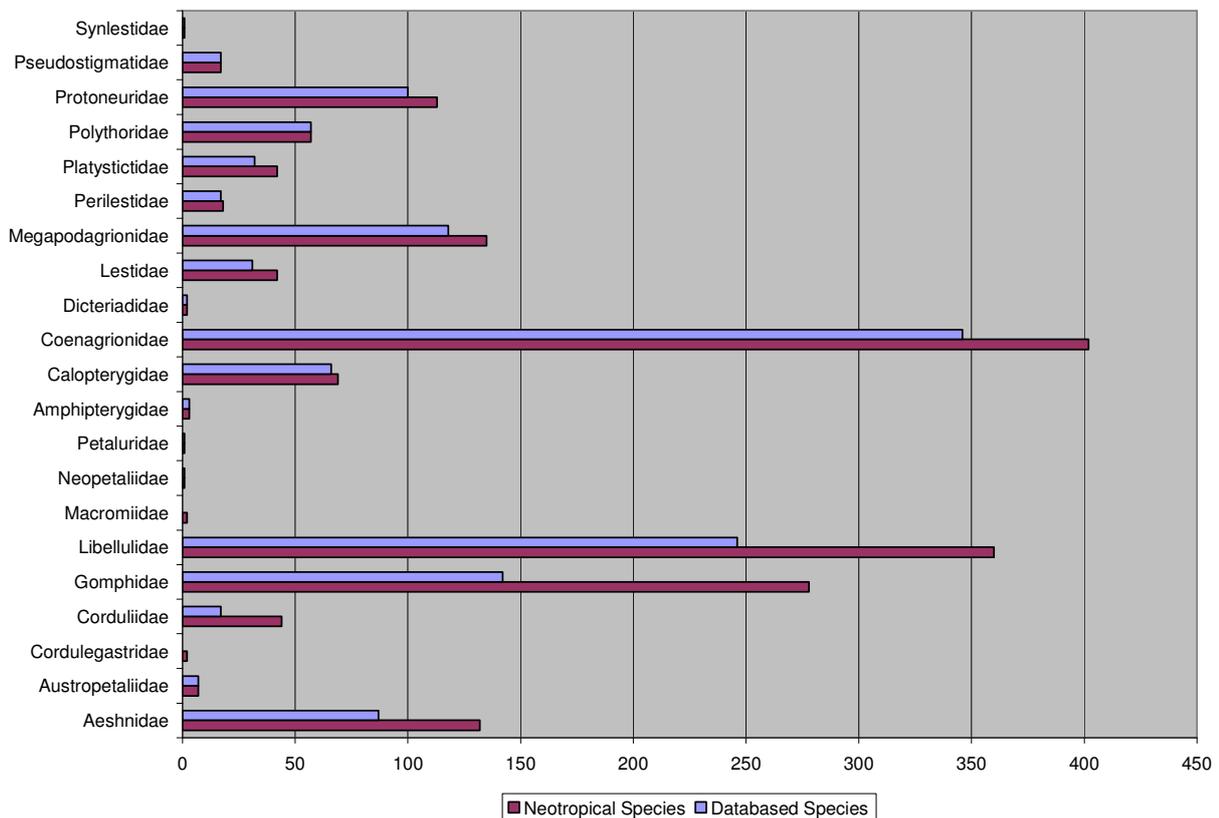


Table 1. Species of Odonata described from the Neotropical region between 2004 and 2009.

Family/Species	Author	Family/Species	Author
Polythoridae (1)		<i>Schistobos boliviensis</i>	(Daigle, 2007)
<i>Chalcopteryx machadoi</i>	Costa, 2005	<i>Telebasis carvalhoi</i>	Garrison, 2009
Calopterygidae (7)		<i>Telebasis corbeti</i>	Garrison, 2009
<i>Mnesarete drepane</i>	Garrison, 2006	<i>Telebasis farcimentum</i>	Garrison, 2009
<i>Mnesarete ephippium</i>	Garrison, 2006	<i>Telebasis leptocycla</i>	Garrison, 2009
<i>Mnesarete lencionii</i>	Garrison, 2006	<i>Telebasis levis</i>	Garrison, 2009
<i>Mnesarete loutoni</i>	Garrison, 2006	<i>Telebasis williamsoni</i>	Garrison, 2009
<i>Mnesarete machadoi</i>	Garrison, 2006	<i>Tepuibasis garciana</i>	De Marmels, 2007
<i>Mnesarete rhopalon</i>	Garrison, 2006	<i>Tepuibasis nigra</i>	De Marmels, 2007
<i>Mnesarete williamsoni</i>	Garrison, 2006	<i>Tepuibasis rubicunda</i>	De Marmels, 2007
Lestidae (1)		<i>Tepuibasis thea</i>	De Marmels, 2007
<i>Lestes fernandoi</i>	Costa <i>et al.</i> , 2006	<i>Tuberculobasis arara</i>	Machado, 2009
Megapodagrionidae (7)		<i>Tuberculobasis geijskesi</i>	Machado, 2009
<i>Heteragrion archon</i>	De Marmels, 2008	<i>Tuberculobasis guarani</i>	Machado, 2009
<i>Heteragrion bickorum</i>	Daigle, 2005	<i>Tuberculobasis karitiana</i>	Machado, 2009
<i>Heteragrion gracile</i>	Machado, 2006	<i>Tuberculobasis macuxi</i>	Machado, 2009
<i>Heteragrion luizfelipei</i>	Machado, 2006	<i>Tuberculobasis tirió</i>	Machado, 2009
<i>Heteragrion mantiqueirae</i>	Machado, 2006	<i>Tuberculobasis williamsoni</i>	Machado, 2009
<i>Heteragrion makiritare</i>	De Marmels, 2004	Aeshnidae (3)	
<i>Heteragrion tiradentense</i>	Machado & Bedé, 2006	<i>Gynacantha bartai</i>	Paulson & von Ellenrieder, 2005
Protoneuridae (20)		<i>Rhionaeschna itatiaia</i>	(Carvalho & Salgado, 2004)
<i>Drepanoneura donnellyi</i>	von Ellenrieder & Garrison, 2008	<i>Rhionaeschna serrana</i>	(Carvalho & Salgado, 2004)
<i>Drepanoneura flinti</i>	von Ellenrieder & Garrison, 2008	Gomphidae (3)	
<i>Drepanoneura janirae</i>	von Ellenrieder & Garrison, 2008	<i>Peruviogomphus bellei</i>	Machado, 2005
<i>Drepanoneura loutoni</i>	von Ellenrieder & Garrison, 2008	<i>Progomphus lambertoii</i>	Novelo, 2007
<i>Drepanoneura muzoni</i>	von Ellenrieder & Garrison, 2008	<i>Progomphus marcelae</i>	Novelo, 2007
<i>Drepanoneura tennesseii</i>	von Ellenrieder & Garrison, 2008	Corduliidae (7)	
<i>Epipleoneura demarmelsi</i>	von Ellenrieder & Garrison, 2008	<i>Laumacromia bedei</i>	Machado, 2005
<i>Epipleoneura janirae</i>	Machado, 2005	<i>Laumacromia pinguaba</i>	Carvalho <i>et al.</i> , 2004
<i>Epipotoneura machadoi</i>	von Ellenrieder & Garrison, 2008	<i>Neocordulia caudacuta</i>	De Marmels, 2008
<i>Forcepsioneura grossiorum</i>	Machado, 2005	<i>Neocordulia fiorentini</i>	Costa & Machado, 2007
<i>Forcepsioneura juruaensis</i>	(Machado, 2004)	<i>Neocordulia gaucha</i>	Costa & Machado, 2007
<i>Idioneura celioi</i>	Lencioni, 2009	<i>Neocordulia matutuensis</i>	Machado, 2005
<i>Neoneura anaclara</i>	Machado, 2005	<i>Neocordulia santacatarinensis</i>	Costa <i>et al.</i> , 2008
<i>Neoneura angelensis</i>	Juillerat, 2007	Libellulidae (8)	
<i>Neoneura kiautai</i>	Machado, 2007	<i>Elasmothemis aliciae</i>	González-Soriano & Novelo-Gutiérrez, 2006
<i>Neoneura leonardoii</i>	Machado, 2005	<i>Elasmothemis rufa</i>	De Marmels, 2008
<i>Peristicta jalmosi</i>	Pessacq & Costa, 2007	<i>Garrisonia aurindae</i>	Penalva & Costa, 2007
<i>Peristicta janiceae</i>	Pessacq & Costa, 2007	<i>Macrothemis meurgeyi</i>	Daigle, 2007
<i>Peristicta muzoni</i>	Pessacq & Costa, 2007	<i>Macrothemis taurepan</i>	De Marmels, 2008
<i>Protoneura romanae</i>	Meurgey, 2006	<i>Oligoclada garrisoni</i>	De Marmels, 2008
Coenagrionidae (36)		<i>Oligoclada rubribasalis</i>	von Ellenrieder & Garrison, 2008
<i>Acanthagrion aepiolum</i>	Tennesse, 2004	<i>Perithemis capixaba</i>	Costa <i>et al.</i> , 2006
<i>Acanthagrion hartei</i>	Muzón & Lozano, 2005		
<i>Aceratobasis nathaliae</i>	(Lencioni, 2004)		
<i>Andinagrion garrisoni</i>	von Ellenrieder & Muzón, 2006		
<i>Angelagrion fredericoi</i>	Lencioni, 2008		
<i>Angelagrion nathaliae</i>	Lencioni, 2008		
<i>Argia yungensis</i>	Garrison & von Ellenrieder, 2007		
<i>Bromeliagrion rehni</i>	Garrison, 2005 <i>in</i> De Marmels & Garrison, 2005		
<i>Denticulobasis ariken</i>	Machado, 2009		
<i>Denticulobasis dunklei</i>	Machado, 2009		
<i>Denticulobasis garrisoni</i>	Machado, 2009		
<i>Homeoura obrieni</i>	von Ellenrieder, 2008		
<i>Leptagrion alfonsoi</i>	Machado, 2007		
<i>Mesamphiagrion dunklei</i>	von Ellenrieder & Garrison, 2008		
<i>Mesamphiagrion ecuatoriale</i>	von Ellenrieder & Garrison, 2008		
<i>Mesoleptobasis elongata</i>	Garrison & von Ellenrieder, 2009		
<i>Metaleptobasis lillianae</i>	Daigle, 2004		
<i>Phoenicagrion paulsoni</i>	von Ellenrieder, 2008		

Table 2. Larvae of Odonata described from the Neotropical region between 2004 and 2009.

Family/Species	Larva described by		
Polythoridae (2)			
<i>Euthore fasciata</i> (Hagen in Selys, 1853)	De Marmels 2007a		
<i>Polythore spaeteri</i> Burmeister & Börzsöny, 2003	Etscher <i>et al.</i> 2006		
Calopterygidae (5)			
<i>Hetaerina medinae</i> Rácenis, 1968	De Marmels 2007a		
<i>Hetaerina mendezi</i> Jurzitza, 1982	von Ellenrieder 2007c		
<i>Hetaerina rosea</i> Selys, 1853	Pessacq & Muzón 2004; von Ellenrieder 2007c		
<i>Mnesarete grisea</i> (Ris, 1918)	Garrison 2006		
<i>Ormenophlebia imperatrix</i> (McLachlan, 1878)	Garrison 2006		
Lestidae (3)			
<i>Archilestes tuberalatus</i> (Williamson, 1921)	De Marmels 2004		
<i>Lestes apollinaris</i> Navás, 1934	De Marmels 2004		
<i>Lestes dichrostigma</i> Calvert, 1909	Muzón & Weigel Muñoz 2007		
Megapodagrionidae (11)			
<i>Heteragrion bariai</i> De Marmels, 1989	De Marmels 2004		
<i>Heteragrion breweri</i> De Marmels, 1989	De Marmels 2004		
<i>Heteragrion chlorotaeniatum</i> De Marmels, 1989	De Marmels 2004		
<i>Heteragrion mitratum</i> Williamson, 1919	De Marmels 2004		
<i>Paraphlebia zoe</i> Selys in Hagen, 1861	Novelo-Gutiérrez 2008a		
<i>Philogenia mangosisa</i> Bick & Bick, 1988	Bybee & Tennesen 2008		
<i>Sciotropis cyclanthorum</i> Rácenis, 1959	De Marmels 2004		
<i>Teinopodagrion caquetanum</i> De Marmels, 2001	Pérez-Gutiérrez 2007		
<i>Teinopodagrion decipiens</i> De Marmels, 2001	von Ellenrieder 2006		
<i>Teinopodagrion meridionale</i> De Marmels, 2001	von Ellenrieder 2006		
<i>Teinopodagrion vallenatum</i> De Marmels, 2001	Pérez-Gutiérrez 2007		
Pseudostigmatidae (4)			
<i>Mecistogaster asticta</i> Selys, 1860	Lencioni 2006		
<i>Mecistogaster linearis</i> (Fabricius, 1776)	Salhén & Hedström 2005		
<i>Microstigma maculatum</i> Hagen in Selys, 1860	Neiss <i>et al.</i> 2008		
<i>Microstigma rotundatum</i> Selys, 1860	De Marmels 2007a		
Platystictidae (1)			
<i>Palaemnema clementia</i> Selys, 1886	De Marmels 2007a		
Protoneuridae (4)			
<i>Epipleoneura metallica</i> Rácenis, 1955	De Marmels 2007a		
<i>Neoneura fulvicollis</i> Selys, 1886	De Marmels 2007a		
<i>Peristicta forceps</i> Hagen in Selys, 1860	Pessacq 2007		
<i>Protoneura ailsa</i> Donnelly, 1961	Meurgey 2008b		
Coenagrionidae (27)			
<i>Acanthagrion aepiolium</i> Tennesen, 2004	Lozano <i>et al.</i> 2007		
<i>Acanthagrion vidua</i> Selys, 1876	De Marmels 2007a		
<i>Andinagrion garrisoni</i> von Ellenrieder & Muzón, 2006	von Ellenrieder & Muzón 2006		
<i>Argia adamsi</i> Calvert, 1902	De Marmels 2007a		
<i>Argia barretti</i> Calvert, 1902	Novelo-Gutiérrez 2008b		
<i>Argia croceipennis</i> Selys, 1865	Costa <i>et al.</i> 2008b		
<i>Argia joergenseni</i> Ris, 1913	von Ellenrieder 2007a		
<i>Argia sordida</i> Hagen in Selys, 1865	Costa <i>et al.</i> 2008b		
<i>Argia translata</i> Hagen in Selys, 1865	von Ellenrieder 2007a		
<i>Bromeliagrion rehni</i> Garrison, 2005 in De Marmels & Garrison, 2005	Torreias <i>et al.</i> 2008		
<i>Enallagma novaehispaniae</i> Calvert, 1907	Novelo-Gutiérrez 2005b		
<i>Ischnura ultima</i> Ris, 1908	Muzón & Pessacq 2005		
<i>Leptagrion andromache</i> Hagen in Selys, 1876	Muzón <i>et al.</i> 2009		
<i>Leptagrion bocainense</i> Santos, 1979	Costa <i>et al.</i> 2009		
<i>Leptagrion capixabae</i> Santos, 1965	Costa <i>et al.</i> 2009		
<i>Leptagrion dardanoi</i> Santos, 1968	Costa <i>et al.</i> 2009		
<i>Leptagrion elongatum</i> Selys, 1876	Costa <i>et al.</i> 2009		
<i>Leptagrion macrurum</i> (Burmeister, 1839)	Costa <i>et al.</i> 2009		
<i>Leptagrion perlongum</i> Calvert, 1909	Costa <i>et al.</i> 2009		
<i>Leptagrion vriesianum</i> Santos, 1978	Costa <i>et al.</i> 2009		
<i>Mesamphiagrion laterale</i> (Selys, 1876)		De Marmels 2007a	
<i>Mesamphiagrion tamaense</i> (De Marmels, 1988)		De Marmels 2007a	
<i>Oreiallagma quadricolor</i> (Ris, 1918)		von Ellenrieder & Garrison 2008a	
<i>Oxyagrion ablutum</i> (Calvert, 1909)		Pessacq <i>et al.</i> 2005	
<i>Oxyagrion bruchi</i> Navás, 1924		von Ellenrieder & Garrison 2006	
<i>Oxyagrion imeriense</i> (De Marmels, 1989)		De Marmels 2007a	
<i>Telebasis digitcollis</i> Calvert, 1902		Novelo-Gutiérrez & Gómez-Anaya 2005	
Aeshnidae (3)			
<i>Aeshna williamsoniana</i> Calvert, 1905		Novelo-Gutiérrez 2007	
<i>Castoraeschna colorata</i> (Martin, 1908)		Carvalho <i>et al.</i> 2006	
<i>Castoraeschna longfieldae</i> (Kimmins, 1929)		Carvalho <i>et al.</i> 2006	
Gomphidae (7)			
<i>Erpetogomphus bothrops</i> Garrison, 1994		Novelo-Gutiérrez 2005a	
<i>Erpetogomphus elaps</i> Selys, 1858		Novelo-Gutiérrez 2005a	
<i>Erpetogomphus eutainia</i> Calvert, 1905		Novelo-Gutiérrez 2005a	
<i>Erpetogomphus liopeltis</i> Garrison, 1994		Novelo-Gutiérrez 2005a	
<i>Erpetogomphus viperinus</i> Selys, 1868		Novelo-Gutiérrez 2005a	
<i>Phyllogomphoides joaquinii</i> Rodrigues Capitulo, 1992		Muzón <i>et al.</i> 2006	
<i>Progomphus dorsopallidus</i> Byers, 1934		De Marmels 2005	
Corduliinae (3)			
<i>Laumacromia pinguaba</i> Carvalho <i>et al.</i> , 2004		Carvalho <i>et al.</i> 2008	
<i>Neocordulia caudacuta</i> De Marmels, 2008		De Marmels, 2008	
<i>Neocordulia santacatarinensis</i> Costa <i>et al.</i> , 2008		Costa <i>et al.</i> 2008a	
Libellulinae (20)			
<i>Brechmorhoga archboldi</i> (Donnelly, 1970)		Meurgey 2008a	
<i>Brechmorhoga nubecula</i> (Rambur, 1842)		von Ellenrieder 2007b	
<i>Brechmorhoga praedatrix</i> Calvert, 1909		Fleck 2004	
<i>Cannaphila insularis</i> Kirby, 1889		Trapero-Quintana & Cuellar Araujo 2009	
<i>Dasythemis mincki clara</i> (Karsch, 1890)		von Ellenrieder 2007b	
<i>Dythemis maya</i> Calvert, 1906		Novelo-Gutiérrez & González-Soriano 2004	
<i>Dythemis sterilis</i> Hagen, 1861		Novelo-Gutiérrez & González-Soriano 2004	
<i>Elasmothermis aliciae</i> González & Novelo, 2006		González-Soriano & Novelo-Gutiérrez 2006	
<i>Erythrodiplax atroterminata</i> Ris, 1911		Garré <i>et al.</i> 2008	
<i>Erythrodiplax corallina</i> (Brauer, 1865)		Garré <i>et al.</i> 2008	
<i>Erythrodiplax fervida</i> (Erichson, 1848)		Trapero-Quintana & Reyes-Tur 2008	
<i>Gynothemis pumila</i> (Karsch, 1890)		Fleck 2004	
<i>Idiataphe longipes</i> (Hagen, 1861)		Oldrini & Mascarehnas 2005	
<i>Macrothemis hahneli</i> Ris, 1913		von Ellenrieder 2007b	
<i>Macrothemis ultima</i> González, 1992		Novelo-Gutiérrez 2006	
<i>Micrathyrta unguolata</i> Förster, 1907		Garré & Lozano 2007	
<i>Perithemis lais</i> (Perty, 1834)		Costa & Régis 2005	
<i>Tauriphila argo</i> (Hagen, 1869)		Fleck <i>et al.</i> 2006	
<i>Tholymis citrina</i> Hagen, 1867		Fleck <i>et al.</i> 2004	
<i>Zenithoptera anceps</i> Pujol-Luz, 1993		Costa <i>et al.</i> 2004	

Table 3. Faunal studies from the Neotropical region published between 2004 and 2009.

