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# ARGIA

The News Journal of the Dragonfly Society of the Americas

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# The Dragonfly Society Of The Americas

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## Journals Published By The Society

**ARGIA**, the quarterly news journal of the DSA, is devoted to non-technical papers and news items relating to nearly every aspect of the study of Odonata and the people who are interested in them. The editor especially welcomes reports of studies in progress, news of forthcoming meetings, commentaries on species, habitat conservation, noteworthy occurrences, personal news items, accounts of meetings and collecting trips, and reviews of technical and non-technical publications. Membership in DSA includes a subscription to **ARGIA**.

**Bulletin Of American Odonatology** is devoted to studies of Odonata of the New World. This journal considers a wide range of topics for publication, including faunal synopses, behavioral studies, ecological studies, etc. The BAO publishes taxonomic studies but will not consider the publication of new names at any taxonomic level.

## Membership in the Dragonfly Society of the Americas

Membership in the DSA is open to any person in any country and includes a subscription to **ARGIA**. Dues for individuals in the US, Canada, or Latin America are \$20 US for regular membership and \$25 US for institutions or contributing membership, payable annually on or before 1 March of membership year. Dues for members in the Old World are \$30 US. The **Bulletin Of American Odonatology** is available by a separate subscription at \$20 US for North Americans and \$25 US for non-North Americans and institutions. Membership dues and BAO subscription fees should be mailed to Jerrell Daigle, 2067 Little River Lane, Tallahassee, FL, USA 32311

## ARGIA and BAO Submission Guidelines

Digital submissions of all materials (via e-mail or CD) are much preferred to hardcopy. All articles and notes should be submitted in Word or Rich Text Format, without any figures or tables embedded. Only minimal formatting to facilitate review is needed. Photographs should be submitted at TIFF (preferred) or JPEG files with a minimum of 300 ppi at the intended print size. Charts, graphs, diagrams, and other vector graphics are best submitted in Illustrator format or EPS. If this is not possible, submit as PNG or TIFF at a minimum of 600 ppi at the intended print size. Charts and graphs may also be submitted in Excel documents. Tables may be submitted as Word or Excel documents. For more information see the entire guidelines at the end of this issue or visit <[http://odonatacentral.bfl.utexas.edu/dsa1/submission\\_guidelines.htm](http://odonatacentral.bfl.utexas.edu/dsa1/submission_guidelines.htm)>. **ARGIA** submissions should be sent to John Abbott, Section of Integrative Biology, C0930, University of Texas, Austin TX, USA 78712, <[jcabbott@mail.utexas.edu](mailto:jcabbott@mail.utexas.edu)>; BAO submissions should be sent to Ken Tennessen, P.O. Box 585, Wautoma, WI, USA 54982, <[ktennessen@centurytel.net](mailto:ktennessen@centurytel.net)>.

**Front cover:** (upper left) *Tramea calverti* (Striped Saddlebags) in Lubbock Co., Texas, by Jerry Hatfield; (lower right) *Erythrodiplax basifusca* (Plateau Dragonlet) in Imperial Co., California—a first state record, by David Blue. See notes regarding these finds within.

## In This Issue

I have to start this issue, the first as Editor in Chief, by saying I have some big shoes to fill. Carl Cook first got ARGIA off the ground in December 1989. It's a credit to Carl's vision and dedication to odonatology that nearly 20 year later DSA and ARGIA are still around. In July of 1992, Nick Donnelly took over as Interim Editor for Carl and he tirelessly made sure fourteen volumes of ARGIA found their way into the hands of the DSA membership. I was a bit reluctant to take on this responsibility as I knew it would be tons of work and both Carl and Nick had set the bar so high. I won't be doing this alone, however, as Ken Tennesen will be handling BAO and Jim Johnson will continue to do the layout, printing, and distribution of both ARGIA and BAO. It may be obvious, but I will still point out to the readership that it is taking three to do the job that both Carl and Nick (for most of his tenure) did on their own!

It is election time and everyone needs to cast their vote for President Elect and Regular Member. Be sure to get these ballots in to Steve Valley as soon as possible. It is also time to send in your 2007 membership dues for DSA. This year, make sure to include your e-mail address on the dues form as all members in good standing will have on-line access to the entire library of ARGIA and BAO (if you are currently paying for BAO) back issues.

We have a number of excellent meetings to look forward to in 2007; be sure to check the Calendar of Events and see what is happening near you. The 2007 DSA annual meeting is 27–30 July in Springerville, Arizona. The organizer, Jerrell Daigle, describes what is in store for attendees and some of the more interesting and unusual species we can expect to see. Mark your calendars now and register for this meeting at <<http://www.odonatacentral.com/dsa1>>.

Douglas Aguillard reports on the efforts of the CalOdes group to explore the poorly visited southeastern portion

of California. The nine member SWAT team was not just looking to increase the numbers of species known from this part of the state, but they were specifically looking for *Tramea calverti* (Striped Saddlebags) which many thought should occur there. The group was successful and added this wide-ranging species to California's growing list.

DSA has a new Checklist Committee that will replace the Common Names Committee. The Chair of this new committee, Dennis Paulson, discusses what this means for the DSA membership and what the responsibility of the new committee will be. In his article, you will also find a complete list of all names newly created or changed since the original 1996 publication of common names.


Many of you have been inquiring as to why many of the records submitted to OdonataCentral this last year have not been incorporated into the database. The answer has to do with sheer volume and lack of time, but most importantly because of a required change in the mapping interface we are using. In this issue, I'm bringing everyone up to speed with the current and future plans for OdonataCentral.

Jason Bried, Pam Hunt, and Wade Worthen have contributed a piece that should be interesting to us all. How often and for how long should you visit a locality you are trying to survey? They present some interesting data to help answer this question and you will find a request for help from this same group at the end of the issue. They would like as many as possible to take part in this study by sharing the visits to your favorite haunts with them.

Dennis Paulson details his recent trip to the Hawaiian Islands and specifically the island of Kauai. Although Dennis did not have the success he was hoping for, he certainly didn't come up empty handed. He managed to find several of the archipelago's endemic species and even

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## Calendar of Events for 2007

Event	Date	Location	Contact
WDA International Congress	16–20 April	Swakopmund, Namibia	< <a href="http://wda2007.tu-bs.de/">http://wda2007.tu-bs.de/</a> >
Dragonfly Days	17–20 May	Weslaco, Texas	< <a href="http://www.valleynaturecenter.org/">http://www.valleynaturecenter.org/</a> >
NE Regional	22–24 June	Sussex Co., New Jersey	< <a href="http://www.njodes.com/">http://www.njodes.com/</a> >
SE Regional	5–8 July	southwest Georgia	Giff Beaton < <a href="mailto:giffbeaton@mindspring.com">giffbeaton@mindspring.com</a> >
DSA Annual	27–31 July	Springerville, Arizona	Jerrell Daigle < <a href="mailto:jdaigle@nettally.com">jdaigle@nettally.com</a> > 



found populations of *Crocothemis servilia* (Scarlet Skimmer) and *Orthemis ferruginea* (Roseate Skimmer) which were previously unknown from Kauai.

We have several articles in this issue on Odonata from the West Indies. The first is by Jerrell Daigle and Mark McPeck who report on the DNA status of the closely related species *Enallagma coecum* (Purple Bluet) and *E. cardenium*. Nick Donnelly reports on a collection of Odonata taken in Montserrat by the famed beetle guru Mike Ivie. This island is virtually unsurveyed for odonates and Nick presents convincing evidence of the discoveries to be had there. François Meurgey and Gaëlle Weber detail the fauna of the island of Dominica. Finally, Fred Sibley reports the second finding of the wide ranging African species *Anax ephippiger* (Vagrant Emperor) from the West Indies. You will recall François Meurgey recently reported this species from Guadeloupe and French Guyana.

Fred Sibley and Jerrell Daigle revisited the Florida Keys a year after Hurricane Wilma came through the area. Among the vegetational changes, the death of pine trees on Big Pine Key, they found the loss of pond vegetation on Stock Island was the biggest change to odonate habitats. Overall, the long-term effect of Hurricane Wilma to the odonate community of the Florida Keys seems unclear. Among their finds was the third record of *Anax amazili* (Amazon Darner) in the Keys. This species should be on everyone's watch list that lives around the Gulf Coast. It made numerous appearances in Texas in 2006.

Kirsten Martin provides an interesting observation of chipmunks feeding on emerging *Gomphus vastus* (Cobra Clubtail) along the Connecticut River. Roy Beckemeyer posted the availability of a paper on odonate phylogeny by Hasegawa and Kasuya to the Odonata-l listserv. This was followed up by a discussion on the topic by Don Roberson and then Mike May. It is an important topic that I believe much of our readership is interested in. I asked Mike to provide us with a more thorough outline of his thoughts on odonate phylogeny. He graciously agreed, and readers will find part 1 (Phylogenetic Inference) of this discussion in this issue. I'll warn you there is a lot of information here, but both Mike and I hope that many of you will be interested in the logic of phylogenetic inference and in understanding the real problems applying it.

Dennis Paulson details a useful form of shorthand for documenting species. I was aware of its use in the bird community and have even loosely used it for odonates, but Dennis' note has prompted me to try it more formally.

The big news of course is all the new finds from the past year. Giff Beaton and Marion Dobbs summarized their

efforts in Georgia in 2006. Two species, *Lestes congener* (Southern Spreadwing) and *Macrodiplex balteata* (Marl Pennant), were both found for the first time in Georgia raising that state's species list to 173. Bob Behrstock and Josh Rose detail their finding of yet another species new to Texas found in the Lower Rio Grande Valley. They found two *Triacanthagyna septima* (Pale-green Darner) during the annual Texas Butterfly Festival. It seems a new species is discovered every year by these guys at this event. Everyone living in or visiting the Texas Lower Rio Grande Valley should really keep their eyes peeled. This area continues to be productive for new discoveries.

David Arbour found *Tholymis citrina* (Evening Skimmer) in the southeastern corner of Oklahoma. This tropical species has found its way into Florida and Texas before, but never as far north as Oklahoma. The folks on the west coast aren't letting any dust settle under their feet either. David Blue follows up the earlier mentioned *Tramea calverti* (Striped Saddlebags) with the first record of *Erythrodiplax basifusca* (Plateau Dragonlet) for California. Check out his beautiful photograph of this species on the front cover.

Jerry Hatfield has been busy filling many of the gaps in the Llano Estacado of the Texas Panhandle. This area has received very little attention, but Jerry is putting it on the map. Wade Worthen and Christopher Jones report on their finds in Union County, South Carolina and Charles Mills reports on the first finding of *Aphylla williamsoni* (Two-striped Forceptail) in Arkansas. This species was also found for the first time in Oklahoma in 2006.

There are several notes and requests for assistance with research projects that readers may be able to contribute too. John Heppner is putting together trips to Guatemala and Peru that you may be interested in.

One of the photos on the rear cover is of a beautiful handmade watch that Stanislav Gorb found while attending an exhibition of miniatures in the Ukraine.

Finally, we end with what may be the first formal "complaint" submitted to ARGIA. Apparently the complainants had difficulty guessing the names of the species displayed on the covers of the last issue. Hopefully they will have an easier time in the future!