Country	Area	Source
Mexico	Coahuila State	Behrstock 2008
	Chihuahua State	Behrstock <i>et al.</i> 2007
	Baja California Sur State	Paulson & Mlodinow 2007
	Sonora State	Upton <i>et al.</i> 2007
	Sierra de Coalcomán, Michoacan State	Novelo-Gutiérrez & Gómez-Anaya 2008
Guadeloupe	Guadeloupe	Meurgey 2005
Cuba	Alexander Humboldt N.P.	Trapero-Quintana <i>et al.</i> 2004
	Refugio Monte Cabaniguán, Tuna Prov.	Trapero-Quintana <i>et al.</i> 2008
Colombia	Chocó Dep.	Pérez <i>et al.</i> 2007
Brazil	Marambaia, Rio de Janeiro State	Anjos-Santos & Costa 2006
Argentina	Meseta de Somuncurá, Rio Negro Prov.	Muzón <i>et al.</i> 2005
	Iberá wetland, Corrientes Prov.	Muzón <i>et al.</i> 2008
	Yungas cloud forest, NW Argentina	von Ellenrieder & Garrison 2007b

MNHN: Museo Nacional de Historia Natural, Casilla 787, Santiago, CHILE. Holds most of R. Martin's collection. No electronic database including locality data available.

MNRJ: Museu Nacional, Departamento de Entomologia, Museu Nacional, Univ. Federal Rio de Janeiro, Quinta da Boa Vista, BR-20942-040, Rio de Janeiro, RJ, BRAZIL. One of the largest Odonata collections in South America, containing specimens collected by N.D. Santos and J.M. Costa. Type catalog: Costa & Mascarenhas, 1998. No electronic database including locality data available.

PUC: Pontificia Universidad Católica del Ecuador, Apartado 2184, Quito, Ecuador No electronic database including locality data available.

Existing Databases

Rosser W. Garrison and I maintain an electronic database which includes locality data and is also mostly (80%) georeferenced. It is a Visual FoxPro application which currently contains over 15,500 entries of about 1,150 species (about 66% of the described species for the region) occurring in the New World south to Mexico (Fig. 2). From these, most are known from a few localities, and only a few are widely distributed (Fig. 3) with the three most-recorded species being *Rhionaeschna diffinis* (217), *R. variegata* (216), and *Argia yungensis* (211). Coenagrionidae provide 27% of records, followed by Libellulidae with 19%, Gomphidae with 11%, Megapodagrionidae with 9%, and Protoneuridae with 8%, representing a proportional relationship to the total numbers known for the region for each family (Fig. 4). It was compiled from our personal collections (RWG, NVE), and from all literature records and examined specimens deposited in several Institutions that we examined for our work during the last few years. It includes complete distributional data for 364 species assessed by Dennis Paulson and myself for the Red List in 2005 and as part of the Global Dragonfly Assessment in 2007 (Appendix 1). Complete distribution data for another 211 species Rosser Garrison and I studied are also entered, thus a third (33%) of the total number of described Neotropical species can be considered satisfactorily mapped.

Future

The information from our database can serve as a funding nucleus to build a unifying database for the Neotropical region. In order to achieve this, the following tasks should be undertaken:

1) Published records: Records from the literature need to be added to species not yet revised, including information from numerous regional lists published during the last 30 years.

2) Unpublished records: Large numbers of dragonfly records are stored in collections and have never been published. If all odonatologists interested in the region were to make their unpublished records available, the database could begin to provide us with a fairly good picture of the Odonate distribution patterns in the Neotropics. Some collections do have paper databases, which could be digitalized. In most collections there are also unidentified specimens awaiting examination, which could be identified by the specialists in charge of them or by visiting researchers.

3) New records: Fieldwork is still needed in most areas; the highest priority lies in the lowland Amazon rainforests, the continent's richest Odonata habitat. Of intermediate priority are regions with probably medium-rich faunas for which odonate records are not available, such as S Bolivia, N Paraguay, and E Colombia (Fig. 2).

References

- Anjos-Santos, D., & J.M. Costa, 2006. A revised checklist of Odonata (Insecta) from Marambaia, Rio de Janeiro, Brazil with eight new records. *Zootaxa* 1300: 37-50.
- Behrstock, R.A., 2008. An Updated List of the Odonata of Coahuila, Mexico, including forty-one new State records and the first Mexican occurrence of *Libellula composita* (Hagen). *Bulletin of American Odonatology* 11:

1-7.

- Behrstock, R.A., D. Danforth & S. Upson, 2007. A list of the Odonata of Chihuahua State, Mexico, including new state records and the first Mexican record of *Argia alberta* Kennedy, 1918. *Bulletin of American Odonatology* 10: 52-63.
- Borrer, D.J., 1931. The Genus *Oligoclada* (Odonata). *Miscellaneous Publications, Museum of Zoology, University of Michigan* 22: 42 pp.
- Borrer, D.J., 1942. A revision of Libelluline genus *Erythrodiplax* (Odonata). Graduate School Studies Ohio State University, Contributions in Zoology and Entomology 4, Biological Series xv + 286 pp.
- Borrer, D.J., 1945. A key to the New World Genera of Libellulidae (Odonata). *Annals of the Entomological Society of America* 38: 168-194.
- Brauer, F., 1865. Vierter Bericht über die auf der Weltfahrt der kais. Fregatte Novara gesammelten Neuropteren. *Verhandlungen der zoologisch-botanischen Gesellschaft in Wien* 15: 903-908.
- Burmeister, H.C.C., 1839. *Handbuch der Entomologie. Neuroptera*. T.C.F. Enslin, 2(2): 757-1050.
- Bybee, S.M. & K.J. Tennessen, 2008. Description of the female and nymph of *Philogenia mangosisa* from southern Ecuador (Odonata: Megapodagrionidae). *Zootaxa* 1787: 63-68.
- Calvert, P.P., 1901. Odonata. In: *Biologia Centrali Americana: Insecta Neuroptera*. R.H. Porter & Dulau Co., London pp. 17-72.
- Calvert, P.P., 1902. Odonata. In: *Biologia Centrali Americana: Insecta Neuroptera*. R.H. Porter & Dulau Co., London pp. 73-128.
- Calvert, P.P., 1903. Odonata. In: *Biologia Centrali Americana: Insecta Neuroptera*. R.H. Porter & Dulau Co., London pp. 129-144.
- Calvert, P.P., 1905. Odonata. In: *Biologia Centrali Americana: Insecta Neuroptera*. R.H. Porter & Dulau Co., London. pp. 145-212.
- Calvert, P.P., 1906. Odonata. In: *Biologia Centrali Americana: Insecta Neuroptera*. R.H. Porter & Dulau Co., London pp. 213-308.
- Calvert, P.P., 1907. Odonata. In: *Biologia Centrali Americana: Insecta Neuroptera*. R.H. Porter & Dulau Co., London pp. 309-404.
- Calvert, P.P., 1908. Introduction to the Odonata, in *Biologia Centrali Americana: Insecta Neuroptera*. R.H. Porter & Dulau Co., London. pp. i-xxx.
- Calvert, P.P., 1908. Odonata. In: *Biologia Centrali Americana: Insecta Neuroptera*. R.H. Porter & Dulau Co., London pp. 405-420.
- Calvert, P.P., 1908. Introduction to the Odonata. In: *Biologia Centrali Americana: Insecta Neuroptera*. R.H. Porter & Dulau Co., London pp. v-xxx.
- Calvert, P.P., 1909. Contributions to a knowledge of the Odonata of the Neotropical region, exclusive of Mexico and Central America. *Annals of the Carnegie Museum* 6(3): 73-280.
- Carvalho, A.L., L.G.V. Salgado & G. Fleck, 2008. Description of the larva of *Laurochromia pinguaba* Carvalho, Salgado & Werneck-de-Carvalho 2004, with a key to the genera of Corduliidae larvae occurring in South America (Odonata: Anisoptera). *Zootaxa* 1848: 57-65.
- Carvalho, A.L., P.H.R. Souza & E.R. Calil, 2006. Description of the larvae of *Castoraeschna colorata* (Martin, 1908) and *C. longfieldae* (Kimmins, 1929) (Insecta: Odonata: Aeshnidae), with a key to the known larvae of the genus. *Zootaxa* 1296: 19-28.
- Costa, J.M. & B. Mascarenhas, 1998. Catálogo do material-tipo de Odonata (Insecta) do Museu Nacional. *Publicações Avulsas do Museu Nacional* 76: 1-30.
- Costa, J.M. & L.P.B. Regis, 2005. Description of the last instar larva of *Perithemis lais* (Perty) and comparison with other species of the genus (Anisoptera: Libellulidae). *Odonatologica* 34: 51-57.
- Costa, J.M., J.R. Pujol-Luz & L.P.B. Regis, 2004. Descrição da larva de *Zenithoptera anceps* (Odonata, Libellulidae). *Iheringia, Série Zoologia* 94: 421-424.
- Costa, J.M., L.O.I. Souza & B.B. Oldrini, 2004. Chave para identificação das famílias e gêneros das larvas conhecidas de Odonata do Brasil: Comentários e registros bibliográficos (Insecta: Odonata). *Publicações Avulsas do Museu Nacional* 99: 3-42.
- Costa, J.M., C.T. Ravello & G.M. Souza-Franco, 2008a. Description of a new species of *Neocordulia* Selys, 1882 (Odonata: Libellulidae, Corduliinae) from southern Brazil. *Zootaxa* 1704: 64-68.
- Costa, J.M., C.T. Ravello & G.M. Souza-Franco, 2008b. The larva of *Argia croceipennis* Selys (Zygoptera: Coenagrionidae). *Odonatologica* 37: 265-271.
- Costa, J.M., B.B. Oldrini & D. Anjos-Santos, 2009. Eight new *Leptagrion* larvae from Brazil (Zygoptera, Coenagrionidae). *Odonatologica* 38: 93-111.
- De Marmels, J., 2004. *Heteragrion makiritare* sp. nov., with descriptions of hitherto unknown females and larvae of other species from Venezuela (Odonata: Megapodagrionidae, Lestidae). *International Journal of Odonatology* 7: 439-458.

- De Marmels, J., 2005. La larva de *Progomphus dorsopallidus* Byers, 1934, (Odonata: Gomphidae), con una clave para identificar las larvas de otras especies del género del norte del Río Orinoco, Venezuela. *Entomotropica* 20: 235-238.
- De Marmels, J., 2007a. Thirteen new Zygoptera larvae from Venezuela (Calopterygidae, Polythoridae, Pseudostigmatidae, Platystictidae, Protoneuridae, Coenagrionidae). *Odonatologica* 36: 27-51.
- De Marmels, J., 2007b. *Tepuibasis* gen. nov. from the Pantepui region of Venezuela, with descriptions of four new species and with biogeographic, phylogenetic and taxonomic considerations on the Teinobasinae (Zygoptera: Coenagrionidae). *Odonatologica* 36: 117-146.
- De Marmels, J., 2008. *Neocordulia caudacuta* sp. nov. from the Coastal Cordillera, Venezuela (Odonata: Corduliidae). *International Journal of Odonatology* 11: 15-20.
- Esquivel, C., 2005. *Libélulas de Mesoamérica y el Caribe [Dragonflies and damselflies of Middle America and the Caribbean]*. Instituto Nacional de Biodiversidad, INBio 319 pp.
- Etscher, V., M.A. Miller & E.-G. Burmeister, 2006. The larva of *Polythore spaeteri* Burmeister & Boerzoeny, with comparison to other polythorid larvae and molecular species assignment (Zygoptera: Polythoridae). *Odonatologica* 35: 127-142.
- Fleck, G., 2004. Contribution à la connaissance des Odonates de Guyane française: les larves des *Macrothemis pumilla* Karsch, 1889 et de *Brechmorhoga praedatrix* Calvert, 1909. Notes biologiques et conséquences taxonomiques (Anisoptera: Libellulidae). *Annales de la Société entomologique de France* 40: 177-184.
- Fleck, G., M. Brenk, & B. Misof, 2006. DNA taxonomy and the identification of immature insect stages: the true larva of *Tauriphila argo* (Hagen 1869) (Odonata: Anisoptera: Libellulidae). *Annales de la Société Entomologique de France (Nouvelle série)* 42: 91-98.
- Fleck, G., J. De Marmels & D. Grand, 2004. La larve de *Tholymis citrina* Hagen, 1867 (Odonata, Anisoptera, Libellulidae). *Bulletin de la Société entomologique de France* 109: 455-457.
- Flint, Jr., O.S., 1991. The Odonata collection of the National Museum of Natural History, Washington, U.S.A. *Advances in Odonatology* 5: 49-58.
- Förster, F., 1903. Neotropische Libellen. *Entomol. Wochenblatt (Insektenbosse)* 20: 355-356.
- Förster, F., 1905. Neotropische Libellen. II. *Entomologische Zeitschrift* 22(19): 75-76.
- Förster, F., 1906. Neotropische Libellen. III. *Entomol. Wochenblatt (Insektenbosse)* 23: 15-16.
- Förster, F., 1907. Neotropische Libellen. V. *Entomol. Wochenblatt (Insektenbosse)* 24: 153-154, 157, 16***.
- Förster, F., 1909. Beiträge zu den Gattungen und Arten der Libellen. *Jahrbücher des nassauischen Vereins für Naturkunde, Wiesbaden* 62: 211-235.
- Förster, F., 1914. Beiträge zu den Gattungen und Arten der Libellen. III. *Archiv für Naturgeschichte* 80: 59-83.
- Förster, S., 2001. The dragonflies of Central America exclusive of Mexico and the West Indies. A guide to their identification [Second edition]. *Odonatological monographs* 2, Gunnar Rehfeld 141 pp.
- Fraser, F.C., 1933. A Revision of the Fissilabioidea (Cordulegasteridae, Petaliidae and Petaluridae) (Order Odonata). Part II. Petaliidae and Petaluridae and appendix to Part I. *Memoirs of the Indian Museum* 9(6): 205-260.
- Fraser, F.C., 1946. Notes on Amazonian Odonata in the Leeds Museum. *Transactions of the Royal Entomological Society of London* 97(18): 443-472.
- Fraser, F.C., 1947. The Odonata of the Argentine Republic I. *Acta Zoologica Lilioana* 4: 427-461.
- Fraser, F.C., 1948. The Odonata of the Argentine Republic II. *Acta Zoologica Lilioana* 5: 47-67.
- Garrison, R. W., 2006. A synopsis of the genera *Mnesarete* Cowley, *Bryoplathanon* gen. nov., and *Ormenophlebia* gen. nov. (Odonata: Calopterygidae). *Contributions to Science Series* 506: 1-84.
- Garrison, R. W., 2009. A Synopsis of the genus *Telebasis* Selys (Odonata: Coenagrionidae). *International Journal of Odonatology* 12: 1-121.
- Garrison, R.W., N. von Ellenrieder and J.A. Louton, 2006. *The dragonfly genera (Odonata: Anisoptera) of the New World: An illustrated and annotated key*. The Johns Hopkins University Press xiv + 368 pp.
- Garrison, R.W., N. von Ellenrieder and M.F. O'Brien, 2003. An annotated list of the name bearing types of species-group names in Odonata preserved in the University of Michigan, Museum of Zoology. *Occasional Papers of the Museum of Zoology, University of Michigan* 736: 1-73.
- Garré, A. & F. Lozano, 2007. Descripción del último estadio larval de *Micrathyria unguolata* (Odonata: Libellulidae). *Revista de la Sociedad Entomológica Argentina* 66: 5-9.
- Garré, A., J. Muzón & D.M. Ardohain, 2008. Description of the final instar larvae of *Erythrodiplax atroterminata* Ris and *E. corallina* (Brauer) (Odonata: Libellulidae). *Zootaxa* 1896: 45-50.
- González-Soriano, E. & R. Novelo-Gutiérrez, 2006. *Elasmothermis aliciae* spec. nov., a new dragonfly from Mexico, Belize and Costa Rica with a description of its larva and a key to the known larvae of the genus (Anisoptera: Libellulidae). *Odonatologica* 35: 243-253.
- Hagen, H.A., 1860. Über die Neuropteren-Fauna Amerikas. *Stettiner Entomologische Zeitung* 21(4-6): 209-216.
- Hagen, H.A., 1861. A synopsis of the Neuroptera of North America with a list of the South American species.

- Smithsonian Institution Miscellaneous Collections* xx + 347 pp.
- Hagen, H.A., 1868. Odonaten Cubas (Fortsetzung). *Stettiner Entomologische Zeitung* 29: 274-287.
- Heckman, C.W., 2006. *Encyclopedia of South American Aquatic Insects: Odonata - Anisoptera*. Springer vol. 4, viii+ 725 pp, 793 illus.
- Heckman, C.W., 2008. *Encyclopedia of South American Aquatic Insects: Odonata - Zygoptera*. Springer vol. 5, viii+ 687 pp, 763 illus.
- Kalkman, V.J., V. Clausnitzer, K.-D. Dijkstra, A. G. Orr, D.R. Paulson & J. van Tol, 2008. Global diversity of dragonflies (Odonata) in freshwater. *Hydrobiologia* 595: 351-363.
- Karsch, F., 1890. Beiträge zur Kenntniss der Arten und Gattungen der Libellulinen. *Berliner Entomologische Zeitschrift* 33: 347-392.
- Karsch, F., 1891a. Kritik des Systems der Aeschniden. *Entomologische Nachrichten* 17(18): 273-290.
- Karsch, F., 1891b. Neue Odonaten von Ecuador. I. Agrionidae. *Societas Entomologica* 6(14): 105.
- Karsch, F., 1891c. Neue Odonaten von Ecuador. II. Calopterygidae. III. Libellulidae. *Societas Entomologica* 6(15): 113.
- Karsch, F., 1891d. Neue Odonaten von Ecuador. IV. Aeschnidae. *Societas Entomologica* 6(16): 121-122.
- Kimmins, D.E., 1966. A list of the Odonata types described by F.C. Fraser, now in the British Museum (Natural History). *Bulletin of the British Museum (Natural History)* 18(6): 173-227.
- Kimmins, D.E., 1969a. A list of the type-specimens of Libellulidae and Corduliidae (Odonata). *Bulletin of the British Museum (Natural History)* 22(6): 277-305.
- Kimmins, D.E., 1969b. A list of the type-specimens of Odonata in the British Museum (Natural History) Part II. *Bulletin of the British Museum (Natural History)* 23(7): 287-314.
- Kimmins, D.E., 1970. A list of the type-specimens of Odonata in the British Museum (Natural History) Part III. *Bulletin of the British Museum (Natural History)* 24(6): 171-205.
- Kirby, W.F., 1890. *A synonymic catalogue of Neuroptera Odonata, or dragonflies, with an appendix of fossil species*. Gurney & Jackson ix + 202 pp.
- Lencioni, F.A.A., 2005. *Damselflies of Brazil. An illustrated identification guide. 1 - The non-Coenagrionidae families*. All Print Editora iv + 324pp
- Lencioni, F.A.A., 2006. *Damselflies of Brazil. An illustrated identification guide. 2 - Coenagrionidae*. All Print Editora VIII + 419 pp
- Lieftinck, M.A., 1971. A catalog of the type-specimens of Odonata preserved in the Netherlands, with a supplementary list of the Odonata types described by Dutch scientists deposited in foreign institutional collections. *Tijdschrift voor Entomology* 114(2): 65-139.
- Lozano, F., A. Garré & P. Pessacq, 2007. Descripción del último estadio larval de *Acanthagrion aepiolum* (Odonata: Coenagrionidae). *Revista de la Sociedad Entomológica Argentina* 66: 1-4.
- Machado, A.B.M., 2009. *Denticulobasis* and *Tuberculobasis*; new genera close to *Leptobasis*, with description of ten new species (Zygoptera: Coenagrionidae). *Zootaxa* 2108: 1-36.
- Martin, R., 1907. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue Systématique et descriptif*. Cordulines. 17: 1-94.
- Martin, R., 1908. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue Systématique et descriptif*. Aeschnines. 18: 1-84.
- Martin, R., 1909a. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue Systématique et descriptif*. Aeschnines. 19: 85-156.
- Martin, R., 1909b. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue Systématique et descriptif*. Aeschnines. 20: 157-223.
- Martin, R., 1911. Odonata. Fam. Aeschnidae, Subfam. Aeschninae. *Genera Insectorum* 115: 1-34.
- Martin, R., 1914. Odonata. Fam. Libellulidae, Subfam. Cordulinae. *Genera Insectorum* 155: 1-32.
- Martin, R., 1921. Sur les odonates du Chili. *Revista Chilena de Historia Natural* 25: 19-25.
- McLachlan, R., 1878. VI. Calopterygina collected by Mr. Buckley in Ecuador and Bolivia. *Transactions of the Entomological Society* 1: 85-94.
- McLachlan, R., 1881. II. Notes on Odonata, of the subfamilies Corduliina, Calopterygina, and Agrionina (Legion Pseudostigma), collected by Mr. Buckley, in the district of the Rio Bobanaza, in Ecuador. *Transactions of the Entomological Society of London* 1881: 25-34.
- McLachlan, R., 1897. *Thaumatoneura inopinata*, a new genus and species of Calopteryginae. *The Entomologist Monthly Magazine* (2)8: 130-131.
- Meurgey, F., 2005. Contribution à la connaissance des Odonates de l'archipel guadeloupéen IV. Faune de l'île de Marie-Galante (Antilles françaises). *Martinia* 21(4): 51-58.
- Meurgey, F., 2008a. Description of the adult male and larva of *Brechmorhoga archboldi* (Donnelly) from the French West Indies (Anisoptera: Libellulidae). *Odonatologica* 37: 161-166.
- Meurgey, F., 2008b. Description of the larva of *Protoneura ailsa* Donnelly (Zygoptera: Protoneuridae). *Odonatologica*

- 37: 279-282.
- Morrone, J.J., 2001. Biogeografía de América Latina y el Caribe. M&T - Manuales & Tesis SEA, vol. 3. Zaragoza 148 pp.
- Muzón, J. & A. Garré, 2005. Description of the last instar larva of *Erythrodiplax paraguayensis* (Anisoptera: Libellulidae). *Revista de la Sociedad Entomológica Argentina* 64: 85-91.
- Muzón, J. & P. Pessacq, 2005. Description of the last larval instar of *Ischnura ultima* Ris (Zygoptera: Coenagrionidae). *Odonatologica* 34: 303-306.
- Muzón, J. & M.S. Weigel Muñoz, 2007. Description of the final instar larva of *Lestes dichrostigma* Calvert (Zygoptera: Lestidae). *Studies on Neotropical Fauna and the Environment* 42: 235-239.
- Muzón, J., P. Pessacq & L. Ramos, 2007. Odonata type specimens preserved in the Museo de La Plata, Argentina. *Odonatologica* 36: 301-306.
- Muzón, J., P. Pessacq & N. von Ellenrieder, 2006. Description of the female and larva of *Phyllogomphoides joaquina* Rodrigues Capitulo, 1992 (Anisoptera: Gomphidae). *Odonatologica* 35: 55-60.
- Muzón, J., G.R. Spinelli, P. Pessacq, N. von Ellenrieder, A.L. Estevez, P.I. Marino, P.J. Pérez Goodwyn, E.B. Angrisano, F. Díaz, L.A. Fernández, S. Mazzucconi, G. Rossi & O.D. Salomón, 2005. Insectos acuáticos de la Meseta de Somuncurá, Patagonia, Argentina. Inventario preliminar. *Revista de la Sociedad Entomológica Argentina* 64: 47-68
- Muzón, J., N. von Ellenrieder, P. Pessacq, F. Lozano, A. Garré, J. Lambruschini, L. Ramos & M.S. Weigel Muñoz, 2008. Odonata from Iberá Wetlands (Corrientes, Argentina): Preliminary Inventory and Biodiversity. *Revista de la Sociedad Entomológica Argentina* 67: 59-67.
- Muzón, J., S. Weigel Muñoz & R. Campos, 2009. Description of the last larval instar of *Leptagrion andromache* Hagen in Selys (Coenagrionidae). *Zootaxa* 2089: 65-68.
- Neiss, U.G., F.A.A. Lencioni, N. Hamada & R.L. Ferreira-Keppler, 2008. Larval redescription of *Microstigma maculatum* Hagen in Selys, 1860 (Odonata: Pseudostigmatidae) from Manaus, Amazonas, Brazil. *Zootaxa* 1696: 57-62.
- Novelo-Gutiérrez, R., 2005a. Five new *Erpetogomphus* Hagen in Selys larvae from Mexico, with a key to the known species (Anisoptera: Gomphidae). *Odonatologica* 34: 243-257.
- Novelo-Gutiérrez, R., 2005b. La larva de *Enallagma novaehispaniae* Calvert, 1902 (Odonata: Coenagrionidae). *Folia Entomologica Mexicana* 44: 219-224.
- Novelo-Gutiérrez, R., 2006. The larva of *Macrothemis ultima* González-Soriano, 1992 (Odonata: Anisoptera: Libellulidae). *Transactions of the American Entomological Society* 132: 151-156.
- Novelo-Gutiérrez, R., 2007. The larva of *Aeshna williamsoniana* (Odonata: Anisoptera: Aeshnidae). *Canadian Entomologist* 139: 195-200.
- Novelo-Gutiérrez, R., 2008a. Description of the larva of *Paraphlebia zoe* Selys in Hagen, 1861 (Odonata: Megapodagrionidae). *Zootaxa* 1876: 29-34.
- Novelo-Gutiérrez, R., 2008b. Description of the last instar larva of *Argia barretti* Calvert (Zygoptera: Coenagrionidae). *Odonatologica* 37: 367-373.
- Novelo-Gutiérrez, R. & E. González-Soriano, 2004. The larva of *Dythemis maya* Calvert, 1906 and a redescription of the larva of *Dythemis sterilis* Hagen, 1861 with a key to the larvae of the genus (Anisoptera: Libellulidae). *Odonatologica* 33: 279-289.
- Novelo-Gutiérrez, R. & J.A. Gómez-Anaya, 2005. Description of the larva of *Telebasis digiticollis* (Odonata: Zygoptera: Coenagrionidae). *Canadian Entomologist* 137: 61-66.
- Novelo-Gutiérrez, R. & J.A. Gómez-Anaya, 2008. A comparative study of Odonata (Insecta) assemblages along an altitudinal gradient in the sierra de Coalcomán Mountains, Michoacán, Mexico. *Biodiversity Conservation* 18: 679-698.
- Oldrini, B.B. & B.J. de A. Mascarehnas, 2005. Descrição da larva de *Idiataphe longipes* (Odonata, Libellulidae, Trameini). *Iheringia, Série Zoologia* 95: 431-433.
- Paulson, D.R., 2004. Critical species of Odonata in the Neotropics. In: Clausnitzer & Joedicke (eds.), Guardians of the watershed. Global status of dragonflies: critical species, threat and conservation. Special issue: IUCN Regional Reports. *International Journal of Odonatology* 7: 163-188.
- Paulson, D.R. & S. Mlodinow, 2007. New records of Odonata from Baja California Sur, Mexico, and a checklist of the odonate fauna of that state. *Argia* 19(2): 26-27.
- Pérez, L., Monroy, D. & E. Realpe, 2007. Local assemblage patterns of odonates in central Chocó, colombian pacific. pp. 183-199. In B. K. Tyagi (ed.) *Odonata: Biology of dragonflies*. Scientific Publishers.
- Pérez-Gutiérrez, L.A., 2007. The larvae of *Teinopodagrion caquetanum* De Marmels and *T. vallenatum* De Marmels (Zygoptera: Megapodagrionidae). *Odonatologica* 36: 307-313.
- Pessacq, P., 2007. *Peristicta aenoviridis* Calvert, 1909 and *P. forceps* Hagen in Selys, 1860: redescrptions and a new synonymy (Zygoptera: Protoneuridae). *Odonatologica* 36: 207-218.
- Pessacq, P. & J. Muzón, 2004. Description of the final stadium larva of *Hetaerina rosea* Selys (Zygoptera:

- Calopterygidae). *Studies on Neotropical Fauna and Environment* 39: 239-242.
- Pessacq, P. & J.M. Costa, 2007. Three New Species of *Peristicta* Hagen in Selys (Odonata: Zygoptera: Protoneuridae) from Brazil. *Neotropical Entomology* 36: 46-52.
- Pessacq, P., J. Muzón & N. von Ellenrieder, 2005. Description of the last larval instar of *Acanthagrion ablutum* Calvert (Zygoptera: Coenagrionidae). *Odonatologica* 34: 73-76.
- Rambur, P., 1842. Histoire Naturelle des Insectes: Névroptères. *Librairie Encyclopédique de Roret* xvii + 534 pp.
- Ris, F., 1904. *Odonaten*, 44 pp. In: Friederichsen & Co.: Hamburg Magallaenischen Sammelreise 1892/93. Hamburg.
- Ris, F., 1908. Beitrag zur Odonatenfauna von Argentina. *Deutsche Entomologische Zeitschrift* 518-531.
- Ris, F., 1909a. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue systématique et descriptif. Libellulinen 1*. 9: 1-120.
- Ris, F., 1909b. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue systématique et descriptif. Libellulinen 2*. 10: 121-244.
- Ris, F., 1910. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue systématique et descriptif. Libellulinen 3*. 11: 245-384.
- Ris, F., 1911a. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue systématique et descriptif. Libellulinen 4*. 12: 385-528.
- Ris, F., 1911b. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue systématique et descriptif. Libellulinen 5*. 13: 529-700.
- Ris, F., 1912. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue systématique et descriptif. Libellulinen 6*. 14: 701-836.
- Ris, F., 1913a. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue systématique et descriptif. Libellulinen 7*. 15: 837-964.
- Ris, F., 1913b. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue systématique et descriptif. Libellulinen 8*. 16 (Première partie): 965-1042.
- Ris, F., 1913c. Neuer Beitrag zur Kenntnis der Odonatenfauna von Argentina. *Mémoires de la Société de Belgique* 22: 55-102 (1-48 separate).
- Ris, F., 1918. Libellen (Odonata) aus der Region der amerikanischen Kordilleren von Costarica bis Catamarca. *Archiv für Naturgeschichte* A(9): 1-197.
- Ris, F., 1919. Collections Zoologiques du Baron Edm. de Selys Longchamps. *Catalogue Systématique et descriptif. Libellulinen 9*. 16 (Deuxième partie): 1043-1278.
- Sahlén, G. & I. Hedström, 2005. The larva of *Mecistogaster linearis*, with notes on its abundance in lowland rainforest of Costa Rica (Odonata: Pseudostigmatidae). *International Journal of Odonatology* 8: 59-66.
- Selys-Longchamps, Edm. de, 1853. Synopsis des Caloptérygines. *Bulletin de l'Académie royale de Belgique* 20(Annexe): 1-73.
- Selys-Longchamps, Edm. de, 1854. Monographie des Caloptérygines. *Mémoires de la Société royale des Sciences de Liège* 9: xi + 291 pp.
- Selys-Longchamps, Edm. de, 1854. Synopsis des Gomphines. *Bulletin de l'Académie royale de Belgique* 21: 23-112 (1-93 reprint).
- Selys-Longchamps, Edm. de, 1857. "1856" [1857]. *Odonates de Cuba*. pp. 183-201, In: Ramón de la Sagra (Ed.), *Historia física política y natural de la Isla de Cuba. Segunda parte. Historia natural* [Natalia. Tomo VII. Crustáceos, Arácnidos é Insectos. Paris; Arthus Bertrand; Artículos de animales xxxii + 371.
- Selys-Longchamps, Edm. de, 1858. Monographie de Gomphines. *Mémoires de la Société royale des Sciences de Liège* 11: 257-720 (xiii + 460 reprint).
- Selys-Longchamps, Edm. de, 1859. Additions au synopsis des Caloptérygines. *Bulletin de l'Académie royale de Belgique* (2)7: 437-451 (1-16 reprint).
- Selys-Longchamps, Edm. de, 1859. Additions au Synopsis des Gomphines. *Bulletin de l'Académie royale de Belgique* (2)7: 530-552 (1-26 reprint).
- Selys-Longchamps, Edm. de, 1860. Synopsis des Agrionines, Première légion: *Pseudostigma*. *Bulletin de l'Académie royale de Belgique* (2)10: 9-26 (1-20 reprint).
- Selys-Longchamps, Edm. de, 1860. Synopsis de Agrionines, Dernière Légion: *Protonevra*. *Bulletin de l'Académie royale de Belgique* (2)10: 431-462 (1-34 reprint).
- Selys-Longchamps, Edm. de, 1862. Synopsis des Agrionines, Seconde légion: *Lestes*. *Bulletin de l'Académie royale de Belgique* (2)13: 287-338 (1-54 reprint).
- Selys-Longchamps, Edm. de, 1862. Synopsis des Agrionines, Troisième légion: *Podagrion*. *Bulletin de l'Académie royale de Belgique* (2)14: 5-44 (1-42 reprint).
- Selys-Longchamps, Edm. de, 1865. Synopsis des Agrionines, 5me légion: *Agrion*. *Bulletin de l'Académie royale de Belgique* (2)20: 375-417 (1-45 reprint).
- Selys-Longchamps, Edm. de, 1868. Note sur quelques odonates nouveaux du Mexique. *Bulletin de l'Académie royale de Belgique* (2)20: 418-422 (1-4 reprint).

- Entomologique de Belgique* 11: 66-71.
- Selys-Longchamps, Edm. de, 1869. Secondes additions au synopsis des Caloptérygines. *Bulletin de l'Académie royale de Belgique* (2)27: 645-680 (1-36 reprint).
- Selys-Longchamps, Edm. de, 1869. Secondes additions au synopsis des Gomphines. *Bulletin de l'Académie royale de Belgique* (2)28: 168-208 (1-45 reprint).
- Selys-Longchamps, Edm. de, 1869. Secondes additions au synopsis des Gomphines. *Bulletin de l'Académie royale de Belgique* (2)28: 168-208 (1-45*).
- Selys-Longchamps, Edm. de, 1870. Resume d'une nouvelle classification des Cordulines. *Bulletin de l'Académie royale de Belgique* 14: 4-7.
- Selys-Longchamps, Edm. de, 1871. Synopsis des Cordulines. *Bulletin de l'Académie royale de Belgique* (2)31: 238-316 (1-128 reprint).
- Selys-Longchamps, Edm. de, 1873. Troisièmes additions au synopsis des Caloptérygines. *Bulletin de l'Académie royale de Belgique* (2)35: 469-519 (1-55 reprint).
- Selys-Longchamps, Edm. de, 1873. Appendice aux troisièmes additions au synopsis des Caloptérygines. *Bulletin de l'Académie royale de Belgique* (2)36: 610-619 (57-66 reprint).
- Selys-Longchamps, Edm. de, 1873. Troisièmes additions au synopsis des Gomphines. *Bulletin de l'Académie royale de Belgique* (2)35: 732-774, (2)36: 492-531 (1-87 reprint).
- Selys-Longchamps, Edm. de, 1873. Appendices aux troisièmes additions et liste des Gomphines, décrites dans le synopsis et ses trois additions. *Bulletin de l'Académie royale de Belgique* (2)36: 492-531 (47-87 reprint).
- Selys-Longchamps, Edm. de, 1874. Additions au synopsis des Cordulines. *Bulletin de l'Académie royale de Belgique* (2)37: 16-34 (1-24 reprint).
- Selys-Longchamps, Edm. de, 1876. Synopsis des Agrionines, 5me légion: *Agrion* (suite). Le genre *Agrion*. *Bulletin de l'Académie royale de Belgique* (2)41: 247-322, 496-539, 1233-1309 (1-199 reprint).
- Selys-Longchamps, Edm. de, 1876. Synopsis des Agrionines, 5me légion: *Agrion* (suite). Le genre *Agrion*. *Bulletin de l'Académie royale de Belgique* (2)42: 490-531, 952-991 (200-282 reprint).
- Selys-Longchamps, Edm. de, 1877. Synopsis des Agrionines, 5me légion: *Agrion* (suite et fin). Les genres *Telebasis*, *Argiocnemis* et *Hemiphlebia*. *Bulletin de l'Académie royale de Belgique* (2)43: 97-159 (1-65 reprint).
- Selys-Longchamps, Edm. de, 1878. Quatrièmes additions au synopsis des Gomphines. *Bulletin de l'Académie royale de Belgique* (2)46: 408-698 (1-106 reprint).
- Selys-Longchamps, Edm. de, 1878. Secondes additions au synopsis des Cordulines. *Bulletin de l'Académie royale de Belgique* 2(45): 183-222 (1-44 reprint).
- Selys-Longchamps, Edm. de, 1879. Quatrièmes additions au synopsis des Caloptérygines. *Bulletin de l'Académie royale de Belgique* (2)47: 349-409 (1-63 reprint).
- Selys-Longchamps, Edm. de, 1883. Synopsis des Aeschnines. Première partie: Classification. *Bulletin de l'Académie royale de Belgique* 3(5): 712-748 (1-40 reprint).
- Selys-Longchamps, Edm. de, 1886. Revision du Synopsis des Agrionines. Première partie comprenant les légions *Pseudostigma-Podagrion-Platycnemis* et *Protonevra*. *Mémoires couronnés et autres Mémoires, Académie royale de Belgique* 38(4): iv + 233.
- Selys-Longchamps, Edm. de, 1889. *Protonevra*, nouveau genre d'Agrionines de la légion des Protonevras. *Annales de la Société Entomologique de Belgique* 33: 172-174.
- Torreias, S.R.S., U.G. Neiss, N. Hamada, R.L. Ferreira-Keppler & F.A.A. Lencioni, 2008. Description of the larva of *Bromeliagrion rehni* (Odonata: Coenagrionidae) with bionomic notes concerning its phytotelmic habitat in central Amazonas, Brazil. *Revista Brasileira de Zoologia* 25: 479-486.
- Trapero-Quintana, A.D. & N. Cuéllar Araújo. 2009. Description of the last instar larva of *Cannaphila insularis funerea* (Carpenter, 1897) (Anisoptera: Libellulidae), with notes on the habitat of the species. *Zootaxa* 2034: 61-64..
- Trapero-Quintana A.D. & B. Reyes Tur, 2008. Description of the last instar larva of *Erythrodiplax fervida* (Erichson, 1848). *Zootaxa* 1688: 66-68.
- Trapero-Quintana, A., M.A. Tabet, B.R. Tur, Y.A. Jiménez & M. López, 2008. Notes on the Odonata of Refugio de Fauna Monte Cabaniguán, Las Tunas, Cuba. *Bulletin of American Odonatology* 11: 26-28.
- Trapero Quintana A. D., Y. Torres Cambas, C. Naranjo Lopez & O. C. Bello Gonza, 2004. Annotated list of the odonates in the Alexander Humboldt National Park, Guantanamo Province, Cuba. *Argia* 16(2): 16-19.
- Upson, S., D. Danforth, E. Gonzalez-Soriano, R.A. Behrstock & R.A. Bailowitz, 2007. A preliminary checklist of the odonata of Sonora, Mexico. *Bulletin of American Odonatology* 10: 23-51.
- von Ellenrieder, N., 2005. Taxonomy of the South American genus *Phyllopetalia* (Odonata: Austropetaliidae). *International Journal of Odonatology* 8: 311-352.
- von Ellenrieder, N., 2006. The larvae of *Teinopodagrion decipiens* De Marmels and *T. meridionale* De Marmels (Zygoptera: Megapodagrionidae). *Odonatologica* 35: 281-287.
- von Ellenrieder, N., 2007a. The larva of *Argia joergenseni* Ris (Zygoptera: Coenagrionidae). *Odonatologica* 36: 89-

- von Ellenrieder, N., 2007b. Some libellulidae larvae from the Yungas Forest, Argentina: *Macrothemis hahneli* Ris, *Brechmorhoga nubecula* (Rambur) and *Dasythemis mincki clara* Ris (Anisoptera: Libellulidae). *Odonatologica* 36: 263-273.
- von Ellenrieder, N., 2007c. The larva of *Hetaerina mendezii* Jurzitza, with comments on *H. rosea* Selys (Zygoptera: Calopterygidae). *Odonatologica* 36: 405-414.
- von Ellenrieder, N., 2008a. *Phoenicagrion* gen. nov. for *Leptagrion flammeum*, with description of a new species, *P. paulsoni*, from Peru (Odonata: Coenagrionidae). *International Journal of Odonatology* 11: 81-93, pl. IVb.
- von Ellenrieder, N., 2008b. Revalidation of *Argentagrion* and redefinition of *Homeoura*, with the description of *H. obrieni* n. sp. (Odonata: Coenagrionidae). *Revista de la Sociedad entomológica Argentina* 67: 81-106.
- von Ellenrieder, N. & J. Muzón, 2006. The genus *Andinagrion*, with description of *A. garrisoni* sp. nov. and its larva from Argentina (Zygoptera: Coenagrionidae). *International Journal of Odonatology* 9: 205-223.
- von Ellenrieder, N. & R. W. Garrison, 2005. A synopsis of the South American genus *Gomphomacromia* (Odonata: Gomphomacromiinae). *International Journal of Odonatology* 8: 81-96.
- von Ellenrieder, N. & R. W. Garrison, 2006. Rediscovery of *Oxyagrion bruchi* Navás, 1924 from Argentina, with a description of its larva (Zygoptera: Coenagrionidae). *Pan-Pacific Entomologist* 82: 362-374
- von Ellenrieder, N. & R. W. Garrison, 2007a. *Libélulas de las Yungas* (Odonata). *Una Guía de Campo para las especies de Argentina / Dragonflies of the Yungas. A Field Guide to the Species from Argentina*. Pensoft Series Faunistica 67. Pensoft Publishers iv + 116 pp.
- von Ellenrieder, N. & R. W. Garrison, 2007b. *Dragonflies and Damselflies (Insecta: Odonata) of the Argentine Yungas: Species composition and identification*. Scientific Reports, Società Zoologica 'La Torbiera' 7: 1-95.
- von Ellenrieder, N. & R. W. Garrison, 2008a. *Oreiallagma* gen. nov. with a redefinition of *Cyanallagma* Kennedy 1920 and *Mesamphiagrion* Kennedy 1920, and the description of *M. dunklei* sp. nov. and *M. ecuatoriale* sp. nov. from Ecuador (Odonata: Coenagrionidae). *Zootaxa* 1805: 1-51.
- von Ellenrieder, N. & R. W. Garrison, 2008b. *Drepanoneura* gen. nov. for *Epipleoneura letitia* and *Protoneura peruviansis*, with descriptions of eight new Protoneuridae from South America (Odonata: Protoneuridae). *Zootaxa* 1842: 1-34.
- von Ellenrieder, N. & Garrison, R. W., 2009. Odonata. In: Dominguez, E. & Fernández H. R. (eds.). *Macroinvertebrados Bentónicos Sudamericanos*. Fundación Miguel Lillo, Tucumán.
- Wasscher, M. & J. van't Bosch, 2009. Database of Suriname dragonflies. *Agrion* 13: 27-28.