## It's Election Time!

**Steve Krotzer**, DSA President <rskrotze@southernco.com>

I would like to take this opportunity to encourage all DSA members to cast their votes for the offices of President Elect and Regular Member, the two Executive Council positions that will need to be filled in 2007. The Nominating Committee (Steve Hummel (chair), Roy Beckemeyer, Dennis Paulson, Ken Tennesen, and Hal White) nominated Bill Mauffray for the office of President Elect and Natalia von Ellenrieder for the office of Regular Member.

Please use the ballot included with this issue of ARGIA to cast a vote for these candidates or to write in a candidate

of your choice. The completed ballots must be returned to Steve Valley by no later than 15 March 2007. The results of the voting will be published in the next ARGIA and will be announced on the DSA web site, which may be accessed via OdonataCentral <<http://www.odonatacentral.com/dsa1>>.

Thanks to the Nominating Committee for all their good work in coming up with these excellent candidates, and thanks in advance to the DSA membership for participating in the voting process. 

## Minutes of the 2006 Annual Meeting of the Dragonfly Society of the Americas

**Steve Valley**, DSA Secretary <svalley2@comcast.net>

The annual meeting of the Dragonfly Society of the Americas was held on Saturday, 10 June 2006, at Caverna Elementary School in Cave City, Kentucky, with President Steve Krotzer presiding.

Introduction and welcoming statements by hosts Carl Cook and Ellis Lauder milk Jerrell J. Daigle passed out the meeting buttons.

Treasurer's Report: We began the 2006 year with a balance forward of \$8,048.77. Our current balance is \$14,922.49. Our projected year-end balance should be about \$8,000. A final report will be presented in ARGIA later.


Jerrell J. Daigle proposed that the 2007 annual meeting be held in Springerville, Arizona. The proposal was voted on and carried. There was a discussion of future annual meetings, and the 2007 northeast and southeast regional meetings.

Bill Mauffray gave a report for the International Odonata Research Institute (IORI).

Steve Krotzer announced that a Nominating Committee had been formed: Steve Hummel (Chair), Ken Tennesen, Dennis Paulson, and Hal White. The committee will choose nominees for President Elect and a Regular Member in the 2007 election.

A special presentation was made by Ellis Lauder milk and Mary Jane Krotzer honoring Carl Cook for his many years of service to DSA and the study of odonates. Stories

about Carl were told by Ken Tennesen, Jerrell J. Daigle, Nick Donnelly, and Ellis Lauder milk. Mary Jane Krotzer narrated a slide show about Carl, and a plaque and honorary membership in DSA were presented to him.

There were 64 participants at the 2006 meeting who introduced themselves: Steve Valley and Cary Kerst from Oregon; Jim Johnson and Dennis Paulson from Washington; Bob Thomas and John Abbott from Texas; Steve and Marcia Hummel from Iowa; Bob DuBois and Ken Tennesen from Wisconsin; Joe Smentowski, Jane Walker, and Tim Vogt from Missouri; George and Phoebe Harp from Arkansas; Ken and Tim Allison, and Colin Jones from Ontario, Canada; Tim Cashatt, Yvette Liautaud, and Kathy Kozacky from Illinois; Julie Craves and Darrin O'Brien from Michigan; Bob Glotzhofer, Jim Davidson, Greg Dinney, and Dave McShaffrey from Ohio; Carl Cook, Ellis Lauder milk, Richard Cassell, Gary Sprandel, Heidi Peters, plus Kurt, Brennan, and Hannah Helf from Kentucky; Richard Connors from Tennessee; Randy Emmitt, Roger Rittmaster, John Thomas, and Duncan Cuyler from North Carolina; Bruce Grimes and Richard Groover from Virginia; Bill Mauffray and Jerrell J. Daigle from Florida; Marion Dobbs, Giff Beaton, Allan, Tracey, and Charlie Muisse from Georgia; Steve and Mary Jane Krotzer from Alabama; Mike Blust and Brian Pfeiffer from Vermont; Nancy Rideout from New Hampshire; David Fitch from Massachusetts; Ed Lam, Thomas Cullen, Jan Trybula, Nick and Ailsa Donnelly from New York; Jeremy Huff, Jessica Ware, and Aeshna Ware-Huff from New Jersey; Jennifer Wykle from West Virginia. 


## The 2007 Annual DSA Meeting in Arizona

Jerrell J. Daigle, 850/878-8787, <Jdaigle@nettally.com>

The 2007 Annual DSA meeting will be held in Springerville, Arizona from 27–30 July with the business meeting set for Saturday, 28 July. We have reserved a block of 30 rooms at the America Best Value Inn (928-333-2655), formerly Super 8, in Springerville. We have negotiated a rate of \$68.00 including taxes and they will hold the rooms until 30 days before the meeting. Ask for Raj and tell them you are with the Dragonfly Society of the Americas and mention my name. Please reserve your room as soon as possible. For more about this hotel, check its web site at <www.americasbestvalue.com> and navigate to “Arizona”. For more about Springerville, go to <www.springerville.com> for more information about other motels, activities, campgrounds, and restaurants. By plane, Phoenix and Albuquerque, New Mexico are about the same distance (3–4 hours). We recommend flying in on 26 July and taking your time sightseeing on the way to Springerville.

The business meeting will be held at the Round Valley School District Boardroom in Springerville. This place is air-conditioned with facilities. Please let me know of any items for the agenda, and if you want to schedule a presentation or workshop. Let me know of any presentation needs or if you are bringing your own projectors.

We will be conducting odonata inventories at nearby Lyman State Park (Big Lake) and Sitgreaves National Forest. Hopefully, we will see *Aeshna interrupta interna* (Variable Darner), *A. persephone* (Persephone’s Darner), *Oplonaeschna armata* (Riffle Darner), *Cordulegaster diadema* (Apache Spiketail), *Ophiogomphus arizonicus* (Arizona Spiketail), *Amphiagrion abbreviatum* (Western Red Damsel), and *Argia tonto* (Tonto Dancer).

We will leave the morning of 31 July for the post-symposium field trip to Safford, Arizona, about 80 miles south of Springerville. The odonata community here should be different, especially with the many species of *Argia* (dancers). We have reserved a block of 20 rooms at the Days Inn (928-428-5000) from 31 July to 2 August. We have negotiated a rate of \$75.00, not including taxes and they will hold the rooms until 30 days before the meeting. Ask for Vanessa and tell them you are with the Dragonfly Society of the Americas, and mention my name. Please reserve your room as soon as possible. There are other similarly priced motels in Safford like the Econo Lodge (928-348-0011). If you have any questions, please let me know. Also, check out our web site at <www.odonatacentral.com> to register, view a list of participants, and see the meeting agenda. Thanks! Hope to see you there! 

## CalOdes/DSA Blitz II—The Desert Experience (A New State Record)

Douglas Aguillard

In September 2005, seven members of the CalOdes (California Odonates Yahoo Internet group) decided to get together and search an under explored area of California for new records of dragonflies and damselflies. We searched Modoc County, which is located in the extreme northeastern section of California. We were rained on, and snowed on, but yet we all had a lot of fun and the experience was wonderful. We all decided to make this an annual event where our goals were:

- (1) Seek out new areas and records for California to further the knowledge base of California’s odonates.
- (2) Be able to socialize with our fellow dragonfly enthusiasts, and just have fun.

It was decided that the 2nd Annual CalOdes/DSA Blitz would be held from 7–8 October 2006 in the extreme

southeasterly portion of the state, along the Colorado River. This time, we decided that instead of roughing it in the great (hot) deserts of California, that we would base ourselves in a motel in Yuma, Arizona, which is just across the California border.

While a few of the original attendees couldn’t make it this year, we picked up several new folks who joined in on the fun. Attendees included original CalOdes Blitz I members, David & Kathy Biggs (Sonoma County), Ray Bruun (Shasta County), Doug Aguillard & Patricia Sherman (San Diego County), and newcomers, Paul Johnson (San Benito County), Bob Miller (Imperial County), Rod Miller (Arizona), and Ed Lam (New York).

Picking this area for our search was done as an educated guess. Several authorities including Sid Dunkle, Tim Manolis, and Kathy Biggs had been predicting that

*Tramea calverti* (Striped Saddlebags) would show up in California for some time. In October of 2005, I had read a message on the SoWestLep Yahoo Group, that Jim Brock and Hank Brodtkin had seen a *T. calverti* on the Arizona side of the Colorado River at Betty's Kitchen in late October. After a discussion with Tim Manolis, it was decided to try for *T. calverti* during early October, so as to increase our chances of a larger number of species in the area, besides matching the dates when *T. calverti* had been seen near the California border.

On 6 October, Ray Bruun and Paul Johnson stopped in Riverside and Imperial Counties near the Salton Sea, as did Kathy and David Biggs, both groups looked for odes there. Seen en route to the Blitz:

- Common Green Darner (*Anax junius*)
- Blue-eyed Darner (*Rhionaeschna multicolor*)
- Western Pondhawk (*Erythemis collocata*)
- \*Comanche Skimmer (*Libellula comanche*)
- Flame Skimmer (*Libellula saturata*)
- Roseate Skimmer (*Orthemis ferruginea*)
- Blue Dasher (*Pachydiplax longipennis*)
- Variiegated Meadowhawk (*Sympetrum corruptum*)
- Red-tailed Pennant (*Brachymesia furcata*)
- Wandering Glider (*Pantala flavescens*)
- Spot-winged Glider (*Pantala hymenaea*)
- Black Saddlebags (*Tramea lacerata*)
- Red Saddlebags (*Tramea onusta*)
- American Rubyspot (*Hetaerina americana*)
- California Dancer (*Argia agrioides*)
- \*Paiute Dancer (*Argia alberta*)
- Powdered Dancer (*Argia moesta*)
- Blue-ringed Dancer (*Argia sedula*)
- Vivid Dancer (*Argia vivida*)
- Familiar Bluet (*Enallagma civile*)
- Desert Forktail (*Ischnura barberi*)
- Black-fronted Forktail (*Ischnura denticollis*)
- Rambur's Forktail (*Ischnura ramburii*)

\* = new late flight data for California

Paul and Ray arrived early enough to scout the Imperial Dam area later on the 6th. They found *Stylurus plagiatus* (Russet-tipped Clubtail) and were able to share their location with the rest of the group, which arrived that night and early the next morning.

On 7 October we all met for breakfast at the local Denny's, and got on the road by 9:30 AM. Our FRS radios were set to channel 11, and the caravan rolled into California, and north along the Colorado River. The weather was pleasant with the temps in the 80s and a westerly breeze helped keep the heat down. Since Bob Miller was the most familiar with the area, he was designated as the leader. We headed for

an area called Senator's Wash, which was next to Senator's Reservoir. Here we immediately started seeing odes, and soon discovered 4–5 *Brechmorhoga mendax* (Pale-faced Clubskimmers), a new Imperial County record.

We continued to poke around different areas without seeing anything real exciting, until we came to the West Pond area, near the Imperial Dam on the Colorado River. It was here that things really started getting us excited. We found a road along the northern stretch of this rather large pond/lake, and we immediately found a female and then a male *Macrodiplox balteata* (Marl Pennant), which is uncommon anywhere in California. This was a lifer for many in the group and photographs were taken and then a specimen was collected to upgrade Imperial County's record from a photo voucher to a specimen.