Some Odonata from the Northern Sierra Madre Natural Park, Isabela, Luzon, Philippines

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The Northern Sierra Madre Natural Park (NSMNP) covers an area of 359,486 ha (DENR 2001). The park harbors a variety of terrestrial habitats: mangrove forests and beach forests along the coast, ultra-basic forest, lowland dipterocarp forest, and montane oak-laurel forest and mossy forest at high elevations (Mallari et al., 2001). The NSMNP is one of ten priority protected areas in the Philippines: it holds 25 percent of the remaining primary lowland forest of the archipelago (Tan, 2000). The area has remarkably high levels of endemism: 30 percent of bird species and 62 percent of mammal species recorded in the NSMNP are endemic to the Philippines (Van Weerd 2002). Thirty-five globally threatened species are recorded in the protected area.

Logging, agricultural encroachment, the use of destructive fishing and hunting methods, and the conversion of wetlands form major threats to the biodiversity of the protected area. Government plans for infrastructural development and mining could have a severe impact on the park.

From 12 to 24 September 2008, we organized a biodiversity survey to sitio Dipagsangan, barangay Didian in the municipality of Palanan. We camped in lowland dipterocarp forest at Dipinantahikan (campsite 1), and in mid-elevation forest at Pinakdatdatin ti Bulayo (campsite 2) (see table 1).

	Altitude (m.a.s.l)	Location
Dipinantahikan (campsite 1)	300	N 16° 53.398' E 122° 20.471'
Pinakdatdatin ti Bulayo	700	N 16° 51.984' E 122° 18.859'

The following is an annotated list of the species encountered during the expedition. We only include species found in the forest areas; species encountered near Palanan town proper are not included. The short field survey revealed 35 species, and represents the first odonata survey in the eastern side of NSMNP. New records

are predominantly zygopteran, which, with one exception, are all endemic. This shows the remarkable odonata assemblage in this largest remaining Philippine forest block. The present list is the result of a short fieldwork period (with field days further shortened by a tropical depression hitting the area during the survey). Additional species are to be expected when more fieldwork is conducted during good weather conditions. More field work is also necessary to provide distributional data for the undescribed species.

Platystictidae

Drepanosticta sp. (?n.)

Large solitary species presumed endemic in Luzon Island. The species was found perching in well shaded areas of the creek. It belongs to the *Drepanosticta halterata*-group and is allied to the undescribed species from Cebu and Bohol islands characterized by a triangular-shaped posterior lobe process.

Drepanosticta halterata (Brauer, 1868)

The dominant zygopteran encountered in well shaded rheophilous areas.

Drepanosticta moorei van Tol, 2001

This Luzon endemic was encountered beside a partially shaded creek perching high on the shrubs.

Protosticta lepteca van Tol, 2005

A dainty north central Luzon species.

Sulcosticta sp. n.

In the field the species at first glance resembles lestids with the abdomen positioned like a golf-tee. This small species perched among hanging vines and roots a few feet from the ground.

Coenagrionidae

Amphicnemis isabelae Gapud, 2006

This species was described based on a single male collected in the Forest Dynamic Plot, Palanan in 2004 (Gapud, 2006). The species was encountered perching near the forest floor with no nearby water source.

Pseudagrion p. pilidorsum (Brauer, 1868)

This was the only Oriental damselfly species encountered in the area.

Teinobasis cf. filiformis (Brauer, 1868)

Two mature males of this Luzon region endemic were encountered.

Teinobasis nigra Campion and Laidlaw, 1928

The species is a Luzon endemic. It was encountered above a stagnant portion of the stream with muddy substrate.

Teinobasis samaritis Ris, 1915

Platycnemididae

Risiocnemis arator Hamalainen, 1991

Risiocnemis atropurpurea (Brauer, 1868)

Risiocnemis ignea (Brauer, 1868)

Risiocnemis incisa Kimmins, 1936

This north and central Luzon endemic was encountered at forest seepages, small streams and springs, though occurring in lower numbers than the similar *R. ignea*.

Risiocnemis elegans Kitagawa 1990

The species is a north Luzon endemic. It was encountered in shaded seepages and even in moist forest floor several meters from water sources. Pairs were seen ovipositing on moist moss with no standing or running water nearby. *Risiocnemis varians* was listed by Gapud (2006) from Forest Dynamic Plot, Palanan. We believe this was a misidentification of *Risiocnemis elegans*, whose type locality is San Mariano, Isabela.

Risiocnemis sp. n.1

The species was encountered only in the stream running along ultrabasic forest. The only member of the genus noted perching in warm well-lit areas.

Risiocnemis sp. n.2

The species was encountered in low numbers in the site occupied by the previous species. The species resembles *R. arator* in the shape of the inferior anal appendage while the superior anal appendage resembles that of the previous species.

Megapodagrionidae

Argiolestes baltazarae Gapud and Adorada, 2003

The species is presumed endemic in Sierra Madre area. The species was seen in well shaded seepages.

Rhinagrion sp. (n.)

This is a larger species with different bluish markings than *R. philippina*.

Chlorocyphidae

Cyrano unicolor (Hagen in Selys, 1869)

The species is a Luzon and Western Visayas endemic. Only the red form was noted in the survey area.

Rhinocypha colorata (Hagen in Selys, 1969)

Rhinocypha turconii Selys, 1891

This species was seen in less disturbed lowland forest areas compared to its congener and was more abundant in the campsite at Dipinantahikan (primary lowland forest) than in Dipagsangan, a small village (rice fields and orchards in secondary lowland forest).

Calopterygidae

Neurobasis luzoniensis Selys, 1873

This large beautiful metallic green damselfly is endemic in the Luzon region. The species prefers undisturbed habitat and is known to be dwindling in central Luzon areas.

Vestalis melania Selys, 1873

This endemic species is widely distributed in the archipelago, except Palawan.

Gomphidae

Gomphidia kirschii Selys, 1878

Aeshnidae

Tetracanthagyna sp. (based on larva)

Dredging done on selected areas revealed middle instar larva of the species.

Chlorogomphidae

Chlorogomphus sp.

The species closely resembles *C. dyak* but with several differences.

Corduliidae

Heteronaias heterodoxa (Selys, 1878)

This widespread endemic species was encountered only on a few occasions.

Idionyx philippa Ris, 1912

A specimen was noted at the first campsite in Dipinantahikan.

Libellulidae

Diplacina bolivari Selys, 1882

Lyriothemis ?cleis (could not be verified based on quick sighting)

The identity of the species could not be confirmed due to a very brief sighting of a single male perching near the campsite on Pinakdatdatin ti Bulayo.

Onychothemis abnormis Brauer, 1868

A single male of this rare genus was encountered.

Orthetrum pruinosum clelia (Selys, 1878)

Orthetrum s. sabina (Drury, 1770)

Pantala flavescens (Fabricius, 1798)

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Literature

DENR. 2001. *Management plan Northern Sierra Madre Natural Park*. DENR. Palanan.

Gapud, V.P. 2006. Damselflies (Odonata: Zygoptera) Of Greater Luzon, Philippines with Description of two new species. *Philippine entomologist* **19**(2): 1-42

Mallari, N.A.D., B.R. Tabaranza Jr. & M.J. Crosby. 2001. *Key conservation sites in the Philippines*. Haribon Foundation and Birdlife International. Bookmark Inc., Makati.

Tan, J.M.L. 2000. *The last great forest: Luzon's Northern Sierra Madre Natural Park*. Bookmark. Makati City.

Van Weerd, M. 2002. *Summary report of the fauna study results in the Northern Sierra Madre Natural Park*. Plan International NSMNP-CP. Cabagan.

Some new provincial records of Odonata made in Thailand in 2007–2009 and a new record for Vietnam

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In 2005–2009 we made several visits to Thailand in winter and made observations and collections of Odonata, including some new provincial records. Those of the first visit in 2005 were published in *Agrion* (Kosterin, 2006), and an extended version of our odonatological data and impressions, updated with those of the visit in January 2006, was published in *Malangpo* (Kosterin & Vikhrev, 2008). We have to make a correction to these two publications: the locality Sai Kaew beach in Chon Buri province, which we thought to be on Ko Khram island as misled by a local boatman, was in fact on a peninsula, N of Ban Bang Sare at 12°44'31.39" N, 100°50'31.84" E. Below, we present our findings made during further trips. The new provincial records with reference to the distributional atlas by Hämäläinen & Pinratana (1999) and later additions (Pinratana, 2003) were kindly confirmed by Dr. M. Hämäläinen. Most of the trips were undertaken by one of us, Nikita Vikhrev, a dipterologist who concentrated his attention on flies but made occasional collections and photos of Odonata. He visited the environs of Pattaya and Chan-ta-Then Waterfalls (Chon Buri Province) and the Khao-Khitchatut National Park (Chanthaburi Province) in November 2006, December 2007, December 2008 and February 2009; the Khao-Chamao-Khao-Wong National Park (Rayong Province) in December 2007 and December 2008, and the Pong Nam Ron environs (Chanthaburi Province) in December 2008 and February 2009. In the second half of February we made a joint trip to the island of Phuket.

New records are listed below. Coordinates were taken from Google Earth. All our photos of odonates have been or will be uploaded to the Asia Odonata Home Page by Eric Gibert: <http://www.asia-dragonfly.net/index.php>; and the photos by the first author to be soon available at his own page at: <http://pisum.bionet.nsc.ru/kosterin/odonata/thailand.htm>.

New records for Thailand provinces

Rayong Province:

Vestalis gracilis (Rambur, 1842): 1 ♂, 1 ♀ photographed - Khao-Chamao – Khao-Wong National Park, 10.12.2008.
Heliocypha biforata (Selys, 1859): 1 ♂, 1 ♀ photographed - Khao-Chamao – Khao-Wong National Park, 11.12.2007; 1 ♀ photographed – the same place, 8.12.2008, 1 ♂, photographed – the same place, 10.12.2008
Aciagrion pallidum Selys, 1891: 1 ♂ photographed - Khao-Chamao – Khao-Wong National Park, 10.12.2008.
Ceriagrion indochinense Asahina, 1967: 1 ♂, 1 ♀ collected – a dry forest at Banthe, 6.12.2008.
Coelliccia yamasakii Asahina, 1984: 1 ♂ photographed - Khao-Chamao – Khao-Wong National Park, 11.12.2007.

Chanthaburi Province:

Ceriagrion praetermissum Lieftinck, 1929: 1 ♀ - the Krating Country Resort environs (2–3 km S of the Khao-Khitchakut National Park office), 21–23.12.2007.

Sa Kaeo Province:

Agriocnemis femina femina Lieftinck, 1929: 3 ♂, 1 ♀ collected – a roadside pool at Sa Kaeo, 9.02.2009.

Phuket Province:

Echo modesta (Selys, 1860): 1 ♂, 1 ♀ photographed – Khao Phra Theo National Park, Ton Sai rivulet headwaters, herbs at a path through virgin forest, 8°01'49" N, 98°22'21" E, 19.02.2009 (both individuals persisted nearby each other); 2 ♀ visually – the same place, a bit downstream, 27.02.2009; 1 ♂, 1 ♀ photographed – Khao Phra Theo National Park, the Bang Pae valley upper part, 8°02'09" N, 98°22'54" E, 27.02.2009.

Vestalis anne Hämäläinen, 1985: 1 ♂ collected, 1 ♂ and ♀ photographed – Khao Phra Theo National Park, the Bang Pae valley upper part, 27.02.2009. The male specimen is reliably identified by the labium colouration and the structure of the upper appendages (Hämäläinen, 1985); the individuals photographed were found nearby and their identification is putative (but certainly they were not *Vestalis gracilis*, met with at some distance).

Podolestes coomansi Lieftinck, 1940: 1 ♀ collected – a grassy swamp in Nai Yang beach area, 8°05'27.3" N, 98°18'13.7" E, 17.02.2009; 2 ♂, 1 ♀ collected – the same place, 20.02.2009; 1 ♂ collected – the same place, 21.02.2009. This species (and genus) has already been discovered, quite unexpectedly, in three central provinces of Thailand: Nakhon Sawan, Pathum Thani and Nakhon Patom (Makbun, 2009). Our specimens fit perfectly to the original description by Lieftinck (1940) in every detail, including the male appendage structure, with the only minor difference being a more distinct pattern in the mesepimeron fore part: it is of a dark ground colour with a small distinct roundish blue spot at the level of the hind end of the large wedge-shaped antehumeral blue spots above them, on the mesepisternum (Fig. 1) (in the figure of the original description the mesepimeron fore part has

Fig. 1. *Podolestes coomansi*, a male, a swamp in Nay Yang Beach area, 17.02.2009.



an indistinct pattern). This spot is also seen on the photographs of Thai specimens of *P. coomansi* from Nakhon Sawan by Mr. Noppadon Makbun (Malangpo 32: cover) and from Nakhon Patom (www.siamensis.org/board/10242.ht). All our specimens had brownish rather than black ground colour, and were obviously young. It was surprising to find this species so close to Peninsular Malaysia from where only *Podolestes orientalis* Selys, 1862 and *P. buwaldai* Lieftinck, 1940 are known (Orr, 2005). This very specific damselfly appeared to be numerous (about 8-10 individuals per 100 m walk) on a swamp 120 x 120 m situated at 'Dang Bungalow' about 700 m from the sea, dry in this season, of quite undisturbed appearance, overgrown with some Poacea grass of human height and densely twined by a winding fern *Ligodium* sp. and the pitcher plant *Nepenthes mirabilis* (Lour.) Druce, 1918 (Fig. 2). Of 8 individuals of *P. coomansi* observed on 17.02, 6 were females, one being fresh, others mostly young (with dull greyish-

blue instead of bright blue) patches, from 20.02 both sexes were equally common, from 21.02 fully coloured individuals were common, and on 28.02 a pair in copula was observed. Nearby (8°05'26.4" N, 98°18'10.2" E) was another swamp, 210 x 150 m (at 'Dee Bungalow'), also dry, of an appearance more familiar for a northern observer: with lower grass dominated by *Eleocharis* sp. with *Scirpus* sp., *Aconogonon* sp. and some Thelypteridaceae fern, locally with *Typha* sp. It was visited three times: on 17.02 one individual of *P. coomansi* was found there, on 21.02 they were as numerous as at the previous swamp, including young individuals with glistening wings and dull marking, while on 28.02 they were absent, although in the former swamp being as numerous as usually. Lieftinck (1954: 28) indicated the following habitat of *P. coomansi*: "Marshy spot in second growth forest". In our case there were just narrow patches of trees separating wide swamps. It was noteworthy that during our observations both swamps had no surface water (damp ground at most) but all individuals of *P. coomansi* were young and some almost teneral. We may suppose that the larvae can tolerate seasonal drying of the habitat.

Ceragrion auranticum Fraeser, 1922: 2 ♂, 3 ♀ collected – the same grassy swamp with *Nepenthes* in Nai Yang beach area where *Podolestes coomansi* occurred, P, 8°05'27.3" N, 98°18'13.7" E, 17.02.2009; 1 ♀ collected – the second, *Eleocharis* swamp nearby, 8°05'26.4" N, 98°18'10.2" E, 21.02.2009. These damselflies were extremely numerous at the *Nepenthes* swamp from where they penetrated to the nearby lawns; at the *Eleocharis* swamp only the single female was met with.

Pseudagrion williamsoni Fraeser, 1922: 1 ♂ collected – a pond on a rivulet flowing to the western coast between Ban Naithon and Ban Layan, 8°02'34.6" N, 98°16'48.4" E, 19.02.2009. (A male and female of *Pseudagrion pruinosum* (Burmeister, 1839) were observed in the same place).

Argiocnemis rubescens rubeola Selys, 1877: 1 mature ♂ collected – a grassy slope at a bank of the rivulet at its mouth at Naithon beach, 8°03'47.2" N, 98°16'38.9" E; 17.02.2009; 1 mature ♂ photographed – a pond on a rivulet flowing to the western coast between Ban Naithon and Ban Layan, 8°02'34.6" N, 98°16'48.4" E, 22.02.2009.

Coeliccia albicauda (Förster in Laidlaw, 1907): 1 ♂ collected - pristine forest in the Bang Pae valley, on a bush, 8°02'09" N, 98°22'54" E, 19.02.2009; 1 mature ♂ photographed, 1 not fully coloured ♂ collected – the same place, 27.02.2009; 1 ♂, 1 ♀ collected - a rivulet flowing to the western coast between Ban Naithon and Ban Layan, overgrown with secondary forest with a lot of bamboo and old *Gewea* trees, 8°02'36" N, 98°16'48" E, 19.02.2009; 1 ♀ collected – the same place, 26.02.2009. Of two males met on 27.02, one was mature and exhibited the colouration characteristic for the species while another one was obviously young and, instead of two pairs of bluish spots on a black background on the pterothorax, had contiguous but dorsally incised whitish

humeral stripes on brownish background (Fig. 3). The same young male was observed [together with 1 female of *C. albicauda* and 2 males and 1 female of *C. didyma* (Selys, 1863)] on 23.02.2009 at Khao Khuan Kha Mt., 5 km NE of Khok Kloi, Phang Nga Province (8°18'04.5" N, 98°20'08.8" E).

Prodasineura collaris (Selys, 1860): 1 ♂ collected- an old *Gewea* plantation overgrown with wild vegetation on a steep eastern slope of a brook valley near Ban Sakhu, 8°04'02,8" N, 98°18'30.6" E, 16.02.2009. A photo of a male, taken by René Manger on 1.03.1994 in Khao Phra Theo National Park, is present in the database at <http://www.asia-dragonfly.net> (but subscribed by the author as *Prodasineura* sp. and identified by someone else). It is interesting that it was *P. laidlawii* (Förster in Laidlaw, 1907) which we observed very numerous at the Bang Pae river (flowing to the eastern coast) in the same (very small) Khao Phra Theo National Park, as well as at the rivulet flowing to the west coast between Ban Naithon and Ban Layan, but not a single individual of *P. collaris* was recorded among them (while the rivulet of the Kathu waterfalls in the south-western part of the island for some reason lacked lotic odonates but for *Zygonyx iris malayana* (Laidlaw, 1902)).

Gomphidia abbotti (Williamson, 1907): 2 ♂ photographed – Khao Phra Theo National Park, the Ban Pae river flowing among huge boulders downstream of waterfalls, 8°02'21.4" N, 98°23'27.9" E, 19.02.2009; 1 ♂ visually – the same place, 27.02.2009; 1 ♂ collected - a rivulet flowing to the western coast between Ban Naithon and Ban Layan, below the pond dam, 8°02'34.6" N, 98°16'48.4" E, 22.02.2009. Our specimen, as well as the individuals photographed, belong to the dark form A according to Asahina (1986); the collected specimens have even further shrunken light pattern than described by him as the yellowish-white stripe on the labrum is interrupted at the middle (Fig. 4).

Tetrathemis irregularis hyalina Kirby, 1889: 1 ♂ photographed - Khao Phra Theo National Park, the Ban Pae river downstream of waterfalls, 8°02'21.4" N, 98°23'27.9" E, 19.02.2009. The male perched at a small twig near a pool at a boulder in the valley bed; upon revisiting this place on 27.02.2009 it was not observed.

Pseudothemis jorina (Förster, 1904): 1 ♂ photographed – a huge pond at a road 1 km NE of Khao Sai Tan Kiang Mt., 8°05'25" N, 98°19'24" E, 18.02.2009. The male perched on a dry branch hanging over the open water in the pond corner with dense tree stand at the steep bank.

Orchithemis pulcherrima Brauer, 1878: 1 ♀ collected (among females of *Neurothemis fluctians* (Fabricius, 1793)) - a hill crest with old *Gewea* stand overgrown by forest vegetation near Ban Sakhu, 8°03'57.7" N, 98°18'19.4" E, 16.02.2009. The female is rather large (hind wing 26 mm long) and has almost even brownish colouration: abdomen brown, unmarked except for black lateral and hind (but not middorsal) carinae, thorax unmarked yellowish-brown, fore side of pterothorax hairy with the hairs rising from dark specks, legs brownish with dark spines, head brown,

Fig. 2. Habitat of *Podolestes coomansi*, a swamp in NayYang Beach area. 28.02.2009.



Fig. 3. *Coeliccia albicauda*, an immature (right) and mature (left) male the Bang Pae valley, Khao Phra Theo National Park, 27.02.2009



hairy, frons and vertex with some greenish lustre. These characters might indicate *O. pruinans* (Selys, 1878) (Orr, 2005) but Mr. Rory Dow who kindly agreed to examine the specimen photo identified it as *O. pulcherrima* by certain venational characters.

Hydrobasileus croceus (Brauer, 1867): 1 ♂ collected, several visually – the same pond as above but its shallower part at the slope forest, 18.02.2009; several ♂ visually – a huge pond at Ban Layan, 8°02'31.9" N, 98°18'10.5" E, 25.02.2009; 1 ♂ visually – a pond on the Bang Pae rivulet at the National

Park headquarters, 8°02'19.6" N, 98°23'29.1" E, 27.02.2009. Several males patrolled 2-4 m above the water surface. In the former locality an exuviae of this species was found in grass at the bank.

Orthetrum luzonicum (Brauer, 1868): 1 ♀ collected – a pass through a hilly ridge between Ban Sakhu and Ban Naithon, an old *Gewea* plantation, 8°03'48.2" N, 98°17'14.4" E, 26.02.2009.

Potamarcha congener (Rambur, 1842): 1 ♂ visually – grassy and muddy riverside swamps at SW suburbs of Thalang, 8°01'32.6" N, 98°19'39.0" E, 21.02.2009; 1 ♂ photographed, 1 ♀ collected – small muddy pools at a buffalo pasture, 8°04'53.7" N, 98°18'05.6" E, 28.02.2009 (the male perched, the female oviposited).

Macrodiplax cora (Brauer, 1867): 1 ♂ photographed – a huge pond at Ban Layan, 8°02'31.9" N, 98°18'10.5" E, 22.02.2009. The male perched on a prominent grass at an open and clear bank. Not observed upon a revisit on 25.02.2009, perhaps we saw a stray from the mangrove banks.

Totally, for the second half of February we met 47 odonate species in Phuket.

Some other observations and collections

The Krating River valley, including the Khao Khitchakit National Park (Chanthaburi Province) was a site repeatedly visited in the same dry season, each time some additional species being recorded. To those reported in (Kosterin & Vikhrev, 2008), we add *Argiocnemis rubescens rubeola* Selys, 1877, a juvenile (red) female of which was observed and photographed on 20.11.2006 in the lower reaches of the Krating falls. On 21-23.12.2007, the environs of the Krating Country Resort, 2-3 km S of the Khao-Khitchakut National Park office but beyond the park territory were visited. This area was situated at the foot of the same mountain but had no rivers, there was just a shady brook or ditch about 5 m wide. At this ditch, at meadows and forest and plantation edges, quite a handful of Zygoptera were collected: *Aristocypha fenestrella* (1 teneral ♂), *Copera ciliata* (2 ♂), *C. vittata* (1 ♂), *Prodasineura autumnalis* (1 ♂), *Argiocnemis femina* (1 ♂), *A. pygmaea* (1 ♂), *Mortonagrion aborensense* (Laidlaw, 1914) (2 ♂), *Aciagrion borneense* (6 ♂, 4 ♀), *A. pallidum* (4 ♂, 1 ♀), *Archibasis oscillans* (1 ♀) and *Ceriagrion praetermissum* (1 ♀). On 9.02.2009 a male of *Idionyx thailandica* Hämäläinen, 1985 was collected, which fluttered slowly among bush branches.

On 2.12.2008 at the Jomtien beach in Pattaya (Cho Buri Province) a male of *Zyxomma petiolatum* Rambur, 1842 was found, with non-coloured wing tips, attracted by light to a hotel, which is a common habit of this species, which is uncommon in Thailand (Hämäläinen & Pinratana, 1999).

Congregations of different species of *Rhyothemis* seem to be a commonplace. Earlier we observed one female of *R. phyllis* among a group of three females of *R. variegata* in Chon Buri Province (Kosterin, Vikhrev, 2008), both species being of the same size and similar principle colouration. At a large, shallow and muddy roadside pond 5.8 km S of Khok Kloi, 8°13'31.1" N, 98°17'55.8" E, on 23.02.2009 we observed together two *Rhyothemis* species very dissimilar in size and wing colouration: a male of *R. phyllis* and a male of *R. triangularis*

perched nearby (within 1-2 m) on lotos stalks.

A new record for Vietnam

Dr. Pavel Kvartalnov, an ornithologist from Moscow State University who for a long time worked in Vietnam, has kindly sent us a male specimen collected by him in late June 2008 in grass at a pool at the Cattien National Park headquarters, which has turned out to be *Agriocnemis nana* (Laidlaw, 1914), not listed for Vietnam in Tsuda (2000) and Do & Dang (2006). The black pattern of tergite VIII consists of a black dorsal patch broad at the segment base and narrowing to but not touching its distal margin, with a pair of black dots at the end (the same in a male from Chanthabury, Thailand (Kosterin & Vikhrev, 2008) and two males from Angkor Wat, Cambodia (Kosterin & Vikhrev, 2006) available to us), that is corresponds to *Agriocnemis naia* Fraeser, 1923 (Fraeser, 1933) later synonymised to *A. nana* by D. E. Kimmins (1966).

Acknowledgements

We express our gratitude to Mr. R. Dow (Surrey) for identification of *Orchithemis*, to him and Dr. Vincent Kalkman (Leiden) for many valuable comments, to André Günther (Freiburg) and Bro. Amnuay Pinratana (Bangkok) for help with literature, to Dr. M. Hämäläinen (Helsinki) for his permanent help as an expert in Odonata of Thailand, to Dr. Pavel Kvartalnov (Moscow) for offering a specimen of *A. nana* from Vietnam. Ms. N. Dvoretzkaya (Moscow) and Ms. N. Priidak (Novosibirsk) helped much in the field.

References

- Asahina, S. 1986. A list of Odonata recorded from Thailand. Part XIV. Gomphidae-2. *Tombo* 29 (1-2): 7-53.
- Cuong, D.M., D.T.T. Hoa, 2006. *Checklist of Dragonflies from Vietnam*. Vietnam National University Publisher, Hanoi, Vietnam. 182 pp
- Fraser, F. C. 1933. *Fauna of British India including Ceylon and Burma. Odonata. Vol. 1*. Tailor and Frangis, London, 423 p.
- Hämäläinen, M. 1985. *Vestalis anne* spec. nov., a new species of the *Vestalis amoena* group from Thailand and Burma (Zygoptera, Calopterygidae). *Odonatologica* 14: 345-348.
- Hämäläinen, M. & A. Pinratana. 1999. *Atlas of the dragonflies of Thailand – distribution maps by provinces*. Brothers of Saint Gabriel in Thailand, Bangkok.
- Kimmins, D. E. 1966. A list of the Odonata types described by F.C. Fraser, now in the British Museum (Natural History). *Bull. Brit. Mus. Nat. Hist. (Ent.)* 18(6): 173-227.
- Kosterin, O. E. 2006. The journey of a dilettante. *Agrion* 10(1): 5-7.
- Kosterin, O. R. & N. E. Vikhrev. 2006. Odonata seen during three days in a populated lowland part of Cambodia. *Malangpo* 21: 212-217.
- Kosterin, O. E., N. E. Vikhrev. 2008. Odonatological field notes of two January trips to SE Thailand, in 2005 and 2006. *Malangpo* 22: 222-236.
- Lieftinck, M. A. 1940. Descriptions and records of S.E. Asiatic Odonata. *Treubia* 17: 347-350.
- Lieftinck, M. A. 1954. Handlist of Malaysian odonata. *Treubia* 22, Supplement xiii, 202 p.
- Makbun, N. 2009. Addition to the odonate fauna of Nakhon Sawan, with a new record for Thailand. *Malangpo* 23: 238-242.
- Orr, A. G. 2005. *Dragonflies of Peninsular Malaysia and Singapore*. Nature History Publishers (Borneo), Kota Kinabalu.
- Pinratana, A. 2003. Editorial. *Malangpo* 20: 195.
- Tsuda, S. 2000. *A Distributional List of World Odonata*. Osaka.



Fig. 4. *Gomphidia abbotti*, a perching male, the Bang Pae valley, Khao Phra Theo National Park, 19.02.2009

Observations of the oviposition behaviour of four species of *Euphaea* Selys (Zygoptera: Euphaeidae)

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Introduction

The calopterygoid family Euphaeidae contains eight Indomalayan genera and a single Palearctic genus. The Indomalayan genus *Euphaea* is the most speciose in the family, comprising approximately thirty species (Schorr *et al.*, 2009). Species of *Euphaea* typically inhabit clean, moderate to fast-flowing forest streams, and their robust larvae are found amongst coarse gravel, pebbles and cobbles on the stream bed, often in mid-channel, where the current is at its fastest (Brooks, 2002; Silsby, 2001; Reels & Dow, 2006). This presents adult females with a major problem: how to ensure their eggs are deposited within the larval habitat or as close to the larval habitat as possible?

It is not uncommon for the females of many coenagrionid and calopterygid species to alight on emergent vegetation and slowly submerge themselves by climbing down this support prior to ovipositing in, or very close to, the larval habitat (Brooks, 2002; Corbet, 1999; Silsby, 2001). In the family Chlorocyphidae, adult members of which are often found in the same fast-flowing stream habitats as adult *Euphaea*, females typically lay their eggs on waterlogged, semi-submerged logs and branches close to the larval habitat (leaf litter and gravel in backwaters; A.G. Orr, pers. comm.), usually (but not always) without needing to submerge.

As noted by Silsby (2001), there is little information in the published literature on the oviposition behaviour of euphaeids. What little information there is was reviewed by Reels & Dow (2006). This review indicated that adult *Euphaea* females frequently lay their eggs whilst submerged or highly exposed in the same high energy lotic habitats inhabited by the larvae. In some species, females have been observed to boldly dive head first into the water, in flight, in order to reach a suitable oviposition site.

Below, we present observations and remarks on the oviposition behaviour (real or inferred) of four *Euphaea* species, from Borneo, Thailand, Hainan and Hong Kong.

Observations

Euphaea subcostalis (Selys, 1873)

11 February 2008, Sungai Sjong, Kapit, Sarawak, Malaysia, 200m, N02°00.322 E113°06.287

At about 1110h, in bright but overcast weather, GTR saw a pair of *Euphaea subcostalis* in copula, flying low over a small (2 m wide) moderately fast-flowing forest stream in a shaded shallow cobble area, depth 5-10 cm. The pair settled on a leaf pack protruding from the mid-channel of the stream. After a minute or so, they broke tandem and the female commenced a rapid, low flight back and forth over the stream (5 cm above the water), with the male following close behind. The flight area covered approximately 3 m of stream length (= 6 m²). She repeatedly entered the water, by suddenly rising up to 30 cm above the surface then abruptly diving head first, at an angle of ca 70 degrees to the horizontal, very fast. The momentum gained easily permitted her to enter the water, although GTR was too far away from the behaviour to verify that her momentum always took her to the stream bed. All her



Photo: 1. Female *E. subcostalis* with male in foreground, Sarawak, Malaysia. Photo by G.T. Reels

dives were made at least 0.5 m in from the edge of the stream. She stayed submerged for one or two seconds each time, before re-emerging and resuming her rapid presumed 'oviposition flight'. In total, she performed this diving submergence about 25 times in the space of three minutes. She also interrupted this pattern three times to alight on a semi-submerged twig in the mid-channel, about 50 cm long and 5 mm diameter, where she made brief unsubmerged oviposition movements

for up to five seconds before flying again. The male perched on the leaf pack in mid-channel on the occasions when she did this. After about three minutes, the female abruptly flew up to an overhanging perch some 2 m above the water. GTR left the scene thereafter. The substrate she had been diving onto was comprised of small cobbles. Aquatic vegetation, leaf litter and rotten wood were scarce in the stream bed and she did not appear to specifically target such substrates, aside from the occasions when she landed on the exposed twig.

***Euphaea ochracea ochracea*
Selys, 1859**

10 April 2001 Khao Panom
Bencha N.P., Thailand

At mid-day a female *Euphaea ochracea* was observed by KDPW ovipositing in a fast flowing hillstream. The female had elected to oviposit into a sodden stick wedged between rocks in the splash zone of a torrential cascade section of the stream. The lower part of the stick, located just above the water level where the female had selected to oviposit, was continuously exposed to strong splashes and on occasions the female was completely submerged for short periods during surges of stream flow. Throughout the oviposition period an attendant male perched nearby, quite close to the female on the same stick, but sufficiently further up to avoid surge flows and most of the strong splashes.



Photo 2: Female *E. ochracea ochracea* ovipositing into sodden stick at the splash zone in a fast-flowing stream, with guarding male perched nearby, Thailand. Photo credit: K.D.P. Wilson

***Euphaea ornata* (Campion, 1924)**

23 May 2007 Ganzaling, Hainan, China, 180m, N18°22 E109°38 (approx.).

At 1245h, in warm, sunny weather, GTR saw a female *Euphaea ornata* dive into the water onto a submerged twig ca 1 cm underwater in the mid-channel of a fast-flowing shallow riffle of a small (3 m wide) shady cobble-boulder forest stream. It clung onto the twig for 30 s in the current before abruptly exiting the water. It was accompanied by a male which perched 10cm away on a leaf sticking out of the water, and flew off with her (not in tandem) when she exited. No oviposition movements were discernible during the female's period of submergence.



FPhoto 3: Male *E. ornata*, Hainan, China. Photo credit: G.T. Reels

23rd April 2008 Wuzhishan, Hainan, China, 500m, N18°58.305 E109°40.654

At ca 1100h, GTR was on a small (1 m wide) sunlit cobble-boulder tributary in secondary forest, when a tandem pair of *E. ornata* came down to the water at a semi-submerged leaf pack in the mid-channel. The male alighted on the above-water part of the leaf pack; the female in the water. The female broke tandem and quickly submerged herself beneath the leaf pack. The water depth was 8 cm. She stayed submerged (and out of sight) for about 3 minutes before she was inadvertently disturbed, whereupon

she flew out of the water and settled on nearby vegetation. The male moved to a boulder about 30 cm from the presumed oviposition site until similarly disturbed.

Euphaea decorata Selys 1853

23 July 2008 Hok Tau, Hong Kong, China, 150m, N19°19.341 E122°56.603

At 1035h at a small (2 m wide) open aspect boulder stream in secondary forest, GTR observed a pair of *Euphaea decorata* in the wheel, perched on a sunlit boulder in mid-channel. After two minutes the pair broke tandem and the female flew low over the water about 1m upstream to a point where some *Acorus* was growing in a short cascade section. The uppermost leaves were intermittently breaking the surface of the water. The female flew upstream slowly, about 5 cm above the water, until reaching the *Acorus*. She then alighted on the semi-submerged leaves, clinging on against the stiff current and commencing oviposition movements. This behaviour was photographed. The male initially accompanied her in flight, then settled on a nearby (50 cm away) perch. The female was observed clambering over the intermittently submerged leaves and ovipositing for ca 10 minutes, before GTR was unfortunately obliged to move on. The female actually disappeared from view for about three minutes, and was presumably completely submerged and beneath the leaves at this point. The male made two short patrol flights over the oviposition site during the ten minutes in which observations were made.



Photo 4: Female *E. decorata* ovipositing into submerged *Acorus* leaves whilst facing into the current of a fast-flowing stream, Hong Kong, China. Photo credit: G.T. Reels



Photo 5: Male *E. decorata*, Hong Kong, China. Photo credit: G.T. Reels

Remarks

Unfortunately, GTR was unable to photograph the spectacular diving behaviour exhibited by the female *E. subcostalis* (which was observed through binoculars at a distance of about 5 m), and could not determine whether the female was able to reach the stream bed (up to 10 cm below the surface). It seems likely, however, that the female repeated her diving behaviour so many times for either (or both) of two reasons: she was trying unsuccessfully to reach the stream bed, or she was reaching the stream bed but repeatedly encountering a substrate unsuitable for oviposition. The force with which the female was striking the water, and the shallow depth, suggests that the latter explanation may be the more probable, particularly bearing in mind the observation by Choong (2005) of a female *Euphaea impar* Selys diving into water of similar depth to oviposit on slime-covered rocks and roots. This very dynamic method of submergence and very abrupt re-emergence contrasts with observations of *E.*

subcostalis oviposition made by Reels & Dow (2006), in which the female dove into very shallow water (ca 3 cm) from an adjacent low perch, and stayed submerged, apparently ovipositing into dead leaves, for 20-25 s.

In the case of *E. ochracea*, a sodden stick was observed to be used as a substrate for oviposition, which was located in a torrential section of stream and involved exposure to strong splashes and occasional passive submergence.

The two brief observations of submergence by female *E. ornata* from Hainan represent the first records of this style of (presumed) oviposition-related behaviour for this species. It is unfortunate that actual oviposition was



Photo 6: *Epallage fatima* engaging in group oviposition into floating vegetation, Cyprus. Photo credit: K.D.P. Wilson

not observed, but it is reasonable to suppose that this was the reason for the submergence in both cases.

Underwater oviposition by *E. decorata* into *Acorus* leaves, as described above, is a behaviour which was also observed by Reels & Dow (2006), who noted this was apparently the first observation of *Euphaea* ovipositing into living green vascular plant tissue. It noteworthy the additional record described here also involves the same oviposition substrate.

Females of *Euphaea* spp. are very stout. Their robust build undoubtedly helps several species within this genus to withstand the severe physical stresses encountered during oviposition in cascades and riffles, either from diving headlong into riffle sections and struggling against the current, or from exposure at torrential splash zone sites. The larvae of many oriental euphaeids inhabit fast flowing sections of steep gradient hill streams. This contrasts slightly with *Epallage fatima*, the type species for the family, which frequents riffle sections of streams generally located in areas with moderate gradients and relatively slower current flows. The other notable difference is the males of *Epallage fatima* often remain attached, in tandem, to ovipositing females. The oviposition substrate for *Epallage* is floating vegetation, living or dead. This type of substrate is frequently absent from many oriental, steep gradient hill streams.



Photo 7: *Epallage fatima* often oviposits in tandem as here in Cyprus. Photo credit: K.D.P. Wilson

References

- Brooks, S., 2002. Dragonflies. The Natural History Museum, London.
- Choong, C.Y., 2005. Dive! Dive! Oviposition behaviour of *Euphaea impar*. Malaysian Naturalist 59: 46-48.
- Corbet, P.S., 1999. *Dragonflies: behavior and ecology of Odonata*. Cornell University Press, Ithaca.
- Reels, G.T. & R.A. Dow, 2006. Underwater oviposition behaviour in two species of *Euphaea* in Borneo and Hong Kong (Odonata: Euphaeidae). International Journal of Odonatology 9(2): 197-204.
- Schorr, M., M. Lindeboom & D. Paulson, 2009. List of Odonata of the world (part 1, Zygoptera). University of Puget Sound, Tacoma, USA. <<http://www2.ups.edu/biology/museum/worldodonates.html>>; updated February 2009.
- Silby, J., 2001. Dragonflies of the world. CSIRO Publishing, Collingwood.