When we walked up to an opening in the reeds that allowed us to see the pond, two red-colored *Trameas* (saddlebags) flew by the entire group in tandem, and Rod Miller thought they could possibly have been our quarry. Everyone spread out, and it was Bob Miller (no relation) that spotted a male *Tramea* far out on a reed along the shoreline. Ed Lam and Rod Miller both entered the pond in the hopes of netting this bug, but never could catch it. Eventually, we moved on to the south side of the pond, without being able to firmly say that we had found our new *Tramea* for California. We spent the rest of the afternoon chasing after *Stylurus plagiatus* (Russet-tipped Clubtail), another rarity in California, along the east shore of West Pond.

On Sunday 8 October, we decided to hit the road earlier, and immediately headed back for West Pond to see if we could find those *Tramea* again. One half of the group stopped at a beaver pond along McKinney Road and found *Ischnura hastata* (Citrine Forktail), while the rest did a fruitless search for the *Tramea*.

By noon, the Blitz was coming to a close as people had to start heading home. The small group that remained decided to give it one more shot and went looking for *Tramea calverti* (Striped Saddlebags). When they reached the area from the day before, they did see a male *Tramea*. It was out on the reeds along the shoreline, but due to distance and lighting, they could not make out its identification. Bob Miller decided to digi-scope the *Tramea* and hoped for the best.

There was even a discussion of ways to "Mess with Doug" by really doing a bad job of "Photoshopping in the stripes" and sending the images to me, and stating that I should have stayed 20 minutes longer.

When Bob Miller got home and started to look at his images, it was then discovered that he had actually taken




images of our *new state record*, the *Tramea calverti* (Striped Saddlebags)!!!! Bob immediately put the word out to everyone on CalOdes, and on Friday 13 October, I went back out to West Pond. Within a few minutes, I found a male and female *T. calverti* perched near each other on a tree branch in the original spot that they were seen back on the 7th and 8th. While attempting to get into a good photo shooting position, the male flew away, not to be seen again, but I was able to get good images of the female before she too departed.

West Pond is located north of Winterhaven, California, along the Colorado River in the Imperial Dam Recreation Area. The road to take to get there is Senator Wash Road, and the coordinates are N 32° 52.74' W 114° 28.65'.

Species seen in the Imperial Dam area during the two day (7–8 October) Blitz include:

- Common Green Darner (*Anax junius*)
- Blue-eyed Darner (*Rhionaeschna multicolor*)
- \* White-belted Ringtail (*Erpetogomphus compositus*)
- \* Russet-tipped Clubtail (*Stylurus plagiatus*)
- † Pale-faced Clubskimmer (*Brechmorhoga mendax*)
- Western Pondhawk (*Erythemis collocata*)
- \* Comanche Skimmer (*Libellula comanche*)
- Flame Skimmer (*Libellula saturata*)
- \*† Marl Pennant (*Macrodiplax balteata*)
- Roseate Skimmer (*Orthemis ferruginea*)
- Blue Dasher (*Pachydiplax longipennis*)
- Variiegated Meadowhawk (*Sympetrum corruptum*)

- Red-tailed Pennant (*Brachymesia furcata*)
- Wandering Glider (*Pantala flavescens*)
- Spot-winged Glider (*Pantala hymenaea*)
- Mexican Amberwing (*Perithemis intensa*)
- ‡ Striped Saddlebags (*Tramea calverti*)
- Black Saddlebags (*Tramea lacerata*)
- Red Saddlebags (*Tramea onusta*)
- American Rubyspot (*Hetaerina americana*)
- California Dancer (*Argia agrioides*)
- \* Paiute Dancer (*Argia alberta*)
- Powdered Dancer (*Argia moesta*)
- \* Blue-ringed Dancer (*Argia sedula*)
- Vivid Dancer (*Argia vivida*)
- Familiar Bluet (*Enallagma civile*)
- Desert Forktail (*Ischnura barberi*)
- Black-fronted Forktail (*Ischnura denticollis*)
- Citrine Forktail (*Ischnura hastata*)
- Rambur's Forktail (*Ischnura ramburii*)
- \* = new late flight data
- † = new county record
- ‡ = new state record

I want to thank all of the participants for coming, and helping and sharing some good times with us. Everyone is welcome to join our next CalOdes/DSA Blitz III, which will be held in July 2007 in California's Owens Valley. We will be spending time in the Sierra Nevada, the Owens River Valley (high desert habitat), and the White Mountains. More information to follow. 

## New Checklist Committee for DSA

**Dennis Paulson** <dennispaulson@comcast.net>

The Common Names Committee of the DSA began its existence in 1996 at the request of then-president Ken Tennesen. The members appointed were Tim Cashatt, Jerrell Daigle, Nick Donnelly, Sid Dunkle, Bob Glotzhober, Dennis Paulson (Chair), and Steve Valley.

The committee was charged with the responsibility for overseeing the common (English) names of the Odonata of Canada and the US after the publication in 1996 of an approved list of common names. As I know people have some interest in the history of such deliberations, I list here the names affected by the committee since the publication of the original list. The year given is the year of the name's publication in ARGIA by the committee. Names published in the Needham, Westfall and May dragonfly manual are indicated by NWM.

### Names Corrected

- Aeshna juncea*, Rush Darner to Sedge Darner (1996)
- Somatochlora hineana*, Hook-tipped Emerald to Hine's Emerald (1997)
- Gomphus adelphus*, Moustached Clubtail to Mustached Clubtail (1998)

### Newly Recorded From the US/Canada

- Palaemnema domina*, Desert Shadowdamsel (1996)
- Dythemis maya*, Mayan Setwing (1996)
- Neoneura amelia*, Amelia's Threadtail (1998)
- Orthemis discolor*, Orange-bellied Skimmer (1998)
- Nehalennia minuta*, Tropical Sprite (1999)
- Gynacantha mexicana*, Bar-sided Darner (1999)
- Erythemis peruviana*, Flame-tailed Pondhawk (2003)



*Argia carlcooki*, Yaqui Dancer (2004)  
*Chrysobasis lucifer*, Lucifer Damsel (2004)  
*Orthemis* sp., Antillean Skimmer (2004)  
*Leptobasis melinogaster*, Cream-tipped Swampdamsel (2005)  
*Anax concolor*, Blue-spotted Comet Darner (2005)  
*Triacanthagyna septima*, Pale-green Darner (NWM)  
*Erythemis mithroides*, Claret Pondhawk (NWM)  
*Phyllocycla breviphylla*, Ringed Forceptail (to be published)

### Newly Described

*Ophiogomphus smithi*, Sioux Snaketail (2004)  
*Stylogomphus sigmastylus*, Interior Least Clubtail (2004)  
*Cordulegaster talaria*, Ouachita Spiketail (2004)  
*Neurocordulia michaeli*, Broad-tailed Shadowdragon (NWM)


### Name Changes or Additions Because of Taxonomic Decisions

*Lestes disjunctus*, Common Spreadwing, split into *Lestes australis*, Southern Spreadwing, and *Lestes disjunctus*, Northern Spreadwing (2004)  
*Enallagma vernale*, Vernal Bluet; had been considered subspecies of *Enallagma cyathigerum*, Northern Bluet (2004); Northern Bluet subsequently changed to *Enallagma annexum* (2005)  
*Stylogomphus albistylus*, Eastern Least Clubtail; species split into two (2004)  
*Erythemis simplicicollis*, Eastern Pondhawk, and *E. collocata*, Western Pondhawk, combined into *Erythemis simplicicollis*, Common Pondhawk (2004)

### Names Changed for a Variety of Reasons

*Zoniagrion exclamationis*, Sierra Damsel to Exclamation Damsel (1998)  
*Cannaphila insularis*, Narrow-winged Skimmer to Gray-waisted Skimmer (2000)  
*Macromia illinoensis*, Illinois River Cruiser to Swift River Cruiser (2004)  
*Leucorrhinia proxima*, Red-waisted Whiteface to Belted Whiteface (2004)  
*Orthemis discolor*, Orange-bellied Skimmer to Carmine Skimmer (2004)  
*Sympetrum vicinum*, Yellow-legged Meadowhawk to Autumn Meadowhawk (2004)  
*Ophiogomphus susbebecha*, Wisconsin Snaketail to St. Croix Snaketail (2006)  
*Epithecica costalis*, Stripe-winged Baskettail to Slender Baskettail (2006)  
*Somatochlora elongata*, Ski-tailed Emerald to Ski-tipped Emerald (2006)  
*Celithemis ornata*, Faded Pennant to Ornate Pennant (2006)

This committee has now been disbanded, to be replaced by a DSA Checklist Committee that will not only continue deliberations on common names but will also attempt to maintain an official checklist of North American Odonata, incorporating published taxonomic proposals.

The Checklist Committee at present consists of John Abbott, Tim Cashatt, Jerrell Daigle, Sid Dunkle, Rosser Garrison, Mike May, Dennis Paulson (Chair), Ken Tennesen, and Steve Valley. Stay tuned for messages from this committee! 

## Update on OdonataCentral

**John C. Abbott**, 1 University Station #L7000, The University of Texas at Austin, Austin, Texas 78712 <jcabott@mail.utexas.edu>

I know many of you have been wondering about the status of the records you submitted to OdonataCentral <<http://www.odonatacentral.com>> over the last year. The success and support for OdonataCentral has been overwhelming, and I do mean overwhelming! However, the ArcIMS mapping interface that so many users found informative, exciting, and useful, has literally collapsed under the weight of the contributions of the Odonata community. Apparently, it was simply not built for the large dataset that the Odonata community has generated and ESRI, the makers of ArcIMS, will soon drop the software from their product line. ESRI does offer another product, ArcSDE, designed to handle large datasets, but it has

other complications and drawbacks. Seeing the writing on the wall we started to work on an alternative using Google Maps in early 2006. Unfortunately, it too came to a screeching halt under the volume of records. Given that one of the major selling points of OdonataCentral was falling apart, we set out to design and implement a new dynamic map interface. I'm happy to report that we have been beta-testing a new mapping interface, which utilizes advanced scripting and an improved Google Maps API. The full version should be up and running by the time you read the next issue of ARGIA.


As a result of these changes, I diverted a number of

resources available to OdonataCentral which meant that vetting and updating records were not the top priority. I can understand why this would be frustrating to many users, but without the mapping interface, the records have limited use on OdonataCentral. Please do not give up on the power of OdonataCentral, and continue to submit your records. This can be done through the web page directly or by contacting me and arranging for larger spreadsheets and databases to be imported.

In 2006, I also received funding from the Texas Natural Science Center and put to work a team of programmers to rebuild the backside of OdonataCentral (this essentially amounts to having trained professionals rewrite code to increase efficiency throughout the site) and create a user interface I'm calling MyOdonataCentral. This interface will allow users to have customized accounts on OdonataCentral, much like Amazon, eBay, MySpace, or Flickr. You will be able to smoothly and efficiently keep track of your records, locations visited, etc. and easily check on the status of submitted records. You will be able to set preferences like requesting e-mail alerts when new species have been reported for your area (county, state, country)

and whether you would like to see species reported (and submitted) by scientific name, common name, or both. This new interface will also allow members of DSA in good standing to access all issues of ARGIA and BAO (if they subscribe to BAO) on line.