The 6th WDA International Congress of Odonatology, Xalapa, Mexico, 7-12 June 2009

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Photo 1: Instituto de Ecología A.C. Delightfully situated in the Botanic Gardens (Jardin Botanico Francisco Javier Clavijero), Xalapa, provided an excellent congress venue.

The organising committee of Rodolfo Novelo-Gutierrez, Enrique Gonzalez-Soriano and Alex Cordoba-Aguilar said “Organizing the 6th WDA 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...given the rather unfortunate swine ('flu) outbreak that occurred in May...many issues became far more complex”. It was, indeed, extremely unfortunate the 'flu outbreak occurred so close to the start of the congress. If I had travelled before the UK Government had lifted its restrictions my travel insurance would have been invalid, and it appears other intended attendees, including our Japanese friends were not so fortunate to be given clearance to travel in time. I appreciate what a logistical nightmare these problems must have created for our organising committee. Those of us who travelled to Xalapa are deeply appreciative for all

of their successful efforts to organise such an interesting and stimulating programme of scientific, cultural and social events.

The scientific programme included 40 oral presentations and 18 poster contributions held in the conference facilities of the Instituto de Ecología AC. Delightfully situated in the Botanic Gardens, the Institute provided an excellent congress venue.

After the opening ceremony on Monday 8 June at which the Director of the Institute, Dr. Miguel Equihua, welcomed all the participants, I was grateful for the opportunity to talk about the life of Professor Philip Corbet who died last year and in whose memory this congress was being held.

Michael Samways (University of Stellenbosch, RSA) gave the first plenary lecture, on conserving dragonflies in a rapidly-changing world. His talk high-lighted the negative and positive effects on dragonflies in today's world and stressed the importance of conserving natural areas in the first place, while recognising dragonflies often respond positively to restored conditions.



Photo 2 & 3: Göran Sählen presents book prizes to the worthy young odonatologist winners for of the best poster to Cornelio A. Bota-Sierra (left) and for the best oral presentations to Melissa Sánchez Herrera (right).





Photo 4: Wolfgang Schneider presents Enrique Gonzalez-Soriano (middle) and Rodolfo Novelo-Gutierrez (right) with a books in appreciation for organising the Xalapa Congress.

The next session of six talks, chaired by Goran Sahlen, focussed on changing dragonfly populations and communities; monitoring schemes; and re-colonisation in Sweden, the Netherlands, Slovakia, Hong Kong and possible new species in the Colombian Andes.

With John Hawking in the chair the final session of 5 talks included phylogenetic research on palaeotropical Zygoptera; an analysis of Odonata community structure in three microbasins in central Mexico; changes in Odonata larval assemblages in relation to the ecological health of a large river; *Ischnura hastata* as an indicator of water quality in the Azores; and dynamics and continuity in Westphalian dragonflies. The Board of Trustees Meeting followed later that evening in the Hotel Crowne Plaza where many of the participants were based.

Tuesday morning's plenary talk was given by Mark Forbes (Carleton University, Canada) on "The ecological Parasitology of Odonates: Resistance to Understanding." Mark considered how dragonflies cope with parasites and pathogens and showed what resistance to parasites looks like. He dealt with understanding how resistance evolves and what constrains it, which necessitates a firm understanding of the natural history of both host and parasite. Alex Cordoba-Aguilar chaired the next four lectures which covered immune ability in Zygoptera and the significance of the red wing spot in *Hetaerina* spp.

This was followed by a series of seven talks chaired by Martin Serrano-Meneses which dealt with reproductive behaviour in *Protoneura cava*; survivorship in *Calopteryx* spp.; sexual selection and evolution of male



Post 5: The 'Neotropic' contingent of delegates gather for a photo at the Conference Dinner held at Hotel Crown Plaza. The conference organisers Rodolfo Novelo-Gutierrez (lower middle, pale shirt), Alex Cordoba-Aguilar (above left of Rodolfo), Enrique Gonzalez-Soriano (above right of Alex). Alex's wife Anna is extreme right.



Photo 6: Photo of delegates taken at the conference venue: the Instituto de Ecología AC, situated in the Jardín Botánico Francisco Javier Clavijero, Xalapa, Veracruz, Mexico. Photo credit Erland Refling Nielsen.

wing pigmentation; interspecific aggression in *Hetaerina* spp.; biogeography, ecology and mimicry in multiple species; and variation of male genitalia in Colombian dragonflies.

Andrea Worthington (Siena College, Loudonville, USA) chaired the final session of the day, papers including a review of group oviposition in damselflies; a comparative study of male reproductive behaviour in chlorocyphids; looming-sensitive neurones predict time to contact prey (Andrea identified a pair of neurones which appear to be involved in calculating the time to contact with prey in hunting Anisoptera); and Bayesian molecular results to estimate divergence times and diversification rates in Anisoptera.

The Mid-Congress tour on Wednesday 10 June was devoted to a cultural visit to the internationally famous El Tajín archaeological site. Our coach took us north along the Gulf of Mexico coast to El Tajín which is an impressive reminder of a classic Veracruz town and ceremonial centre, having its zenith between AD600 and 900. It was abandoned around AD1200 and after being obliterated by jungle encroachment was rediscovered by the Spanish in 1785. Leaving El Tajín we journeyed south and stopped to my great surprise and delight for a warm welcome and splendid meal at Alex Cordoba's in-laws' house. Alex's wife, Anna, her parents, relations and friends had co-operated to produce a wonderful authentic Mexican meal in their garden. We sat at round tables under a large open marquee where we were presented with three courses of delicious servings which were totally new to many of us, but much enjoyed and appreciated by all. And then Anna's father produced a bottle of high quality tequila, the spirit made from distilled *Agave* juice. By the time we rejoined the coach we were feeling very happy!

Thursday 11 June commenced with Rosser Garrison's (California Department of Food and Agriculture) plenary talk on the diversity of neotropical Zygoptera. Rosser said although the Neotropical Region possesses the highest diversity of odonate species in the world, basic information on their taxonomy, life history and biology is fragmentary. He discussed the state of knowledge of the genera and species of the region. Before the coffee break we learned about some surprises in the phylogeny of the Coenagrionidae during a session chaired by Mike May; taxonomic distinctness and the assessment of changes in odonate phylogenetic diversity; and also about validation of standard methodology for populations and community studies.

The day was concluded with a session chaired by Vincent Kalkman, with five papers dealing with dragonfly distribution patterns in Africa, the New World, Australia, Neotropical Region and worldwide. This was followed by the IUCN Meeting.

Short oral presentations preceded each of the two poster sessions. The posters were carefully scrutinised and prompted much discussion.

Andreas Martens chaired the final paper session on Friday; an interesting variety of subjects including: temperature dependence on emergence; seasonal changes in body size, sex size dimorphism and sex ratio; comparison of Odonata and Ephemeroptera; diurnal activity of *Cordulegaster bidentata*.; branched setae on larval feet; and last instar larva and emergence of *Erythrodiplax fervida*.

During the afternoon the Biennial General Meeting took place, and was very efficiently handled from the outset by Wolfgang Schneider in the unfortunate absence of the standing down President and Chairman Gordon Pritchard. With the completion of Gordon's term of office, Wolfgang, our new President and Chair took over the meeting officially. Presentations were made to the worthy winners of the best poster and oral presentations, by the young odonatologists Cornelio A. Bota-Sierra and Melissa Sánchez Herrera.

Later that evening we all assembled for the Congress Dinner in the Hotel Crown Plaza. This was a most happy and enjoyable occasion, not the least because many of the younger members of the international dragonfly

community were present, as well as the older (and oldest!) ones. It is really pleasing to know that Colombia, Costa Rica, Cuba, Mexico and Puerto Rico are to the forefront of modern odonatology with so many enthusiastic, knowledgeable and progressive young scientists. My fervent hope is that many of these young odonatologists will present their research findings, including papers at this congress, for publication in IJO.



Photo 7: Catemaco Lake and town taken from the La Finca Hotel

From Saturday 13 June through to Tuesday 16 June about 30 delegates joined the post-congress tour to Tlacotalpan and Los Tuxtlas in Veracruz State. The World Heritage site of Tlacotalpan is a fascinating old colonial town where we were served a very fine meal washed down with ‘gallons’ of pink refreshing drink (origin unknown), but exceedingly acceptable! That afternoon we travelled on to the La Finca Hotel on the shores of Lake Catemaco – a perfect setting with all the rooms overlooking the lake. My wife and I had good views of a woodpecker visiting a nest in a palm tree trunk right opposite our room.

The next day was spent at a fine river in Tuxtla at the Ecological Research Centre where we were able to ‘get to grips’ with some local odonates. Here we all spread out in various directions, those with nets catching dragonflies, those without, observing, photographing and chatting. Later we were welcomed with a pleasant lunch and delicious rice-water flavoured with cinnamon at the Research Centre. A small, informative Museum attached to the centre was visited before we had a most interesting walk through the surrounding dry forest. Leaf-cutter ants, howler monkeys, dragonflies at a couple of the streams we crossed and sensitive mimosa plants all contributed to a fascinating walk. But most surprising was finding a Keel-billed Toucan on the forest floor. At first thought to be injured or sick, but when Alex Cordoba put a net over it, it showed plenty of active resistance – so quite a puzzle. It was taken back to the Centre for feeding/water/recovery.

Monday 15 June involved travelling to Veracruz city, on the way stopping off for a tour of a cigar factory (all made individually, one at a time by hand) and then on to a most impressive waterfall site. This was quite a good place for dragonflies despite being touristy. Our last tour night was spent in the Hotel Jaragua in Veracruz. In the evening we all went into town in our bus for our final gathering and to sample more authentic Mexican atmosphere and food. The waterfront had a real holiday/party ambience with open-top buses offering tours of the town. All was brightly lit and with lively music playing wherever we walked. It was a fitting end to a delightful congress. Thanks to all who made this such an engaging meeting, and especially to Rodolfo, Enrique and Alex. We hope to see you all in Japan.

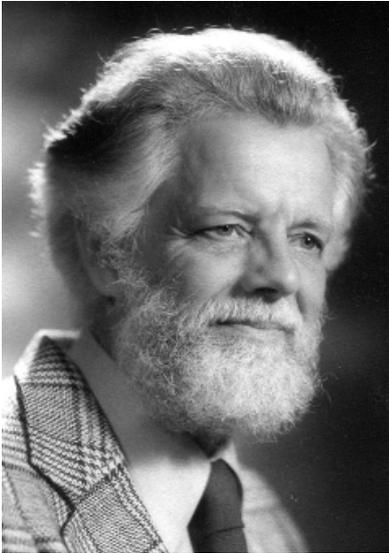


Photo 8: Post symposium tour members gather at the Los Tuxtlas Instituto de Biología Reserch Station at the Los Tuxtlas Nature Reserve in Veracruz State

A few words about Phil Corbet

Tribute to Professor Stephen Corbet (21 May 1929 -13 Feb. 2008) given following the opening ceremony at the 6th WDA International Congress of Odonatology, Xalapa, Mexico, 13 June 2009

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Firstly, may I express my sincere thanks to the organisers of this International Congress for giving me the opportunity to say a few words of appreciation for our dear friend and colleague Professor Philip Corbet who died last year.

Many of you attending this meeting will have known Philip Corbet personally and most of you will certainly be familiar with many of his numerous publications, particularly his outstanding books on dragonflies. Several comprehensive obituaries and tributes have been published in the British press and odonatological journals since his death in Cornwall on 13 February last year. For example: Peter Marren in *The Independent* for 28 Feb. 2008; Anon, the *Daily Telegraph* for 6 March 2008; Mike Parr, vol 25(1) of *Journal of the British Dragonfly Society*; and the special editions of WDA's *Agrion* and *IJO* have been dedicated to his memory.

In view of what has already been said and published about Philip's numerous publications and life achievements I do not propose to repeat or reflect on these in any detail. He was without doubt in my mind, the world's foremost odonatological authority. The range and depth of his knowledge was astonishing, and until the mild stroke in 2001, his recall of scientific details and events was probably unparalleled.

It was indeed fortunate for us, as odonatologists, that Philip chose at the beginning of his career at Reading and Cambridge Universities to make the biology of dragonflies a major subject for study – a subject which absorbed him for the whole of his working life whenever circumstances allowed it. For considerable periods in his career he was employed primarily to pursue other fields of study – in Uganda 1954-62 the food of non-cichlid fishes in the Lake Victoria basin, and also the behaviour and ecology of mosquitoes occupied his actual employment. Nevertheless, during this time (in his spare time?!) he not only wrote most of his *Biology of Dragonflies* (1962) but also produced a series of papers containing descriptions of numerous African odonate larvae. In one of these papers (*The Entomologist*, vol. 9 (1125)) he describes differences in the larvae of *Brachythemis leucosticta* living in different types of substrate and so he may have pre-empted the recognition of *B. impartita* recently separated from *leucosticta* by K.D. Dijkstra and N. Matuskina. Philip would have been excited by this discovery of a new *Brachythemis* species when we all thought we knew *B. leucosticta* well, and I can also imagine his frustration in not having a collection which he could have re-examined. He would also undoubtedly have found the familiar *Trithemis 'stictica'* now comprising three species as a result of Damm and Hadry's work to be reported in this meeting, as a hugely satisfying study in taxonomy.

But apart from dragonflies and mosquitoes, Philip was an excellent and all-round naturalist and biologist. He and I shared a deep common interest in all aspects of natural history. When he visited me in Somerset in the south-west of England we enjoyed walks from my home not only to observe odonates flying along drainage channels and rivers of the Somerset Levels but the whole range of wild life from newts to foxes and butterflies to kingfishers. We both had particular interests in the Lepidoptera in our early days but we agreed the ecology and behaviour of this order of insects could not match that of the odonates, and thus dragonflies eventually became our main field of interest.

However, Philip's fascination for butterflies never really faded, and shortly before his death we found ourselves discussing the British Orange-tip Butterfly, *Anthocharis cardamines*. He said to me "Mike, have you ever seen a female Orange-tip?". I replied "Yes, I think so, but they are much less likely to be recognised than the males". Male Orange-tips are easily recognised even from a distance because of the bright orange fore-wing tips, but females lack this distinguishing characteristic and, in flight, closely resemble the much more common Green-veined white, *Pieris napi* and Small White, *P. rapae*. When I checked my own collection I found I had a single female Orange-tip, dating from the 1940's, alongside several males. On inspecting its label it said 'bred' which indicated I had reared it from a caterpillar, and thus I can only say for certainty I have recognised this sex in captivity and in my collection, not in the wild! The apparent rarity of female Orange-tips is something of a mystery. Philip's seemingly innocuous question about the female Orange-tip was typical of the man – he was always asking himself and his colleagues questions and probing, so that his mind seemed to be for ever alert and looking for answers.

When Philip returned to live and work in the UK we enjoyed many occasions when it was possible to combine dragonfly work and relaxed socialising. It was often convenient for him to break his journey en route to or from BDS or other meetings by staying a night or two with us in Somerset, when his fund of jokes

seemed absolutely limitless, especially when accompanied by a glass or three of whisky – Glenfiddich being one of his specialities. Indeed, I believe these brief periods away from Edinburgh or his Cornwall home were of considerable importance and value to him. He possessed enormous mental and physical energy with respect to the various aspects of his odonatological work, and I suspect Philip would drive himself for too long and too hard without taking recuperative breaks. But I think we all realize without his intense capacity to focus on, for example, the complete range of odonatological literature, the 1999 work *Dragonflies: Ecology and Behaviour of Odonata* would never have seen the light of day. And indeed, that wonderful volume took longer to appear than it might have done because one of Philip's determining characteristics was his attention to detail, and that implied ensuring each chapter was up to date. Repeatedly, new research findings encouraged him to revise or rewrite chapters, but eventually he accepted a text of this magnitude could never be fully up to date and he (reluctantly, I think) finally drew a line under it all.

Philip's professional working life always seemed to be exceptionally well ordered and planned, so that not only was his research work meticulously executed, but he considered one needed to observe the official guidelines and rules governing the organisation of scientific societies. That is to say, for example, a formally drawn up, approved and adopted constitution must be respected and adhered to whenever problems arise. He had an immense sense of right and wrong which was severely tested on numerous occasions in the functioning of, and during the demise of SIO. Problematic periods of both BDS and WDA caused him great anguish because he was certain procedures being followed, or projected possible developments would not be in the best interests of the members. The difficulties in SIO led to him resigning his honorary life membership, and other prominent members acted similarly at the same time. Thankfully, most (but not all) of the difficulties he encountered in BDS and WDA were eventually resolved before his death.

Another facet of Philip's being involved correct and unambiguous use of English. He was punctilious in attempting to avoid confusing or conflicting words or sentence constructions, although I, and I'm sure others, sometimes suggested ways of avoiding unnecessary verbosity in his drafts of papers or letters! One particular instance of the confusion of terms is in the English speaking world where 'dragonfly' can refer both to the order Odonata and the sub-order Anisoptera; the Zygoptera being referred to as damselflies. In their New Naturalist series book 'Dragonflies' (2008), Philip and his co-author Steve Brooks discussed the problem, which they accurately define as an "ambiguity" (but he used much stronger terms in correspondence with me!) and they went on to say "and poor Linnaeus (one may suppose) will continue to turn in his grave". Linnaeus, of course, devised his binomial system of nomenclature to avoid the confusions caused by descriptive vernacular names. Thus Philip and Steve suggest the new name of Warriorfly as the English equivalent of Anisoptera, allowing the term dragonfly to refer exclusively to the order Odonata. Personally, I consider it would be an excellent tribute to him if Warriorfly were to be adopted in the English-speaking world.

Whilst his prowess as a biologist of international standing is widely recognised and respected, he was certainly equally regarded for his personal and human qualities. He was always happy to share his expert knowledge, treating young and older odonatologists as equals, so that numerous entomologists of all ages and levels of expertise and experience have been inspired by his enthusiasm and encouragement. His note-taking and listening capacities were legendary and he made it clear how much one's own knowledge and research was valued when discussing any dragonfly biology.

But Philip was not only the consummate odonatologist and gatherer and analyst of dragonfly data – he was also musical and enjoyed sport. As a postgraduate student at Cambridge he played the clarinet in a quartet including the bassoonist Stanley Sadie, recording music by Mozart and Schubert. His interest in music was lifelong, enjoying traditional jazz as well as classical works.

Whilst at Reading university he participated competitively in table tennis and swimming. Philip's interest in table tennis extended into his seventies when I understand he could still give members of Sarah Jewell's family a good game.

Philip was married three times and he has a daughter, Katarina, by his second wife. On moving to Cornwall from Edinburgh he met Sarah Jewell who became his partner through his remaining years. Sarah and Philip seemed to complement each other perfectly and she clearly was highly important to him as someone with whom he could discuss his work and other interests, including music. Philip and Sarah rejoiced in each others companionship which they expressly found so satisfying and pleasurable. Philip was also very happy to have his sister Sally residing close by throughout his time in Cornwall. Sally is an entomologist specialising in the study of bumble bees (Hymenoptera) and pollination mechanisms. It seems almost unnecessary to say that with both Sally and Sarah in close proximity he was indeed a lucky and happy man.

Philip was a wonderful, engaging and stimulating companion for many people, as well as being an extraordinary scientist. He is, of course, sorely missed by family, friends and dragonfly lovers everywhere, but he lives on through his very exceptional contributions to odonatology and through our memories of a special human being. I personally have been immensely fortunate and grateful to have known Philip for some forty-three years. I have had no better friend.

Philip S. Corbet
List of publications including observations on Odonata

(compiled by PSC up to 2000, and thereafter by Sarah A. Corbet; further additions abstracted from IDF report no. 14: 1-39 compiled by Hoffmann & Schorr, 2008)

- Corbet, P.S., 1949. County records of Odonata. *Entomologist* 82: 239.
- Corbet, P.S., 1950. Some observations on *Ceriagrion tenellum* (Villers) (Odonata). *Entomologist* 83: 27.
- Corbet, P.S., 1950. Missing caudal lamellae in Odonata. *Entomologist* 83: 18.
- Corbet, P.S., 1950. The dragonflies of Berkshire. *Reading Naturalist* 1: 65-67.
- Corbet, P.S., 1950. Observations on the development and ecology of *Sympetrum striolatum* (Charpentier) (Odonata). B.Sc. dissertation, University of Reading, UK. 202 pp.
- Corbet, P.S., 1950. Rapid colonization of ponds by Odonata. *Entomologist* 83: 87.
- Corbet, P.S., 1951. The emergence and sex ratio of *Anax imperator* Leach (Odon., Aeshnidae). *Entomologist's Monthly Magazine* 87: 176-179.
- Corbet, P.S., 1951. The development of the labium of *Sympetrum striolatum* (Charp.) (Odon., Libellulidae). *Entomologist's Monthly Magazine* 87: 289-296.
- Corbet, P.S., 1952. An adult population study of *Pyrrosoma nymphula* (Sulzer) (Odonata: Coenagrionidae). *Journal of Animal Ecology* 21: 206-222.
- Corbet, P.S., 1953. A terminology for the labium of larval Odonata. *Entomologist* 86: 191-196.
- Corbet, P.S., 1954. *The seasonal ecology of dragonflies (Odonata)*. Ph.D. dissertation, University of Cambridge, UK. 205 pp.
- Corbet, P.S., 1954. [Account of quantitative methods used in the study of dragonfly ecology.] *Proceedings of the Royal Entomological Society of London (C)* 18: 54.
- Corbet, P.S., 1954. Seasonal regulation in British dragonflies. *Nature, London* 174: 655; 777.
- Corbet, P.S., 1955. The immature stages of the Emperor Dragonfly, *Anax imperator* Leach (Odonata: Aeshnidae). *Entomologist's Gazette* 6: 189-204.
- Corbet, P.S., 1955. A critical response to changing length of day in an insect. *Nature, London* 175: 338-339.
- Corbet, P.S., 1955. The larval stages of *Coenagrion mercuriale* (Charp.) (Odonata: Coenagrionidae). *Proceedings of the Royal Entomological Society of London (A)* 30: 115-126.
- Corbet, P.S., 1956. Larvae of East African Odonata. Introduction and 1. *Ictinogomphus ferox* Rambur. *Entomologist* 89: 97-100.
- Corbet, P.S., 1956. Larvae of East African Odonata. 2-3. 2. *Ceriagrion glabrum* Burmeister. 3. *Metacnemis valida* Selys. *Entomologist* 89: 148-151.
- Corbet, P.S., 1956. Larvae of East African Odonata. 4-5. 4. *Lestiniogomphus angustus* Martin. 5. *Phyllomacromia aethiops* Selys. *Entomologist* 89: 216-219.
- Corbet, P.S., 1956. Environmental factors influencing the induction and termination of diapause in the Emperor Dragonfly, *Anax imperator* Leach (Odonata: Aeshnidae). *Journal of Experimental Biology* 33: 1-14.
- Corbet, P.S., 1956. The life-histories of *Lestes sponsa* (Hansemann) and *Sympetrum striolatum* (Charp.): (Odonata). *Tijdschrift voor Entomologie* 99: 217-229.
- Corbet, P.S., 1956. The influence of temperature on diapause development in the dragonfly *Lestes sponsa* (Hansemann) (Odonata: Lestidae). *Proceedings of the Royal Entomological Society of London (A)* 31: 45-48.
- Corbet, P.S., 1956. Book review: "The dragonfly larva" by R.E. Snodgrass. *Journal of the Royal Microscopical Society (Series 3)* 76: 182.
- Corbet, P.S., 1957. Larvae of East African Odonata. 6-8. 6. *Brachythemis lacustris* Kirby. 7. *Brachythemis leucosticta* (Burmeister). 8. *Zyxomma flavicans* (Martin). *Entomologist* 90: 28-34.
- Corbet, P.S., 1957. Larvae of East African Odonata. 9-11. 9. *Phyllomacromia picta* (Selys). 10. *Phyllomacromia reginae* (Le Roi). 11. *Phyllomacromia sylvatica* Fraser. *Entomologist* 90: 111-119.
- Corbet, P.S., 1957. Larvae of East African Odonata. 12-14. 12. *Crenigomphus rennei* Fraser. 13. *Paragomphus cognatus* (Rambur). 14. *Paragomphus hageni* (Selys). *Entomologist* 90: 143-147.
- Corbet, P.S., 1957. The life-history of the Emperor Dragonfly, *Anax imperator* Leach (Odonata: Aeshnidae). *Journal of Animal Ecology* 26: 1-69.
- Corbet, P.S., 1957. The life-histories of two spring species of dragonfly (Odonata: Zygoptera). *Entomologist's Gazette* 8: 79-89.
- Corbet, P.S., 1957. The life-histories of two summer species of dragonfly (Odonata: Coenagriidae). *Proceedings of the Zoological Society of London* 128: 403-418.
- Corbet, P.S., 1958. Temperature in relation to seasonal development of British dragonflies (Odonata). *Proceedings of the 10th International Congress of Entomology, Montreal (1956)* 2: 755-757.
- Corbet, P.S., 1958. Some effects of DDT on the fauna of the Victoria Nile. *Revue Zoologiques et Botaniques Africaines*

57: 73-95.

- Corbet, P.S., & S.A. Corbet, 1958. Emergence of a summer species of dragonfly. *Nature*, London 182: 194.
- Corbet, P.S., 1959. Notes on the insect food of the Nile Crocodile in Uganda. *Proceedings of the Royal Entomological Society of London (A)* 34: 17-22.
- Corbet, P.S., 1959. The larval development and emergence of *Aeshna cyanea* (Müll.) (Odon., Aeshnidae). *Entomologist's Monthly Magazine* 95: 241-245.
- Corbet, P.S., 1960. The food of a sample of crocodiles (*Crocodilus niloticus* L.) from Lake Victoria. *Proceedings of the Zoological Society of London* 133: 561-572.
- Corbet, P.S., 1960. Breeding sites of non-cichlid fishes in Lake Victoria. *Nature*, London 187: 616-617.
- Corbet, P.S., 1960. Patterns of circadian rhythms in insects. *Cold Spring Harbor Symposia on Quantitative Biology* 25: 357-360.
- Corbet, P.S., C. Longfield & N.W. Moore, 1960. *Dragonflies*. Collins. London. xii + 260 pp.
- Corbet, P.S., 1961. Entomological studies from a high tower in Mpanga Forest, Uganda. XII. Observations on Ephemeroptera, Odonata and some other orders. *Transactions of the Royal Entomological Society of London* 113: 356-361.
- Corbet, P.S., 1961. The recognition of parous dragonflies (Odonata) by the presence of follicular relics. *Entomologist* 94: 35-37.
- Corbet, P.S., 1961. The food of non-cichlid fishes in the Lake Victoria basin, with remarks on their evolution and adaptation to lacustrine conditions. *Proceedings of the Zoological Society of London* 136: 1-101.
- Corbet, P.S., 1962. A Biology of Dragonflies. Witherby, London. xvi + 247 pp.
- Corbet, P.S., 1962. Observations on the attachment of *Simulium* pupae to larvae of Odonata. *Annals of Tropical Medicine and Parasitology* 56: 136-140.
- Corbet, P.S., 1962. Age-determination of adult dragonflies (Odonata). *Verhandlung der XI Internationaler Kongress für Entomologie*, Wien (1960) 3: 287-289.
- Corbet, P.S., 1963. The reliability of parasitic water-mites (Hydracarina) as indicators of physiological age in mosquitoes (Diptera: Culicidae). *Entomologia Experimentalis et Applicata* 6: 215-233.
- Corbet, P.S., 1964. Book review: "Les Libellules du Quebec" by A. Robert. *Canadian Field-Naturalist* 78: 123-124.
- Corbet, P.S., 1964. Temporal patterns of emergence in aquatic insects. *Canadian Entomologist* 96: 264-279.
- Corbet, P.S., 1965. Book review: "Les Libellules du Quebec" by A. Robert. *Canadian Entomologist* 97: 111-112.
- Corbet, P.S., 1966. The role of rhythms in insect behaviour. *Symposia of the Royal Entomological Society of London* 3: 13-28.
- Corbet, P.S., 1966. The study of Odonata. In G.B. Wiggins, "Centennial of Entomology in Canada 1863-1963. A Tribute to Edmund M. Walker", pp. 70-78. *Life Sciences*, Royal Ontario Museum, University of Toronto.
- Corbet, P.S., 1967. A dragonfly new to Canada. *Canadian Field-Naturalist* 81: 230.
- Corbet, P.S., 1968. The Odonata of Ontario. *Proceedings of the North Central Branch of the Entomological Society of America* (1967) 22: 116-117.
- Corbet, P.S., 1968. Book review: "Les Odonates de l'Europe Occidentale, du Nord de l'Afrique et des Îles Atlantiques" by P. Aguesse. *Nature*, London 220: 1359.
- Bick, G.H. & P.S. Corbet, 1969. A translation information service for odonatologists. *Tombo* 12: 35-39.
- Corbet, P.S., 1969. Book review: "Les Odonates de l'Europe Occidentale, du Nord de l'Afrique et des Îles Atlantiques" by P. Aguesse. *Canadian Entomologist* 101: 335-336.
- Corbet, P.S., 1969. Dr. Edmund Murton Walker (1877-1969) in memoriam. *Tombo* 12: 2-3.
- Corbet, P.S. & S. Eda, 1969. Odonata in southern Ontario, Canada, in August 1968. *Tombo* 12: 4-11.
- Corbet, P.S. & G.S. Walley, 1969. The dragonflies (Odonata) of the Mer Bleue. *Canadian Field-Naturalist* 83: 14-16.
- Corbet, P.S., 1970. [Letter to the Editor.] *Tombo* 13: 32.
- Corbet, P.S., 1972. Announcing the formation of the International Odonatological Society and its journal. *Bulletin of the Entomological Society of America* 18: 6.
- Corbet, P.S., 1972. International Odonatological Society. *Bulletin of the Entomological Society of Canada* 4: 12
- Corbet, P.S., 1972. *Dragonflies*. In "Encyclopedia of the Animal World", pp. 592-596. Elsevier International Projects, London.
- Corbet, P.S., 1972. *Damselflies*. In "Encyclopedia of the Animal World", p. 528. Elsevier International Projects, London.
- Corbet, P.S., 1974. *Odonata*. In "Encyclopaedia Britannica", 15th Edition, Volume 13, pp. 507-509. Benton, Chicago.
- Corbet, P.S., 1974. Entomological reflections. *Bulletin of the Entomological Society of Canada* 6: 70-75.
- Butler, T., J. E. Peterson, & P.S. Corbet, 1975. An exceptionally early and informative arrival of adult *Anax junius* in Ontario (Odonata: Aeshnidae). *Canadian Entomologist* 107: 1253-1254.

- Walker, E.M. & P.S. Corbet, 1975. *The Odonata of Canada and Alaska*. Volume III. Part III: The Anisoptera – Three Families. University of Toronto Press, Toronto. xvi + 307 pp.
- Corbet, P.S., 1976. Obituary: A.E. Gardner. *Odonatologica* 5: 387-390.
- Corbet, P.S., 1977. Obituary: J.S. Armstrong. *Odonatologica* 6: 293-295.
- Corbet, P.S., 1978. John Scaife Armstrong: 1892-1977. New Zealand *Entomologist* 6: 444-446.
- Corbet, P.S., 1978. Book review: “The Dragonflies of British Columbia” by R.A. Cannings & K.M. Stuart. *Notulae Odonatologicae* 1: 32-34.
- Walker, E.M. & P.S. Corbet, 1978. *The Odonata of Canada and Alaska*. Volume III. Part III: The Anisoptera – Three Families. Reprint with corrections. University of Toronto, Toronto. xvi + 308 pp.
- Corbet, P.S., 1979. *Pantala flavescens* (Fabricius) in New Zealand (Anisoptera: Libellulidae). *Odonatologica* 8: 115-121.
- Corbet, P.S., 1979. Corrigenda for Volume III of “The Odonata of Canada and Alaska” (1975). *Canadian Entomologist* 111: 225-232.
- Corbet, P.S., 1979. Odonata. In Danks, H.V. (ed.), “Canada and its Insect Fauna”, pp. 308-311. *Memoirs of the Entomological Society of Canada* 108.
- Armstrong, J.S. & P.S. Corbet, 1980. Conversations about New Zealand dragonflies. *Rapid Communications of the Societas Internationalis Odonatologica* 2: xiv + 73.
- Corbet, P.S., 1980. Biology of Odonata. *Annual Review of Entomology* 25: 189-217.
- Corbet, P.S., 1981. Seasonal incidence of Anisoptera in light-traps in Trinidad, West Indies. *Odonatologica* 10: 179-187.
- Corbet, P.S. & A.W.R. McCrae, 1981. Larvae of *Hadrothemis scabrifrons* (Ris) in a tree cavity in East Africa (Anisoptera: Libellulidae). *Odonatologica* 10: 311-317.
- Corbet, P.S., 1982. Water lizards and aerial dragons. [Inaugural lecture, University of Dundee.] *Contact, University of Dundee* 7: 47-50.
- McCrae, A.W.R. & P.S. Corbet, 1982. Oviposition behaviour of *Tetrathemis polleni* (Selys): a possible adaptation to life in turbid pools (Anisoptera: Libellulidae). *Odonatologica* 11: 23-31.
- Corbet, P.S., 1983. *A Biology of Dragonflies* (1962). Reprinted with replacement title page and verso. Clasley, Faringdon.
- Corbet, P.S., 1983. *Odonata in phytotelmata*. In J.H. Frank & L.P. Lounibos (eds), “Phytotelmata: Terrestrial Plants as Hosts of Aquatic Insect Communities”, pp. 29-54. Plexus, Marlton, New Jersey.
- Corbet, P.S., S.A. Corbet & K.A. Kjellström-Corbet, 1983. *Somatochlora arctica* (Zetterstedt) in Perthshire, Scotland. *Journal of the British Dragonfly Society* 1: 25.
- Corbet, P.S., 1984. Dr. M.A. Lieftinck's 80th birthday celebrated. *Selysia* 13: 19.
- Corbet, P.S., 1984. Orientation and reproductive condition of migrating dragonflies (Anisoptera). *Odonatologica* 13: 81-88.
- Corbet, P.S., 1984. Current topics in dragonfly biology. [Volume 1.] *Rapid Communications of the Societas Internationalis Odonatologica* (Supplements) 2: x + 46.
- Corbet, P.S., C.M. Scrimgeour & B. Kiauta, 1984. Author index for *Odonatological Abstracts* 1-4225 from *Odonatologica* Volumes 1-12. *Rapid Communications of the Societas Internationalis Odonatologica* (Supplements) 4 (A): viii + 63.
- Corbet, P.S., C.M. Scrimgeour, J.E. Holmquist & B. Kiauta, 1984. A topic index for *Odonatological Abstracts* 1-4225 from *Odonatologica* Volumes 1-12. *Rapid Communications of the Societas Internationalis Odonatologica* (Supplements) 4 (B): viii + 41.
- Corbet, P.S., 1985. Book review: “Proceedings of the First Indian Symposium of Odonatology” edited by S. Mathavan. *Notulae Odonatologicae* 2: 107.
- Corbet, P.S., C. Longfield & N.W. Moore, 1985. *Dragonflies* (1960). Reprinted in limpback with monochrome plates and new Preface. Collins, London.
- Harvey, I.F. & P.S. Corbet, 1985. Territorial behaviour of larvae enhances mating success of male dragonflies. *Animal Behaviour* 33: 561-565.
- Corbet, P.S., 1986. Using dragonflies to suppress mosquitoes in domestic water storage containers. *Waterlines* 4(3): 10-11.*
- Corbet, P.S., 1986. Current topics in dragonfly biology. Volume 2. *Rapid Communications of the Societas Internationalis Odonatologica* (Supplements) 6: x + 32.
- Corbet, P.S. & R.J.S. Prosser, 1986. Diagnosis of interecdysial development in final-instar larvae of *Pyrrhosoma nymphula* (Sulzer) (Zygoptera: Coenagrionidae). *Odonatologica* 15: 23-28.
- Harvey, I.F. & P.S. Corbet, 1986. Territorial interactions between larvae of the dragonfly *Pyrrhosoma nymphula*: outcome of encounters. *Animal Behaviour* 34: 1550-1561.
- Chowdhury, S.H. & P.S. Corbet, 1987. New external morphological characters for distinguishing larvae of *Enallagma cyathigerum* (Charpentier) and *Ischnura elegans* (Vander Linden) (Zygoptera: Coenagrionidae).

- Odonatologica* 16: 375-378.
- Corbet, P.S., 1987. Dragonflies and their New Zealand representatives; *Pantala flavescens* (Fabricius); *Tramea transmarina* Brauer. In R.J. Rowe, "The Dragonflies of New Zealand", pp. 32-53; 203-207; 208-211. Auckland University Press, Auckland.
- Corbet, P.S., 1987. Meeting and mating in dragonflies. *Antenna* 11: 22-24.
- Corbet, P.S., 1987. Obituary: Thomas Townley Macan. *Odonatologica* 16: 99-102.
- Corbet, P.S., 1988. Foreword. In R.R. Askew, "The Dragonflies of Europe", pp. 7. Harley Books, Colchester, UK.
- Corbet, P.S., 1988. Current topics in dragonfly biology. Volume 3. *Rapid Communications of the Societas Internationalis Odonatologica (Supplements)* 8: viii + 24.
- Corbet, P.S., 1988. Ninth International Symposium of Odonatology, Madurai, India, 18-23rd January, 1988. *Antenna* 12: 65.
- Chowdhury, S.H. & P.S. Corbet, 1988. Feeding rate of larvae of *Enallagma cyathigerum* (Charpentier) in the presence of conspecifics and predators (Zygoptera: Coenagrionidae). *Odonatologica* 17: 115-119.
- Chowdhury, S.H. & P.S. Corbet, 1989. Feeding-related behaviour in larvae of *Enallagma cyathigerum* (Charpentier) (Zygoptera: Coenagrionidae). *Odonatologica* 18: 285-288.
- Chowdhury, S.H., P.S. Corbet & I.F. Harvey, 1989. Feeding and prey selection by larvae of *Enallagma cyathigerum* (Charpentier) (Zygoptera: Coenagrionidae) in relation to size and density of prey. *Odonatologica* 18: 1-11.
- Corbet, P.S. & I.F. Harvey, 1989. Seasonal regulation in *Pyrrhosoma nymphula* (Sulzer) (Zygoptera: Coenagrionidae) 1. Seasonal development in nature. *Odonatologica* 18: 133-145.
- Corbet, P.S., I.F. Harvey, J. Abisgold & F. Morris, 1989. Seasonal regulation in *Pyrrhosoma nymphula* (Sulzer) (Zygoptera: Coenagrionidae) 2. Effect of photoperiod on larval development in spring and summer. *Odonatologica* 18: 333-348.
- Corbet, P.S., 1990. Suppression of the Yellow Fever Mosquito by augmentative release of dragonfly larvae (Odonata: Libellulidae). *Kimminsia* 1(2): 12.*
- Corbet, P.S., 1990. Current topics in dragonfly biology. Volume 4. *Rapid Communications of the Societas Internationalis Odonatologica (Supplements)* 12: viii + 28.
- Corbet, P.S., 1990. Tenth International Symposium of Odonatology. *Antenna* 14: 24.
- Moore, N.W. & P.S. Corbet, 1990. Guidelines for monitoring dragonfly populations. *Journal of the British Dragonfly Society* 6: 21-23.
- Reuben, R., D.R. Rao, A. Sebastian, P.S. Corbet, N. Wu & G. Liao, 1990. Biological control methods suitable for community use. In C.F. Curtis (ed.), "Appropriate Technology for Vector Control", pp. 139-158. CRC Press, Boca Raton, Florida.*
- Sebastian, A., M.M. Sein, M.M. Thu & P.S. Corbet, 1990. Suppression of *Aedes aegypti* (L.) (Diptera: Culicidae) by augmentative release of dragonfly larvae (Odonata: Libellulidae) with community participation in Yangon, Myanmar. *Bulletin of Entomological Research* 80: 223-232.
- Åbro, A. & P.S. Corbet, 1991. Obituary: Audfinn Tjønneland. *Odonatologica* 20: 479-481.
- Corbet, P.S., 1991. Obituary: Cynthia Longfield (1896-1991). *Journal of the British Dragonfly Society* 5: 29-32.
- Corbet, P.S., 1991. Odonatology in Algeria. [1]. *Kimminsia* 2(2): 14.
- Corbet, P.S., 1991. Suppression of the Yellow Fever Mosquito by augmentative release of dragonfly larvae (Odonata: Libellulidae). *Selysia* 20(1): 3.*
- Corbet, P.S., 1991. Dragonflies. *British Wildlife* 2: 175.
- Corbet, P.S., 1991. Suppression of the Yellow Fever Mosquito by augmentative release of dragonfly larvae (Odonata: Libellulidae). *Vector Ecology Newsletter* 22(3): 5.*
- Corbet, P.S., 1991. Obituary: Cynthia Longfield. *The Independent*, 5 July: 27.
- Corbet, P.S., 1991. Further comments on suppression of the Yellow Fever Mosquito by augmentative release of dragonfly larvae. *Selysia* 20(2): 7.*
- Corbet, P.S., 1991. Robert Gambles -- a tribute. *Kimminsia* 2(2): 14.
- Corbet, P.S., 1991. Book review: "Madam Dragonfly. The life and times of Cynthia Longfield" by Jane Hayter-Hames. *Journal of the British Dragonfly Society* 5: 45-47.
- Corbet, P.S., 1991. A brief history of odonatology. *Advances in Odonatology* 5: 21-44.
- Corbet, P.S., 1991. Suppression of the Yellow Fever Mosquito by augmentative release of dragonfly larvae (Odonata: Libellulidae). *Kimminsia* 2(2): 13-14.*
- Corbet, P.S. & P.L. Miller, 1991. 'Accompanying' behaviour as a means of prey acquisition by *Brachythemis leucosticta* (Burmeister) and other Anisoptera. *Odonatologica* 20: 29-36.
- [Corbet, P.S.] & S. Young, 1991. Dragonflies help to defeat dengue fever. *New Scientist* 30(1766): 26.*
- Sebastian, A., M.M. Sein, M.M. Thu, M.M. & P.S. Corbet, 1991. Suppression of the Yellow Fever Mosquito, *Aedes aegypti* (L.) (Diptera: Culicidae) by augmentative release of the dragonfly *Crocothemis servilia* (Drury) (Odonata: Libellulidae). *Opuscula Zoologica Fluminensia* 72: 1-5.*
- Pritchard, G. (Ed.) & P.S. Corbet, 1992. Current topics in dragonfly biology Volume 5 – including a discussion