Another change I am making is to help with the timely feedback of submitted records. All records will become visible throughout the site (on the checklists, maps, etc.) as soon as they are submitted. They will, however, be tagged as unvetted until they have been officially accepted. Users will be able to filter records and decide whether to include unvetted records. In the same way, the site will be able to handle larval, sight, and photographic records. Settings for the default filtering of these records will be available in the preferences of MyOdonataCentral, but you will be able to quickly include or exclude records on individual pages.

OdonataCentral is a community endeavor meant to facilitate the collection and dissemination of information pertaining to Odonata. As such, I openly encourage users to send me suggestions for improvement and I thank those that already have done so. 

## How Often and How Long? Studying Temporal Survey Design for Adult Odonates

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**Wade B. Worthen**, Biology Dept., Furman University, Greenville, SC 29613 <worthen@furman.edu>

### Introduction

How often should I survey and how long should the surveys last? This is a fundamental and often troublesome question that comes up at the start of most animal research and conservation monitoring projects. Valid inferences must be made, which requires accurate and thorough data. However, researchers and especially conservation practitioners may also be interested in minimizing effort. Conservation actions require a major investment of limited human resources, so if intense effort provides no greater biological payoff than some lesser effort, practitioners will happily apply the lesser effort. We have begun to explore the amount of temporal effort needed to adequately sample adult odonates.

The approach is simple: sample frequently with long surveys, then reduce the data set and count how many species or occurrences remain. Weekly samples can be cut into less frequent return intervals, like biweekly, triweekly, and monthly. Obviously these "slices" will support equal or fewer observed species and occurrences compared to the complete data set, but to what degree? We are asking if there is a point of diminishing returns. Is weekly sampling

necessary if just as many or almost as many species are found by sampling every other week? These same ideas and questions extend to the duration of survey, which may influence the choice of return interval. Are shorter surveys permissible when frequent surveys are used or, conversely, can one get away with fewer but longer-lasting surveys?

### Field Methods

We did a test run this past summer at four sites in the Albany Pine Bush Preserve (Albany Co.), New York, one in Concord (Merrimack Co.), New Hampshire, and one at Furman Lake on the campus of Furman University in Greenville, South Carolina. The pine bush sites included three pine barrens vernal ponds and a beaver marsh, the New Hampshire site was a vegetated retention pond, and the South Carolina site was a 28-acre man made impoundment lacking emergent vegetation and surrounded by mown lawns. We tried to keep a weekly survey schedule all summer long, and managed to accrue 19 surveys at each Pine Bush site (by JTB), 22 at the New Hampshire site (by PH), and 16 at the South Carolina site (by WBW). Each survey of each Pine Bush site lasted 40 minutes and each

Table 1. Cumulative species richness at four levels of sampling effort: 100% (weekly surveys), ~50% (biweekly surveys), ~33% (tri-weekly surveys), ~25% (monthly surveys). The preliminary study took place in 2006 at four sites in east-central New York (NY-#) along with sites in New Hampshire (NH) and South Carolina (SC). NY and NH data are based on 40 minute surveys, SC on 60 minute surveys. Naïve = observed species richness accumulations; Chao2 mean = statistically estimated species richness accumulations with 95% confidence intervals (95% CI). The Chao2 mean is an estimate of the true species richness at the site, or an estimate of how many species an observer might accumulate with optimum sampling effort and complete species detection (i.e., no misses).

Site	Weekly		Biweekly		Triweekly	Monthly
	Naïve	Chao2 mean (95% CI)	Naïve	Chao2 mean (95% CI)	(Naïve)	(Naïve)
NY-1	30	30.9 (30.1 – 39.9)	28	30.9 (30.1 – 39.9)	26	26
NY-2	23	23.7 (23.1 – 30.9)	20	20.7 (20.1 – 27.6)	20	16
NY-3	26	29.1 (26.5 – 45.3)	22	23.1 (22.1 – 31.2)	20	21
NY-4	28	30.4 (28.4 – 43.3)	26	27.8 (26.3 – 38.2)	23	25
NH	34	34.6 (34.0 – 40.8)	32	32.5 (32.1 – 37.7)	26	27
SC*	16	20.5 (16.5 – 56.9)	15	16.3 (15.1 – 28.0)	14	12

\*Note: only dragonflies were recorded in SC; all other sites were sampled for dragonflies and damselflies.

of the New Hampshire and South Carolina surveys lasted 40 and 60 minutes, respectively. The observers walked a fixed route throughout each study site, starting and ending in the exact same spot on every sampling occasion, and recorded all detected species. The Pine Bush observer also noted 10 minute elapse periods within each survey to keep track of the rate at which species were encountered.

### Data Summary Approach

Species richness will serve as the primary measure for comparing the different survey return intervals and durations, which represent different levels of sampling effort. In addition to observed species accumulations we used two statistical estimation frameworks: (1) using the number of rarely encountered species to estimate how many species may actually occupy the site, and (2) treating the species accumulation from weekly surveys as analogous to a regional species pool, then modeling the fraction of species left in reduced data sets while accounting for detection error. We loosely define “detection error” as the chance that an observer fails to detect a species present at the site (i.e., the probability of a false absence).

### Results

A major sampling objective for this project was to fall within two days of a weekly survey schedule (i.e.,  $7 \pm 2$  days). The following average return intervals ( $\pm$  s.d.) were attained in the three study areas: NH =  $7.0 \pm 1.8$ , NY =  $6.9 \pm 2.3$ , SC =  $7.4 \pm 2.3$  days.

On average there were 2.3 fewer observed species in the biweekly surveys compared to the weekly surveys and in the

triweekly surveys compared to the biweekly surveys (Table 1). There were only 0.3 fewer observed species, on average, found in the monthly surveys than in the triweekly surveys, and the species accumulation of the monthly surveys actually exceeded that of the triweekly surveys in three study sites. On average, triweekly surveys found 6.7 fewer species than statistically estimated from weekly surveys, whereas monthly surveys found only 5.0 fewer species than observed over weekly surveys. Observed species totals ranged from 78 to 98% (mean 92%) of statistically estimated totals in weekly surveys, and from 91 to 98% (mean 95%) of statistically estimated totals in biweekly surveys, suggesting that sampling coverage was close to complete. Each weekly total ( $S_{obs}$  and Chao2 mean) fell below the biweekly upper confidence limit, lending some support for similar information gains from weekly and biweekly effort at these sites. However, several of the asymptotic estimates appeared relatively unstable based on wide confidence ranges, non-leveling rarefaction curves (not shown), and nearly monotonic error inflation over survey accumulation (not shown).

The length of survey may influence the choice of return interval, and vice-versa (Table 2). For example, more species were observed in 40 or 30 min biweekly surveys than in 20 or 10 min weekly surveys of one pine barrens vernal pond. In fact, more species were observed in the 40 minute triweekly and monthly surveys than in the 10 minute weekly surveys of this site. Nevertheless, a fraction of effort as small as 10 minute monthly surveys, or only 25% of the total samples and survey length, still managed to pick up an average of 68.7% of the species observed in 40 minute weekly surveys. Reductions in total occurrence (“hits” in Table 2) are even more interesting to track because in theory the fraction of sample data should roughly match

Table 2. Fraction of species (Naïve,  $\hat{\theta}$ ) and occurrences (Hits) remaining in data sets reduced from forty-minute weekly surveys in the Albany Pine Bush Preserve, New York. All data shown are averages across the four study sites. The “naïve” fractions are the observed number of species remaining out of the total species detected in the forty-minute weekly surveys. The modeled fractions ( $\hat{\theta}$ ) were estimated from occupancy models incorporating survey-constant or survey-specific detection probabilities. As the names imply, the survey-constant model assumes that the chance of seeing any given species does not vary among survey dates, whereas the survey-specific model assumes that the chance of seeing a species can change over time (such as if the species was scarce at time  $t$  but abundant at  $t \pm 1$ ). If one model was not clearly supported over another ( $\Delta AIC < 4.0$ ), a model-averaged estimator and variance were computed. “Hit” fractions are the number of detections remaining out of the total detections in the full species  $\times$  survey matrix (forty-minute weekly surveys). Time marks indicate 10 minute (min) elapse periods in the surveys. SE = variance,  $\text{Var}(\hat{\theta})$ .

Fraction Estimator	Time mark (min)	Weekly 100% effort	Biweekly ~50% effort	Triweekly ~33% effort	Monthly ~25% effort
Naïve	40	1.0	.895	.832	.816
	30	.982	.860	.797	.780
	20	.928	.860	.756	.734
	10	.900	.797	.690	.687
$\hat{\theta}$ (SE)	40	1.0 (0)	.953 (.038)	.893 (.090)	.911 (.056)
	30	.915 (.059)	.836 (.073)	.919 (.062)	.890 (.081)
	20	.912 (.056)	.963 (.040)	.860 (.079)	.829 (.095)
	10	.948 (.048)	.880 (.096)	.832 (.071)	.837 (.093)
Hits	40	1.0	.510	.325	.267
	30	.940	.484	.312	.253
	20	.877	.455	.292	.234
	10	.762	.393	.243	.202

the amount of effort. It seems that 40 and even 30 minute surveys of these sites were able to gather the expected amount of data in each return interval, with more drastic losses occurring when surveys became shorter, especially reducing from 20 to 10 minutes. The modeled fractions are noisy and difficult to interpret at this time (Table 2), but at least they attempt to account for imperfect detection of species, whereas the naïve (observed) estimates assumed that species were always detected when present.

### Next Steps

We need more study sites. The data so far can be used to make inferences within these specific sites and to pine barrens vernal ponds in the Albany Pine Bush (because three replicate wetlands were sampled), but it is not yet possible to offer general recommendations or options for temporal survey design. In addition to increased sample size, further analysis is needed. For example, we need to check on model fit and for possible over-dispersion in the modeled fraction estimators. Several modeled fractions were lower than the corresponding naïve fractions, which seems counterintuitive given that the modeling approach tried to remove “false-

absences”. It could mean that unmodeled heterogeneity was too severe, or that our models were too simplistic because no covariates were introduced. Many factors may influence the detectability of adult odonates, such as their abundance, activity mode (percher vs. flier), and body size (e.g., dragonfly vs. damselfly), or weather conditions during each survey. The modeling framework used here is flexible and can accommodate such species-specific and time-varying covariates, allowing some control over heterogeneity. We also have plans to try recent innovations that adjust asymptotic richness estimators for detection errors, which would effectively combine the statistical methods used in Tables 1 and 2.

In addition, sampling effort requirements for damselflies and dragonflies may differ, therefore it should also be useful to analyze the suborders separately. Conclusions may further depend on separating vagrant species from likely breeders—it should require less survey effort to compile only the resident species because they should be present more often than vagrant species, and resident-only data sets are more commonly used in odonate research and conservation.


Species-level occupancy modeling should also help, and takes



just a simple conceptual modification of the approach used in Table 2. These models would explicitly test the assumption that necessary survey effort varies by species, with site occupancy rates providing another measure (beyond species richness) for comparing survey return intervals and durations. Ideal species-level occupancy modeling would incorporate detailed measurements of covariates, both site-specific (e.g., habitat type) and time-varying (e.g., weather, water depth). It could make a rewarding research project for graduate students or anyone motivated, and possibly strengthen or qualify conclusions from the community analysis. For example, rare species still might be missed even in cases when reduced sampling captures a substantial fraction of the community, and these species often matter most to conservation objectives. So far there are plans to conduct the species-level study in New York (pending funds).

Another helpful extension of the current work would involve looking more closely at seasonal differences in

optimum return intervals or survey durations. For example, should we be using more frequent and/or longer surveys during rapid adult turnover periods, such as early summer, but get away with less frequent and/or shorter surveys at times when fewer species are recruited, such as in the fall? Declaring broad sets of guidelines for using specific temporal survey designs may be difficult or even impossible because of geographic-based variation in seasonality, but it seems worthwhile even to settle on recommendations that work at smaller scales.

This study is not about trying to find an optimum survey design, as decisions regarding sampling frequency and survey length will depend on the project objectives, the level of accuracy required, and the human resources available. Instead, our mission is to offer a set of guidelines and options built upon rigorous data that will facilitate prudent decisions about temporal survey design in any projects using adult odonates. 

## Hawaii—Another View

Dennis Paulson <dennispaulson@comcast.net>

Well, after reading four of Jerrell Daigle's mouth-watering accounts of odonates in the Hawaiian islands, Netta and I decided it was time to see for ourselves. Unfortunately, Jerrell was down in the Florida Keys at the time so wasn't available as a guide. Thus this account will be free of exclamation points.

Kauai sounded like the place to go, especially as it was the only place Jerrell mentioned seeing *Nesogonia blackburni*, the endemic Hawaiian Skimmer, and of all the species in those islands, that's the species I most wanted to see.

Kauai is the oldest Hawaiian island, with a good share of endemic forest birds, and it lacks mongooses and thus supports colonies of several tropical seabirds, so it makes an obvious destination for the naturalist. On the down side, it doesn't have the big volcanoes that make Maui and the Big Island so spectacular. It also has—surprise—horrendous traffic jams (I almost had to put an exclamation point here). It also has exciting odonates, but you have to work to find them.

We spent five full days on Kauai, 11–15 October 2006. We went to both ends of the semicircular island road twice and tried mightily to reach the good spots that Jerrell described. We failed just as mightily. The trails to Hanakapi'ai stream and Alakai Swamp were long, steep, and slippery, and on both of them it started to drizzle as we ascended. We started meeting people 30 years younger

than us coming back down the trail, saying “no way are we going any farther,” and we started thinking of broken things: broken cameras, broken legs, broken necks. Discretion easily won over valor, and around we turned. We lack certain gazelle and mountain goat genes that Jerrell must possess in plenty.

Quite disappointed, we never even got near the fabled *Nesogonia* sites, nor those of some of the endemic *Megalagrion* damselflies. We did find *Megalagrion vagabundum* in numbers on Makaleha stream, not far from Kapaa, where we stayed. We also found a few *M. oresitrophum* at a little pool on the Kahalau Trail at the north end of the road, and another *vagabundum* at a seep there. Both are beautiful, mostly red damselflies, quite a bit larger than our North American *Amphiagrion* (red damsels) and *Telebasis* (firtails). Netta also saw a single *M. eudytum* at Makaleha stream, a black damselfly with pruinose thorax and abdomen tip. We could never find it again for me to see it.

Thank goodness one of the Hawaiian endemic odonates is relatively easy to find, the impressive *Anax strenuus* (Hawaiian Darner would be an appropriate common name, or perhaps Big Kahuna Darner). This species was common at the Pu'u o Kila lookout in Koke'e State Park at about 4000 feet elevation, just where Jerrell said we would encounter it. Both males and females flew incessantly over the lookout and ridge trail, from near ground level to above the treetops, and sometimes came close enough to capture. Interestingly,


there was no sexual dimorphism in color. Both sexes have a green thorax and black, faintly pale-spotted, abdomen with a conspicuous patch of blue at the base, also lovely blue surrounding a black triangle on top of the frons.

We found *A. strenuus* not only up in the mountains but also cruising along lowland roads through forested areas. They flew rather slowly, checking out the vegetation on the road shoulder, occasionally hovering in front of one spot in a way that made me think they were looking for resting prey and would perhaps pounce on it or at least scare it up and chase it. I have seen that foraging behavior in very few aeshnids, but it may be the normal mode for *Nasiaeschna pentacantha* (Cyrano Darner).

Somewhere I recall reading that *Anax strenuus* was just like a giant-sized *A. junius* (Common Green Darner), but when I saw my first one, that thought was immediately dispelled. Instead I'll bet its ancestry can be traced to the Asian continent or the islands that extend to the east into the Pacific Ocean, where, for example, *A. guttatus* is common. It seems a very different animal from our green darner.

For new records, we had to be satisfied with *Crocothemis*

*servilia* (Scarlet Skimmer) and *Orthemis ferruginea* (Roseate Skimmer), both locally common and both not previously reported from the island. Both are known to be common on other islands of the chain. We also saw three *Anax junius*, all away from water. *Ischnura ramburii* (Rambur's Forktail) was locally common, and we found a few tiny *I. posita* (Fragile Forktail) on forest stream pools. All of these are introduced species. *Pantala flavescens* (Wandering Glider) were scattered thinly over the island, most common at the Hanapepe Salt Pond (great shorebird locality) after a good rain. This worldwide species presumably reached Hawaii on its own.

Because the trails were more strenuous than the *Anax*, we didn't achieve our primary goal of seeing and photographing the only endemic skimmer in the islands. Nevertheless, we enjoyed our visit greatly, got lots of photos, had only one minor earthquake and a few rain storms, saw at least some of the endemic birds, and had great snorkeling. The trip ended on a high note when we got bumped up to first class for the ride back. Maybe our next trip to the islands will produce exclamation points. [Editor's Note: Be sure to check out Dennis' photo of *Anax strenuus* on the back cover.] 

## Chipmunks as Predators of Emerging Odonata

**Kirsten Martin**, PhD. candidate in Environmental Studies, Antioch University New England, Keene, NH <Kirsten\_Martin@antiochne.edu>

Bird predation is an important factor in dragonfly nymph survival (Wagner et al., 1995), but there is little mention in the literature of the predatory role of small mammals on emergent nymphs.


During the summer of 2006 I observed four cases of Cobra Clubtail (*Gomphus vastus*) predation by Eastern Chipmunk (*Tamias striatus*). All of the predation occurred on a sandy exposed beach located within the Turner's Pool area of the Connecticut River. The beach in this area is a wide (100 ft) sandy section, that lacks emergent vegetation and has only a few protruding logs. The beach area abuts a steeply forested slope, which provides ample cover for chipmunks.

Predation was observed on 24 June 2006 between 8:00 and 8:40 AM, 3.7–3.9 m from the water's edge. As I sat at the edge of the study area, I observed several *G. vastus* nymphs emerging from the water, as they proceeded to crawl across the beach toward the bank, two chipmunks emerged from a small hole on the bank. The chipmunks ran down the hill and across to a large fallen log that partially extended over one side of the beach. As the first *G. vastus* neared the tip of the log, one of the chipmunks jumped down, pounced on

the nymph, and carrying it in its teeth, ran up the bank and sat on a large rock. Another nymph neared the log, which the second chipmunk also grabbed and ate.

While I was noting this behavior, two more chipmunks emerged from opposite sides of the study area, and ran out onto the same log. Within a maximum period of five minutes, each of these chipmunks had also grabbed an emerging nymph. I did not observe any aggressive interactions between the four chipmunks. The chipmunks did not venture out onto the exposed section of the beach, but instead stayed near the fallen log, and the exposed roots that lined the bank. Chipmunk predation of dragonfly nymphs may be a rare event, as during the 24 days (192 hours) of fieldwork conducted this season, these were the only such events that were observed.

### Literature Cited

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## DNA Status of *Enallagma coecum* Hagen (Purple Bluet) and *E. cardenium* Hagen

Jerrell J. Daigle <Jdaigle@nettally.com>, Mark A. McPeck <mark.mcpeek@Dartmouth.EDU>

Several years ago, Sid Dunkle and I made a couple trips to the Dominican Republic on the island of Hispaniola in the Caribbean. We collected a series of bluish/purple *Enallagma coecum* (Purple Bluet) and we labeled them as such. Back in Florida, I noticed differences between these specimens, and local populations of what I was calling *Enallagma cardenium* at the time. Recently, several books and manuals have chosen to synonymize the purple *Enallagma cardenium* found in Florida and Cuba with *Enallagma coecum* which is found in the Greater and Lesser Antilles.

This year I was invited to collect dragonflies with François Meurgey on the island of Guadeloupe in the Lesser Antilles. Mark McPeck agreed to do DNA analyses on *Enallagma cardenium* from Florida and *Enallagma coecum* from Guadeloupe. He sent me several vials of ethanol and with the dogged efforts of Fred Sibley, Gaëlle Weber, Ronan Bouanchaud, François, and myself, we were able to collect a series of *E. coecum* and deposited them into the vials of ethanol (See ARGIA 2006, 18[1]).

Back in Florida, I collected a series of *Enallagma cardenium* here in Tallahassee, deposited them in vials of ethanol, and sent them along with the *E. coecum* from Guadeloupe to Mark McPeck. From Mark: "I sequenced 702 base pairs of the cytochrome oxidase mitochondrial gene. Three individuals of *E. cardenium* differed from three *E. coecum* indi-

viduals at 32 sites—a genetic difference of 4.6%. Based on the accepted molecular clock estimate for this gene, this genetic difference suggests that these two species are derived from a common ancestor that lived approximately 2 million years ago. When placed in the overall molecular phylogeny for the *Enallagma*, these species group with *E. novaehispaniae*, but they appear to have been separated from *E. novaehispaniae* for 6–10 million years."

One can separate *Enallagma coecum* males from *E. cardenium* males by the color of the venter. It is completely black in *E. coecum*, but either completely tan or with at least a central tan area in *E. cardenium*. Viewed dorsally, the cerci are longer and straighter in *E. cardenium*, but shorter and curved in *E. coecum*. Also, *E. cardenium* is a larger species than *E. coecum*. Westfall and May (1996) has diagnostic descriptions, commentary, and photos. While I have not seen *E. coecum* specimens from Cuba, it is possible it occurs there in the eastern half of the island. Another possible similar species occurs on Jamaica and may require future DNA testing to ascertain its identity.

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## More on the Caribbean Islands: Odonates Taken During Mike Ivie's Beetle Survey of Montserrat

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My only visit to Montserrat in 1964 was purely geological—to visit the seething, but not yet erupting volcano. I did not find any habitat at that time that invited me back for an insect-centered visit, and the subsequent eruption spread so much ash on the island that I figured there would be no point in going back later. Wrong!

Montserrat is a virtually unsurveyed (for odonates) island near the northern end of the Lesser Antillean volcanic chain. There are several more or less active volcanoes still further north (on Statia, Saba, Nevis, St. Kitts), but those islands have little forested cover, and, consequently, limited interest for the odonatist. The lower "limestone" islands to the east (Antigua, Barbuda, Anguilla) are low and dry, with only low-elevation pond species.