- focusing on survival during the hot dry season. *Societas Internationalis Odonatologica Rapid Communications (Supplements)* 15: VIII, 29 pp.
- Corbet, P.S., 1993. The first ten years of the British Dragonfly Society. *Journal of the British Dragonfly Society* 9: 25-39.
- Corbet, P.S., 1993. Odonatology in Algeria (2). *Kimminsia* 4(2): 14-15.
- Corbet, P.S., 1993. BDS Journal -- a jewel in the crown. *British Dragonfly Society Newsletter* 23: 3-4.
- Corbet, P.S., 1993. International Symposium on the Conservation of Dragonflies and their Habitats. *Kimminsia* 4(2): 13-14.
- Corbet, P.S., 1993. Are Odonata useful as bioindicators? *Libellula* 12: 91-102.
- Samraoui, B., S. Bouzid, R. Boulahbal & P.S. Corbet, 1993. Seasonal migration and pre-reproductive diapause in *Aeshna mixta*, *Sympetrum meridionale* and *S. striolatum* as an adaptation to the Mediterranean climate (N.E. Algeria). *Societas Internationalis Odonatologica Symposium Abstracts* (1993): 33-34.
- Corbet, P.S., 1994. Wonders of dragonfly biology. *Proceedings of the 12th International Symposium of Odonatology, Osaka*: 73-77 [Japanese version: 68-73].
- Corbet, P.S., 1994. Tony Watson -- a tribute. *Kimminsia* 5(1): 1-2.
- Corbet, P.S., 1994. Obituary: J.A.L. Watson. *The Caian*, November: 131.
- Corbet, P.S., 1994. Dr. Tony Watson, 1935-1993. *Selysia* 23: 1.
- Corbet, P.S., 1995. Habitats and habits of world dragonflies and the need to conserve species and habitats. In P.S. Corbet, S.W. Dunkle & H. Ubukata (eds), "*Proceedings of the International Symposium on the Conservation of Dragonflies and their Habitats*", pp. vi + 1-7. Japanese Society for the Preservation of Birds, Kushiro.
- Corbet, P.S., 1995. Perspectives in odonatology. Notes from a workshop during the GdO meeting. Hoxter, 13 March 1994. *Libellula* 14: 105-108.
- Corbet, P.S., 1995. [Habits and habitats of world dragonflies and the need to conserve species and habitats.] In Japanese. In H. Ubukata, N.I. Ichijo & Y. Harauchi (eds), "*Transactions of the International Symposium on the Conservation of Dragonflies and their Habitats*", pp. 32-35 and plates 1-3. *Bulletin of the Hokkaido Odonatological Society* 7 (Supplement), x + 76 pp.
- Corbet, P.S., S.W. Dunkle, & H. Ubukata (eds), 1995. "*Proceedings of the International Symposium on the Conservation of Dragonflies and their Habitats*." Japanese Society for the Preservation of Birds. Kushiro.
- Corbet, P.S., M.J. Samways, J.A.L. Watson, S. Eda, S.W. Dunkle, E. Schmidt, B. Kiauta, & J. Ott, 1995. Impressions and comments about the conservation of Kushiro Marsh as a habitat of dragonflies. *Bulletin of the Hokkaido Odonatological Society* 7 (Suppl.): 18-26.
- Ferreras-Romero, M. & P.S. Corbet, 1995. Seasonal patterns of emergence in Odonata of a permanent stream in southwestern Europe. *Aquatic Insects* 17: 123-127.
- Copeland, R.S., W. Okeka & P.S. Corbet, 1996. Treeholes as larval habitat of the dragonfly *Hadrothemis camarensis* (Odonata: Libellulidae) in Kakamega Forest, Kenya. *Aquatic Insects* 18: 129-147.
- Corbet, P., 1996. Behavior and ecology of dragonflies. *Kimminsia* 7(2): 12.
- Corbet, P.S., 1996. Obituary: Peter Miller. *The Independent*, 6 May: 16.
- Corbet, P.S., 1996. Peter Miller -- a tribute. *Selysia* 24(1): 1-2.
- Corbet, P.S., 1996. Using dragonflies to suppress mosquitoes in domestic water storage containers. *Waterlines* 4: 10-11.
- Corbet, P., 1997. Obituary: Peter Miller (1931-1996). *Journal of the British Dragonfly Society* 11: 1-3.
- Corbet, P.S., 1997. Emperor Dragonfly *Anax imperator* Leach. In S. Brooks (ed.), "*Field Guide to the Dragonflies and Damselflies of Great Britain and Ireland*", pp. 113-114. British Wildlife Publishing, Hook, UK.
- Askew, R.R., R. Prosser & P.S. Corbet, 1998. Odonata of the Cayman Islands: a review. *Bulletin of American Odonatology* 5: 27-32.
- Corbet, P.S., 1998. Préface. In J. d'Aguilar & J. Dommanget, "*Guide des Libellules d'Europe et d'Afrique du Nord*", pp. 5-6. Delachaux & Niestlé, Lausanne & Paris.
- Corbet, P.S. & R. Hoess, 1998. Sex ratio of Odonata at emergence. *International Journal of Odonatology* 1: 99-118.
- Samraoui, B., S. Bouzid, R. Boulahbal, & P.S. Corbet, 1998. Postponed reproductive maturation in upland refuges maintains life-cycle continuity during the hot, dry season in Algerian dragonflies (Anisoptera). *International Journal of Odonatology* 1: 119-135.
- Walker, E.M. & P.S. Corbet, 1998. *The Odonata of Canada and Alaska*. Volume III. Part III: The Anisoptera -- Three Families (1975). Facsimile. University of Toronto Press, Toronto. xvi + 307 pp.
- Agüero-Pelegrin, M., M. Ferreras-Romero & P.S. Corbet, 1999. The life cycle of *Lestes viridis* (Odonata: Lestidae) in two seasonal streams of the Sierra Morena Mountains (southern Spain). *Aquatic Insects* 21: 187-196.
- Corbet, P.S., 1999. An Afrotropical marvel: *Zygonyx natalensis* (R. Martin). *Agrion* 3(1): 13-14.
- Corbet, P.S., 1999. "Dragonflies: Behavior and Ecology of Odonata." Cornell University Press, Ithaca, USA and Harley Books, Colchester, UK. xxxiv + 829 pp.

- Corbet, P.S., 1999. *Odonata*. In “Encyclopaedia Britannica”, Macropaedia. Benton, Chicago. <http://www.britannica.com>
- Corbet, P.S., 1999. *Damselfly. Dragonfly*. In “Encyclopaedia Britannica”, Micropaedia. Benton, Chicago. <http://www.britannica.com>.
- Ferreras-Romero, M. & P.S. Corbet, 1999. The life cycle of *Cordulegaster boltonii* (Donovan, 1807) (Odonata: Cordulegastridae) in the Sierra Morena Mountains (southern Spain). *Hydrobiologia* 405: 39-48.
- Ferreras-Romero, M. & P.S. Corbet, 1999. The life cycle of *Onychogomphus uncatatus* (Charpentier, 1840) (Odonata: Gomphidae) in the Sierra Morena Mountains (southern Spain): an example of protracted larval development in the Mediterranean basin. *Archiv für Hydrobiologie* 144: 215-228.
- Corbet, P.S., 2000. Book review: “A Guide to the Dragonflies of Great Britain”, Arlequin Press, Chelmsford, Essex, England (1999) 128pp. *Journal of the British Dragonfly Society* 16: 31-32.
- Corbet, P.S., 2000. Corrigenda for “Dragonflies: Behaviour & Ecology of Odonata” by Philip S. Corbet. *Agrion* 4(1): 11.
- Corbet, P.S., 2000. The first recorded arrival of *Anax junius* Drury (Anisoptera: Aeshnidae) in Europe: a scientist’s perspective. *International Journal of Odonatology* 3: 153-162.
- Corbet, P.S. (ed.), 2000. *Current topics in dragonfly biology*. Colgate University, New York. vi+33 pp.
- Corbet, Philip, 2000. Use of odonate larvae for biocontrol of insect pests. *Agrion* 4(2): 22-23.
- Ferreras-Romero, M., M.D. Atienzar & P.S. Corbet, 2000. Voltinism of *Calopteryx haemorrhoidalis* (Van der Linden) in the Sierra Mountains, southern Spain (Zygoptera: Calopterygidae): a preliminary study. *International Journal of Odonatology* 3: 125-130.
- Samraoui, B., S. Bouzid & P.S. Corbet, 2000. Delayed maturation in Algerian Odonata: a response to the Mediterranean climate. *Jahrestagung GdO, Rosenbühl* 19: 16-17 (Abstract).
- Samraoui, B. & P.S. Corbet, 2000. The Odonata of Numidia, northeastern Algeria, Part I: status and distribution. *International Journal of Odonatology* 3: 11-25.
- Samraoui, B. & P.S. Corbet, 2000. The Odonata of Numidia, northeastern Algeria, Part II: seasonal ecology. *International Journal of Odonatology* 3: 27-39.
- Parr, M. & P. Corbet, 2000. The 1999 International Congress of Odonatology. *Agrion* 4(1): 6-7.
- Corbet, P., 2001. Book review: “Damselflies of North America” by Minter J. Westfall Jr. & Michael L. May, 1996. *Agrion* 5(2): 25-26.
- Corbet, P.S., 2001. An abiding magical moment – *Rhyothemis fenestrina* Rambur, 1842. *Agrion* 5(1): 12.
- Corbet, P.S., 2001. Encounters with dragonfly royalty: *Anax tristis*. *Agrion* 5(2): 23-24.
- Corbet, P. S., 2001. Collecting on reserves. *Wild Cornwall* 84:22
- May, M.L. & P.S. Corbet, 2001. Occurrence and taxonomic significance of a palpal spine in larvae of *Enallagma* and other genera (Zygoptera: Coenagrionidae). *International Journal of Odonatology* 4: 41-49.
- Parr, M.J. and P.S. Corbet, 2001. Book review: “Dragonflies of North America” by James G. Needham, Minter J. Westfall Jr. & Michael L. May, 2000. *Agrion* 5(2): 26.
- Averill, L, P. Corbet, & D. Gennard, 2002. Conservation, Subscription and Sponsorship – what does it mean to us? *Agrion* 6(1): 2.
- Corbet, P., 2002. Message from the President. *Agrion* 6(1): 1.
- Corbet, P., 2002. Reprint of Corbet’s 1999 book on dragonflies. *Agrion* 6(1): 11.
- Corbet, P.S., 2002. Stadia and growth ratios of Odonata: a review. *International Journal of Odonatology* 5(1): 45-73.
- Corbet, P.S., 2002. Book review: “Dragonflies of Indiana” by James R. Curry, 2001. *Agrion* 6(1): 11.
- Corbet, P.S., 2002. Book review: “Dragonflies of the World” by Jill Silsby, 2001. *Agrion* 6(1): 11-12.
- Corbet, P., 2002. Waterside reminiscences. *Agrion* 6(2):17
- Corbet, P., 2002. Europese bijeenkomst van de Worldwide Dragonfly Association (WDA) te Leiden. *NVL-Neuwsbrief* 3 (6), September 2002, p. 4.
- Corbet, P.S., 2002. Foreword for Miller, Peter & Kate, “*East African dragonflies*”. Nature Kenya.
- Corbet, P.S. & S.H. Chowdhury, 2002. Voltinism of the common blue damselfly *Enallagma cyathigerum* (Charpentier) in a Scottish loch: a preliminary study. *Journal of the British Dragonfly Society* 18(1/2): 23-39.
- Corbet, P. & M. May, 2002. The Second WDA International Symposium of Odonatology. *Agrion* 6(1): 3-4.
- Corbet, P., M. May, & M. Parr, 2002. Prospects for WDA. *Agrion* 6:13
- Corbet, P.S. & P.L. Miller, 2002. *Dragonflies and damselflies*. Pp. 42-47 in O’Toole, C. (ed.) “The new encyclopaedia of insects and their allies”. Oxford University Press, Oxford.
- Corbet, P., 2003. A brief odonatological excursion to Namibia. *Agrion* 7(1): 6.
- Corbet, P., 2003. Dragonfly workshop in Winnipeg, Manitoba – 9 October 2002. *Agrion* 7(1): 12
- Corbet, P., 2003. Faith Evans (nee Tillyard), 1912-2003. *Agrion* 7(2): 25-26.
- Corbet, P., 2003. Leiden, June 2002. *Agrion* 7(1): 3-4.
- Corbet, P., 2003. Obituary for Ronald Ian Silsby, 1921-2002. *Agrion* 7(2): 25.

- Corbet, P., 2003. R. J. Tillyard FRS (1881-1937): a giant among odonatologists. *Agrion* 7(2): 21-24.
- Corbet, P., 2003. WDA has a patron. *Agrion* 7(1):1.
- Corbet, P. & M. May, 2003. Summaries of Board of Trustees meetings at Beechworth. *Agrion* 7(2): 15-16.
- Corbet, P.S., 2003. A positive correlation between photoperiod and development rate in summer species of Odonata could help to make emergence date appropriate to latitude: a testable hypothesis. *Journal of the Entomological Society of British Columbia* 100: 3-17.
- Corbet, P.S., 2003. Book review: "Introducing the dragonflies of British Columbia and the Yukon" by Robert Cannings. *Agrion* 7(1): 9-10.
- Corbet, P.S., 2003. Book review: "Oaks, Dragonflies and People" by N.W. Moore, 2002. *Journal of the British Dragonfly Society* 19: 57-59.
- Corbet, P.S., 2003. Ecological perspectives of African Odonata. *Cimbebasia* 18: 167-172.
- Corbet, P.S., 2003. Reproductive behaviour of Odonata: the history of a mystery. *International Journal of Odonatology* 6(2): 185-193.
- Corbet, P.S. & M.J. Parr, 2003. Safeguarding the reputation of WDA. *Agrion* 7(2): 28.
- May, M. & P. Corbet, 2003. Gathering useful information about the seasonal ecology of *Anax junius*. *Argia* 15(2): 15-16.
- May, M. & P. Corbet, 2003. The Third WDA International Symposium of Odonatology. *Agrion* 7(2): 14-15.
- Venning, G., R. Caine & P. Corbet, 2003. Obituary for David Allen L. Davies. *The Lancet* 361: 2163.
- Corbet, P., 2004. Book review: "A Guide to the Dragonflies of Borneo: Their Identification and Biology" by A.G. Orr. *Agrion* 8(2): 20-21.
- Corbet, P., 2004. Book review: "Dragonflies" by Steve Brooks. *Agrion* 8(1): 11-12.
- Corbet, P., 2004. Dragonflies: behaviour and ecology of Odonata 62nd Neill Medal Prize Lecture, 3 February 2003. *The Royal Society of Edinburgh Review of the Session 2002-2003*, pp. 74-87.
- Corbet, P.S., 2004. Ballistic defaecation by anisopteran larvae (Odonata): a way to increase foraging success? *International Journal of Odonatology* 7(1): 25-32.
- Corbet, P.S., 2004. Book review: "A field guide to the dragonflies and damselflies of Massachusetts" by B. Nikula, J.L. Loose, & M.R. Burne, 2003. *Northeastern Naturalist* 10(4): 471.
- Corbet, P.S., 2004. Foreword to Askew, R. R. "The Dragonflies of Europe". Harley Books, Colchester.
- Corbet, P.S., 2004. Global protection of Odonata and their habitats: a tribute to Norman W. Moore. *International Journal of Odonatology* 7(2): 111-112.
- Corbet, P.S., 2004. International Members of the ESO. *Entomological Society of Ontario Newsletter* 8(2): 9.
- Corbet, P.S., 2004. The WDA Archive. *Agrion* 8(2): 13-14.
- Corbet, P., 2006. Book review: "Dragonflies of Peninsular Malaysia and Singapore. A pocket guide" by A.G. Orr. *Agrion* 10(2): 27-28.
- Corbet, P.S., 2006. Forests as habitats for dragonflies (Odonata). In Cordero Rivera, Adolfo (ed.) Forests and dragonflies. *Fourth WDA International Symposium of Odonatology*, Pontevedra (Spain), July 2005, pp. 13-36.
- Corbet, P.S., 2006. Foreword to Theischinger, G. & Hawking, J. "The Complete Field Guide to Dragonflies of Australia". CSIRO Publishing.
- Corbet, P.S., F. Suhling, & D. Soendergerath, 2006. Voltinism of Odonata: a review. *International Journal of Odonatology* 9(1): 1-44.
- Corbet, P.S., 2007. *Dragonflies: behaviour and ecology of Odonata*. Kaiyusha Publishers Co. Ltd., Tokyo.
- Corbet, P.S., 2007. Dr Syoziro Asahina: fond recollections of fifty years of friendship. *Tombo*, Matsumoto 50(1/4): 7-9.
- Corbet, P.S., 2007. Foreword to Orr, A. G. and Hämäläinen, M. "The Metalwing Demoiselles of the Eastern Tropics: Their Identification and Biology". Natural History Publications (Borneo), Kota Kinabalu.
- Corbet, P.S., 2007. Two current threats to the future of entomology in Britain. *Antenna* 31: 208-213.
- Corbet, P., 2008. WDA Archivists' Report no. 1. The origin and development of WDA: the first ten years, 1997-2007. *Agrion* 12(1): 30-36.
- Corbet, P. and M. Parr, 2008. The fifth WDA International Symposium of Odonatology at Swakopmund, Namibia, April 2007: the scientific programme. *Agrion* 12 (1): 8-9.
- Corbet, P.S. & S. Brooks, 2008. *Dragonflies*. Collins New Naturalist Library, HarperCollins Publishers, London. 312pp.

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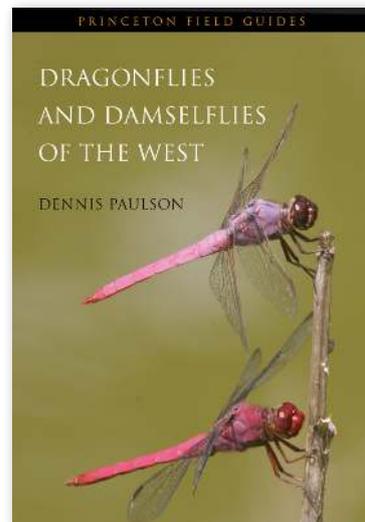
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