Mike Ivie, a dedicated Caribbean coleopterist, recently sent me a small collection of Odonata for examination. As I had hoped, his associates had taken several *Orthemis macrostigma* (the new name for what we used to call *ferruginea* in the Caribbean). But they got some goodies also. The forested northern part of the island is difficult to access but apparently rich in odonates. The almost daily sprinkle of volcanic ash adds a factor to their environment that is missing in most places, and it might be an interesting study to find which species cope and which simply check out under this stress.

*Triacanthagyna trifida*. One of the most interesting things in the bunch was a nice male of this species. According to the recent revision of the genus by Natalia von Ellenrieder,

the range of this species terminates to the southeast at Puerto Rico. I have a female from St. Lucia from 1957, but this is the first male. It was evidently taken in the evening at the crew's guest house. [In this issue François Meurgey also reports the species from Dominica. — Ed.]

***Orthemis macrostigma***. All Caribbean specimens of *Orthemis* were until recently listed as *ferruginea* (Fabricius) 1775. Meurgey (in press) has reinstated the Rambur name *macrostigma* for all Lesser Antillean specimens of this genus. The species is fairly common on Montserrat and, happily, looks exactly as it does down to the south, on Grenada and Trinidad.

***Macrothemis*** undescr sp. An undescribed species of *Macrothemis* first found on neighboring Guadeloupe is represented by three females.

***Dythemis*** sp. The two females found by the coleopterists seem very similar to *Dythemis multipunctata*, which

is widespread from Mexico to South America, including Trinidad. The species has not been taken in the Lesser or Greater Antilles. The two known *Dythemis* from the Caribbean islands are *rufinervis* (Greater Antilles) and *sterilis* (southern Lesser Antilles).

***Protoneura*** new species. This is a newly described species found by Meurgey (in press). Specimens had only been taken in Guadeloupe. This species is very similar to *Protoneura ailsa* which has been taken in Martinique, Dominica, and St. Lucia, and its discovery on Montserrat shows that the species may be more widely distributed.

In spite of the disgustingly glorious winter weather in the Lesser Antilles, a few of the braver souls among you might consider leaving your frozen homes and visiting these islands. There is no telling what you might find! 🦋

## The Odonata of Dominica, British West Indies — 2006 Collecting Trip

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Current studies on French West Indies, namely Guadeloupe and Martinique, have been carried out by the Natural History Museum of Nantes (NHMN) since 2000. The desire for Odonata data from other neighboring islands is much needed. It would help better understand the distribution of species, their relative abundance, and increase our knowledge of their biology and ecology. Dominica is a good example of a fairly pristine tropical island with low deforestation levels, limited urbanization, and a low human population. It is situated between highly disturbed Martinique and semi-natural Guadeloupe. A refuge for French and English settlers, this island was yielded to the Caribbean people during the 18th century. Thus, Dominica has a chance to maintain the greatest part of its forested areas (actually covering 75% of the island), because of traditional agriculture practices without pesticide use. One third of the island is now classified as natural reserves, national parks, or as various protected areas where access is controlled.

The Smithsonian Institution closely studied the dragonfly fauna of Dominica during the Archbold-Bredin survey carried out in the 1960s, and listed 21 species from this island. Additional specimens were gathered by Geijskes in 1965 and Donnelly in 1970. A hydrobiological study carried out on Dominica and Martinique in 1979 (Starmühlner & Therezien, 1982) listed 9 species from Dominica: lar-

vae of *Argia concinna*, *Enallagma coecum*, *Protoneura ailsa*, *Dythemis sterilis*, *Brechmorhoga* sp., *Erythrodiplax umbrata*, *Micrathyria didyma* and *Orthemis ferruginea*. Recently, the NHMN organized a three week mission to Dominica in November and December 2006. Gaëlle Weber undertook fieldwork during this stay and gathered 150 specimens pertaining to 22 species of which four are new records for the island.

Twenty-three stations, mainly in the south part of the island, were surveyed as follows: Saint George Parish (6 stations), Saint Paul Parish (7 stations), Saint John Parish (1 station), Saint Joseph Parish (2 stations), Saint Andrew Parish (6 stations), and Saint Patrick Parish (1 station). Unlike Guadeloupe and Martinique, standing water habitats are very rare on Dominica. Numerous Odonata species associated with this type of habitat are rare here.

The first day on Dominica was devoted to the administrative formalities: purchase of the driving license, maps, lease of a vehicle, and the search for acetone. This miraculous liquid is available in only one shop of Roseau! Since the Dominica government is very attentive to the protection of the environment, we had to request a research permit and to pay a search fee to the Forestry, Wildlife, and Parks division of the Ministry of Agriculture and the Environment. Thus, Gaëlle met Mr. James Arlington,



Forest Officer, who delivered us the research permit and granted access to the protected areas.

Early surveys were devoted to streams and rivers in the Wotten Waven valley, at Springfield Estate, and along the Check Hall River. These areas are mostly at an elevation ranging between 1100 and 1300 feet. Although the weather was cloudy, six species were observed: *Argia concinna*, *Protoneura ailsa*, *Telebasis corallina*, *Dytthemis sterilis*, *Erythrodiplax umbrata* and *Orthemis macrostigma* (= *O. ferruginea*).

One day was spent surveying the National Cabrits Park, between "East Cabrit" and "Cotton Hill Estate". It is a vast wetland of snap rings, surrounded by a belt of interstitial water. The swampy area is bordered with meadows, themselves surrounded of littoral dry forest, with pieces of old flooded Bloodwood forest. Seven species were caught at this site: *Ichnura hastata*, *I. ramburii*, *Erythemis vesiculosa*, *Micrathyria aequalis*, *Micrathyria dydima*, *Tramea abdominalis* and a new island record in *Lestes tenuatus*.

Three males and one female *Lestes tenuatus* were caught in the forest, a few meters from the water's edge, perching on branches. First described from Martinique where the species has not been recorded since 1832, *L. tenuatus* is scarce in Guadeloupe. This species was not mentioned from Dominica during the Archbold-Bredin survey. Interestingly, the only *Lestes* mentioned by Donnelly (1970) was *L. forficula*. It was the only lested species seen during this 2006 collecting trip. A later survey at this site produced the opportunity to observe an additional species, *Pantala flavescens*, which is much rarer here than on Guadeloupe or Martinique.

Layout River is a broad river, swollen by the recent rains. Seven species were seen here, including one male *Enallagma coecum* flying in the shoreline vegetation. Other species collected here were *P. ailsa*, *A. concinna*, *Erythemis vesiculosa*, *Erythrodiplax umbrata*, *O. macrostigma*, and *T. abdominalis*.

The Woodford Hill Lake, or "Pan Lake," is one of the rare stagnant habitats found on Dominica. Located at an altitude of 200 feet, the lake is covered with snap rings and a flooded forest surrounds most of its circumference. Ten species were observed here, including large populations of *P. ailsa*, *M. didyma*, and *O. macrostigma*.

Abundant rainfall and strong winds in late November compromised most fieldwork. No exuviae were collected, and the few adult dragonflies seen were up in the trees, safe from Gaëlle and the rain. Nevertheless, some sunshine made it possible to observe a small population of

*Protoneura ailsa* and *Enallagma coecum* on Pagua River at an elevation of 500 feet. A field course had been scheduled with two foresters, but it was finally cancelled because of the torrential rains. While waiting for the sunshine, Gaëlle got some information about the possible presence of a preserved dragonfly collection in the Ministry. The Dominica Wildlife and Parks Division does not study odonates, but two larvae in a vial sparked our interest. The two final instar larvae, identified as *Orthemis macrostigma*, were taken alive in a hot sulphurous bath in January 2001 at Parish Saint Mark, Soufrière. The temperature was not mentioned on the label, but the bath varies between 30 and 40°C. A visit to this bath provided no larvae or adults, just a very pleasant and well-deserved sulphur bath....

Mr. Arlington mentioned a small pond, not shown on the maps, which deserved a visit. This pond is situated about 2 meters from the shoreline of the Atlantic Ocean, near the Geneva River at Parish Saint Mark. It is abundantly vegetated with some Water Hyacinth cover. Eleven species were seen here, including *Brachymesia herbida*. *B. herbida* seems to occur sparingly on the island, and Donnelly (op. cit.) mentioned only one locality for this species during the Archbold-Bredin survey. At that time, only two localities were known on Dominica for this species which is relatively common in neighboring islands.

More exciting was the capture and the observation of a population of *Micrathyria marcella*. Ten individuals were observed flying above the masses of water hyacinths. This invasive plant has been present on Dominica at least for 30 years, but it has been known from Martinique and Guadeloupe since the 19th century. This could explain why *M. marcella* was not seen by Donnelly during his surveys.

*Anax ephippiger* again....

One of the most impressive Odonata localities in Dominica is the man made Freshwater Lake. It is a foggy, high elevation lake surrounded by a dense rainforest. Before the construction of the hydroelectric reserve, the maximum depth of the lake reached 66 ft. Now, the depth varies between 66 and 85 ft, depending of the rain and periodical releasing flood. The highly vegetated and very abrupt banks are inaccessible. Fortunately, it is possible to borrow a kayak which is extremely useful, and even a little sporting! Five days were necessary to correctly survey Freshwater Lake, between the rain showers, fog and strong winds. Nine species were seen here, notably a mating pair of *Rhionaeschna psilus* in the riverine forest. This species tends to fly away from the open water and mating takes place in the bordering forest belts. Donnelly first mentioned this species from the Lesser Antilles in Dominica. One of the most favorable areas for dragonflies around

Freshwater Lake is a small vegetated pond, where a couple of *Tramea insularis* were seen patrolling above the water. The male was missed, but we got the female.

Most astonishing is the record of a male and two females of *Anax ephippiger*. With a marked territorial behaviour, the male flew along the banks, then to the center of the Lake, and back again. It's the fourth record for this species in the New World. The previous records in French Guyana in February 2003 (Machet & Duquef, 2004), in Guadeloupe in January 2006 (Meurgey, 2006), and in the British West Indies in 2006 (Fred Sibley, pers. comm.) reported only isolated individuals. Some questions are 1) Is this phenomenon older than it appears, or 2) What are exactly the factors which would have caused this sudden apparition of *A. ephippiger* in the New World? Answering these questions is difficult, but we have noticed that the West Indies has been intensively studied for many years. It is difficult to consider that this species remained unknown for so long. On the other hand, the probability to find a unique specimen on an island during a brief period is weak, and this can argue against regular appearances of the species. However, there are many chances for this species become a resident in this part of the world now in the coming years.

Later, another forester who wanted to learn about dragonflies accompanied Gaëlle to some sites. She showed him how to locate exuviae and to catch the tricky adults . . . and the benefits of a bath in the lake while slipping in the kayak! The water of the Freshwater Lake is . . . fresh!

Another rainy visit to the Freshwater Lake was fruitful with the capture of one rather cooperative male *Anax concolor*. This conspicuous species was the last one collected on the trip, and it helped us remember that Dominica is the wettest island of all Antilles!

### Checklist of Dominica Odonata

Twenty five species are recorded from Dominica. Three were not seen during this survey, but were mentioned by Donnelly (1970) (parentheses indicate these species). Four are new for the island and they are indicated in the text.

### Zygoptera


*Argia concinna*  
*Enallagma coecum*  
*Ischnura bastata*  
*Ischnura ramburii*  
(*Lestes forficula*)  
*Lestes tenuatus*  
*Protoneura ailsa*  
*Telebasis corallina*

### Anisoptera

*Anax concolor*  
*Anax ephippiger*  
*Rhionaeschna psilus*  
(*Triacanthagyna trifida*)  
*Brachymesia furcata*  
*Brachymesia herbida*  
(*Brechmorhoga archboldi*)  
*Dythemis sterilis*  
*Erythemis vesiculosa*  
*Erythrodiplax umbrata*  
*Miathyria marcella*  
*Micrathyria aequalis*  
*Micrathyria didyma*  
*Orthemis macrostigma*  
*Pantala flavescens*  
*Tramea abdominalis*  
*Tramea insularis*

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## Second Record of *Anax ephippiger* (Vagrant Emperor) from the West Indies

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François Meurgey (ARGIA 18[1]: 21–22) reported on a female *Anax ephippiger* (Vagrant Emperor) collected on Guadeloupe 26 January 2006 and gave details of a male caught in French Guyana in February 2003.

On 20 October 2006 another female of this African species was collected on Guana Island, British Virgin Islands. Two species of *Pantala* (Gliders) and three of *Tramea* (Saddlebags) were hawking over an extensive grassy field, where a group of us were working on an archeological dig. During breaks I was attempting to catch something other than *Pantala flavescens* (Wandering Glider) from this swarm. Suddenly a dragonfly came directly toward me without all the zigging and zagging of the other species and ended up in the net. I was surprised to find a very small *Anax* which Nick Donnelly subsequently confirmed as *A. ephippiger*. This was the only one observed during the period 12–22 October.

François gives an excellent account of dispersal and wandering of the species. This second record for 2006 would add support to his suggestion that the species may be established in the New World.


Corbet in *Dragonflies: Behavior and Ecology of Odonata* (p.412–413) states the species is highly specialized for

desert conditions and occupies brackish reedy pools in the desert as well as coastal salt marshes. The larvae tolerate high salinity and can complete development in 2–3 months. A pair arriving in the Lesser Antilles would find numerous sites fitting these criteria, and it is difficult to believe the species would not thrive in this environment.

The Guana Island specimen is in excellent condition with no wing wear. François states of the French Guyana record: “This specimen presents the same characteristics as the one of Guadeloupe (seems to be mature but young).”

None of the facts above or the absence of earlier records proves the recent establishment of a breeding population in the New World. But, such a population, if it exists, should quickly increase its numbers and provide a positive answer in the next few years.

### Acknowledgements

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## Florida Keys — September/October 2006 or Where’s Wilma?

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A previous article (ARGIA 2006, 17[4]: 6–8) covered our October 2005 trip just prior to the arrival of Hurricane Wilma. The storm surge washed over all the Lower Keys, even reaching the Blue Hole on Big Pine Key. Following the hurricane, there was a six-month drought before the wet season started. Several locals commented that the wet and dry seasons are now erratic and unpredictable compared to ten years ago.

Our plan was to revisit sites sampled last year and record differences, presumably caused by Hurricane Wilma, from the October 2005 visit. Between 28 September and 3 October, we collected 23 species and had possible sight records of *Tramea abdominalis*, *T. insularis*, and *Triacanthagyna* (common names given in a species list at end). The results

were about the same as last year.

The biggest physical change was the death of pine trees on Big Pine Key, but the change most important to odonates seemed to be the loss of pond vegetation on Stock Island (Botanical Garden and Key West Golf Course). In all low-lying areas on Big Pine, the pine trees were dead. This meant large portions of the Watson Nature Trail, and particularly west and north from there, were affected. Trees around the Blue Hole were only minimally impacted.

On the Key West Golf Course (Stock Island), 99% of the tall reed and rush vegetation surrounding several of the ponds was gone. We associated this change with our

failure to find *Brachymesia herbida* and the near absence of *B. gravida*.

All pond levels on Big Pine were lower than last October. The extensive wet area that was so productive for *Lestes spumarius*, and where Fred found the exuviae of *Remartinia* was dry.

On Stock Island, pond levels were higher than last year. The Key West Botanical Garden suffered major wind damage. They are still recovering and expanding, hoping to have an old pond site restored by next year — covered by parking lot at moment.

The higher salt levels may have impacted many species after the hurricane. *Ischnura hastata*, which was common and widespread in October 2005, was rare. The “purple” *Orthemis* sp. (*O. ferruginea*), made up about 50% of the *Orthemis* population in October 2005, but only 2% this year. The “red” *Orthemis* sp. was still common (Jerrell’s *O. schmidti* Buchholz). Several people are studying the Caribbean *Orthemis* group and some of their answers will be published in the spring.

We added three species to our Lower Keys list. On Big Pine Key, a male *Anax amazili* was collected, and a female was observed ovipositing in shoreline rushes. This is the third record for Florida and one of the few for the US. Bill Mauffray (pers. comm.) considers *A. amazili* to be a vagrant to Louisiana — one 1918 record from New Orleans. John Abbott (pers. comm) says it may be breeding in the Rio Grande Valley, but the scattered Texas county records usually consist of a single individual.

The two Florida records are considered to be vagrants, also. Byers (1938) lists a male and female taken on Garden Key, Dry Tortugas in July 1936. The other record, from Torreya State Park, Liberty County on 8 May 1971, is recounted as follows by Mike May. “We were out with Minter’s aquatic entomology class, and when we returned to camp I noticed a live *Anax* female on the grill of his car. It looked peculiar, so I kept it, and it turned out to be *amazili*.”

It should be looked for by anyone visiting the Lower Keys. Since *A. amazili* is not known from the Bahamas, it is likely that our *A. amazili* came from Cuba about 90 miles away.

One teneral male *Miathyria marcella* was collected in a group of *Tramea* at the Key West Golf Course. *Pantala flavescens* was present in huge swarms everywhere and a few *P. hymenaea* were collected from these swarms and many more were seen.

This time, we became more proficient at finding *Lestes spumarius*. They may also have been more common and conspicuous. We looked for and found numerous small (10–20 feet diameter) sinkholes with freshwater. These were usually in dense vegetation, heavily shaded, hard to see, hard to get to, and hard to find room underneath to swing a net. Almost every small sinkhole had one or more *Lestes*. One might call the species uncommon but reliable. We found them along the Watson Nature Trail, around the north end of Blue Hole, and the southeast corner of No Name Key — a new island record. Last year there were numerous tenerals, but none this year. It is possible that the species could be found in these small sinkholes all year round.

The *Nehalennia minuta* site that was so productive last year was very quiet this year. There is still plenty of good looking habitat, but several hours of searching turned up only two anemic *N. minuta* females and no *N. pallidula*.

## Conclusions

We need at least one more year to judge effects of the 2005 hurricanes. The numbers of several species were down sharply, but presumably due to the “temporary?” habitat change caused by the hurricanes. One formerly common species was missed, but may still be present in minimal numbers. In 2007 there might be no observable difference from the odonate fauna of 2005.

## Species List

Comparison of October 2006 and 2005 trips with 2006 given first; r-rare, u-uncommon, f-fairly common, c-common, a-abundant, #-not seen

Antillean Spreadwing (*Lestes spumarius*) f-u, Citrine Forktail (*Ischnura hastata*) r-c, Rambur’s Forktail (*Ischnura ramburii*) f-f, Tropical Sprite (*Nehalennia minuta*) r-r, Everglades Sprite (*Nehalennia pallidula*) #-r, Amazon Darner (*Anax amazili*) r-#, Common Green Darner (*Anax junius*) c-c, Red-tailed Pennant (*Brachymesia furcata*) a-a, Four-spotted Pennant (*Brachymesia gravida*) r-f, Tawny Pennant (*Brachymesia herbida*) #-f, Halloween Pennant (*Celithemis eponina*) f-a, Eastern Pondhawk (*Erythemis simplicicollis*) f-c, Great Pondhawk (*Erythemis vesiculosa*) f-f, Seaside Dragonlet (*Erythrodiplax berenice*) a+-a, Band-winged Dragonlet (*Erythrodiplax umbrata*) c-c, Marl Pennant (*Macrodiplox balteata*) r-c, Hyacinth Glider (*Miathyria marcella*) r-#, Roseate Skimmer (*Orthemis* “purple”) r-c, (*Orthemis* “red”) c-c, Blue Dasher (*Pachydiplax longipennis*) u-f, Wandering Glider (*Pantala flavescens*) a-c, Spot-winged Glider (*Pantala hymenaea*) u-#, Carolina Saddlebags (*Tramea carolina*) r-r, Antillean Saddlebags (*Tramea*



*insularis*) u-u, Black Saddlebags (*Tramea lacerata*) f-f, Red Saddlebags (*Tramea onusta*) c-c.

Our thanks to Skip Lazell and George Tegzes for accommodations on Middle Torch Key, refuge manager Anne Morkill and Jim Bell of the Key Deer NWR for permits and advice, and to the folks at the Key West Botanical Garden and Key West Golf Course for permission to survey their grounds.

## Phylogeny of Odonata: Part 1, Phylogenetic Inference


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In a moment of extreme weakness, I promised our new editor that I'd try to summarize the state of knowledge of odonate phylogeny. Actually, it's pretty easy—odonate phylogeny is a mess. But I expect that's not exactly all John wanted, so I'll try to fill in some details. As a first step, I thought it would be helpful to review what a phylogeny is and some of the problems that arise in trying to reconstruct them (lectures on theory are what you get when you start letting academics spout off). For readers who heard Eric Pilgrim's talk at the 2004 DSA annual meeting, or who are otherwise familiar with these ideas, I'll move on to review current understanding, and lack of understanding, of odonate relationships in the next issue.

The most fundamental meaning of phylogeny is the actual evolutionary history of a group—the real sequence of speciation, change and extinction of its constituent taxa. The term is also used to refer to patterns of evolutionary relationships that systematists, the biologists who study phylogenetics and taxonomy, infer from the best evidence at hand, i.e., our best guess as to the actual history based on what we can observe. It's probably a good practice to think of these inferences as “phylogenetic hypotheses” and to keep in mind that they are always going to be subject to revision—often radical revision, in the light of new information.

What we can usually observe are the characteristics of the living representatives of the group of interest; data from fossils can also play a role, but for the sake of simplicity, I won't consider that here. It's worthwhile realizing that even the designation of a collection of species (of specimens, really, but for now I'll assume we can pigeonhole them correctly as species) as a “group” usually hides an assumption. Picking a group to study implies that they are more related to one another than to organisms outside the group, but how can you be sure that's true unless you know something about the relationships of the larger assemblage? General experience and knowledge of current tax-

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onomy is usually a pretty good guide, but sometimes it's a bit hard to know where to start.

As in science generally, the first step toward bringing some order to the situation is to gather data. Much of our understanding about phylogeny has grown out of efforts to classify organisms, and classification is based on perceived similarities and differences. Very broad classes might be differentiated by overall appearance, but for the most part it's necessary to decide on a list of specific traits, usually called characters. Each character can exist in two or more alternative forms, called character states. For instance, in odonates the character, thoracic color, might take on the states blue, green, or tan in different species or sexes; the character, dorsal abdominal color pattern might have states “mostly black” or “mostly pale” (actually, you can get into arguments about the difference, if any, between a character and a character state, but let's not go there). Morphological characters such as this are often the same as those used in identification keys, and ideally both the characters and their alternative states should be clearly distinguishable and easy to score. As many readers will know from sad experience, that can be a difficult ideal to attain given the inconvenient fact of inter-individual variability.

Aside from the nitty-gritty of character selection, to which I'll return, there are some important principles that govern how to compare and interpret character differences when analyzing phylogeny. In constructing a key for identification purposes, any contrasts or similarities that help sort species into distinguishable groups can be useful, but in puzzling out evolutionary relationships, some caveats apply. In order to infer relationships from observed differences and similarities, we must show or assume that the characters observed share a common evolutionary origin, i.e., are homologous. If similar characteristics have arisen independently from disparate origins—the wings of birds and the wings of bats are a common textbook example, then they clearly don't indicate close relationship, but are

the result of independent evolution and are sometimes said to be analogous.

The difference between homology and analogy can often be far from obvious, and not infrequently initial assessments of homology may turn out to be incorrect, but systematists make every effort to compare homologous characters in a phylogenetic analysis. This applies to characters based on DNA sequences just as much as to morphological characters, as I'll discuss below. For morphological characters, detecting homology typically requires a close comparison of structural features, since detailed resemblance is less likely to arise by convergence than are broad similarities. For instance, wings of Zygoptera and adult Mymeleonidae (antlions) are quite similar in general shape, but a closer look at the wing veins and structure of the hinge should convince us that the resemblance is merely due to convergence. One situation that is particularly hard to analyze is that in which structures are lost entirely, because it's impossible to compare details of things that aren't there. Thus, reduction of venation, as probably has occurred in coenagrionoid damselflies, makes convergent similarity especially hard to assess.

Even if homology is unambiguous, though, similarity can mislead. Suppose you compare two Anisoptera and note that both have six legs. We know that the common ancestor of the two also had six legs, so you can say that this is a homologous character state in the two. It's not a very useful bit of information, though, if you're wondering about how they are related to one another within Anisoptera—all Anisoptera have six legs because they inherited the trait, ultimately, from the common ancestor of all hexapods. With respect to dragonflies, this is a shared, homologous, ancestral state, otherwise known as a plesiomorphy.

On the other hand, if you also note that both have an anal loop that is distinctly boot-shaped, with a heel and elongated toe, you can conclude that they are both Libellulidae. This character state is unique to that family (or are we talking about states of several different characters—in Comstock–Needham terminology, elongated fusion of  $Cu_2+A_1$ , elongated and curved  $A_2$ , coalescence of crossveins to form a midrib, etc.? Hmmm. Your essay on this is due next week.). That is, it is a derived feature, or unique innovation, found only in Libellulidae, or an apomorphy of the family. It is not shared, at least in exactly that form, with any other family, so, leaving aside the possible information from similarly elongate but not fully boot-shaped anal loop of Corduliidae s.s., we can't actually tell anything about relationships among families from this. It's an apomorphy that is unique to Libellulidae, or an autapomorphy; it does suggest, however, that Libellulidae all evolved from a unique com-

mon ancestor that had this form of anal loop, that is, Libellulidae is monophyletic.

Thus, if we're interested in relationships among genera, we can tentatively conclude that *Libellula*, *Celithemis*, *Tramea*, and *Sympetrum* are more closely related to one another than they are to *Macromia*, because they all share the same basic form of anal loop, which is different in *Macromia*. We can then consider the boot-shaped anal loop a shared, derived characteristic of the first four genera; this is also called a synapomorphy, and it is only synapomorphies that indicate relationships among taxa, although autapomorphies can indicate the identity of individual taxa. Plesiomorphies, however striking, do not provide information about phylogenetic relationships. N.B., the terms just defined are all dependent on the taxonomic rank you're interested in: having six legs is a plesiomorphy of Anisoptera, a synapomorphy of the constituent taxa of Hexapoda, and an autapomorphy of hexapods relative to other arthropods. Similarly, the boot-shaped anal loop is an autapomorphy for Libellulidae, when considering relationships among families, but a synapomorphy that links the many species that possess it together.

The strict insistence that synapomorphies alone unite species into related groups, and the study of phylogeny based on this concept has come to be called cladistics (from the Greek *klados*, "branch") and is the dominant approach to phylogenetic reconstruction from morphological characters. Its formal origin is due largely to the work of Hennig (1966). One of the early rationales of cladistics was to make biological classification, that is, our system of assigning names to taxa, reflect actual evolutionary relationships. A major part of this was their insistence that taxa should be monophyletic, i.e., every named group should include all the organisms descended from a single common ancestor, as well as the ancestor itself (which we know must have existed, even if it is unknown, undescribed and unnamed).

A monophyletic assemblage is also called a clade. Alternatives would be a paraphyletic group, containing its most recent common ancestor but not all the descendants of that ancestor, and a polyphyletic group, which does not contain the most recent common ancestor of all its members. All these are illustrated in Fig. 1. Polyphyletic groups are artificial groupings based, most commonly, on convergent characters and, by almost universal agreement should not be considered taxa. Historically, many systematists recognized paraphyletic taxa, but this practice, too, is becoming progressively less common and acceptable.

Despite that and other disagreements, the importance of distinguishing homologous from non-homologous and

apomorphic from plesiomorphic characters is generally accepted. Aside from those considerations, however, character selection can be complicated. To return to the example of dorsal abdominal coloration, is it better, e.g., to consider “dorsal color pattern” as a single character, or should “color pattern of segment 1”, “color pattern of segment 2”, etc. be scored as 10 separate characters? An important and underappreciated issue here is that of independence. Does the color pattern of each segment change in a way uncorrelated with changes in other segments, or do some or all tend to be all dark or all pale? In the former case, lumping all together as one character will not only cause problems in scoring character states but may well have the effect of underestimating the “importance”, or potential information content, of abdominal color pattern. In the latter situation, though, including 10 characters that all change in lock-step may greatly overestimate their importance and result in a classification that is excessively influenced by that trait. Choosing and using morphological characters is fraught with this and other problems.

Besides morphology, the other major source of phylogenetically informative characters today is nucleotide sequence data from organisms’ DNA (isozyme polymorphisms, direct amino acid sequences from proteins, and a few other methods are also used but are being increasingly superseded by DNA sequencing). In some respects nucleotide data have considerable advantages over morphological data. Each character is a position along a linear string of DNA, and at each position the possible states are simply A, G, C or T; all characters are discrete. Also, at least as was first assumed, changes in character states are equivalent for all characters; a change of, e.g., C→T at one site along a gene provides the same information as the same change at any other site (we’ll qualify this claim later). Furthermore,

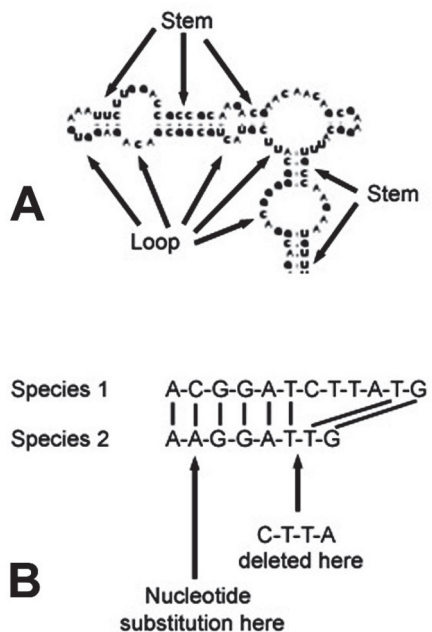


Figure 1.

genomes, all of which may have arisen through some common mechanism.

Nonetheless, there are problems in this molecular paradise. First, of course, is the technology involved—most people interested in Odonata don’t have access to the equipment and expertise required to extract and sequence DNA. Also, perhaps because of its technological cachet, molecular data are often seen as the final answer to questions of phylogeny, but this is far from the case. For one thing, although it is true that hundreds of nucleotides can be sequenced, many of these characters may be uninformative because they do not vary at all within the group examined or have changed in only one of the constituent taxa and thus can’t provide information about relationships among taxa (see below). Even if there are hundreds of “informative” characters in a dataset, 99.9% of them may provide information for questions that we are not particularly interested in (for example, supporting the monophyly of Odonata, when our question of interest is in the position of petalurids within Anisoptera). Thus it’s possible that the amount of useful information obtainable from a particular stretch of DNA is small.

This situation can be partly avoided by selecting genes for analysis that are known to evolve at rates appropriate for the questions being asked. For example, mitochondrial genes change considerably faster than most nuclear genes, probably because DNA repair mechanisms in mitochondria are less efficient than those affecting the nuclear genome. Incidentally, many copies of each mitochondrial gene occur in every cell, so they are relatively easy to amplify, i.e., to make many copies of using a polymerase chain reaction (PCR). Thus mitochondrial genes, especially those coding for cytochrome oxidases I and II (COI and COII) are often very useful for resolving relationships among species within a genus or a few closely related genera. On the other hand, some nuclear protein-coding genes, such as histone 3 (H3), control synthesis of proteins whose function is impaired by almost any change to their amino acid sequence; such genes evolve very slowly because nearly all functional variants are quickly selected out of a population. These would show little if any variation among closely related species but their amino acid sequences (now usually inferred from DNA sequences) might be useful for working out relationships among phyla because enough time may have passed since their initial divergence to allow a useful number of genetic changes to occur (see below). If COI were used for that analysis, most nucleotides would have changed multiple times since divergence, and little if any evidence of phylogenetic relationships would remain.

One of the sources of rate differences applies to charac-

teristics of the “genetic code”. If you think back to high school biology, you probably remember that in protein-coding genes, a nucleotide “triplet” or sequences of three, also called a “codon”, specifies each amino acid of the corresponding protein. However, four nucleotides (A, G, C, T) taken three at a time can form about 60 triplets, whereas only about 20 amino acids occur in proteins. Thus the code is redundant, in that multiple triplets specify the same amino acid so, e.g., the amino acid lysine is specified both by the sequence AAA and by AAG. Consequently, if only the third nucleotide mutates from A to G, this makes no difference in the structure of the protein.

If the A in the second position mutates to G, though, the amino acid specified is now arginine and the resulting protein is likely to be functionally different. Since changes in proteins are most often detrimental, an individual with a second-position A→G change is likely to be eliminated from the population, whereas one with a third-position change is not and is thus more likely to multiply and leave offspring that may eventually fall victim to the cell-grinding systematist. In this sense, third-position nucleotides are likely to change much more frequently than those at first and second positions. This is why, e.g., it’s better to use the inferred amino acid sequence rather than the entire nucleotide sequence from tightly constrained genes like H3; the huge majority of the signal would come from the freely-changing third nucleotide sites, and this would swamp out any information from the slowly changing positions that affect amino acid sequence and thus protein function.

One group of nuclear genes favored for phylogenetic analysis comprises those that code for ribosomal RNA rather than for proteins. These have two advantages: they occur in multiple, tandemly repeated, homogeneous copies throughout the nuclear genome (and so are easier to amplify), and they include some relatively fast and some slow evolving regions. The latter property is because ribosomal RNA is a complex structure that loops back on itself many times, resulting in regions of helical, paired nucleotides, called stems, and other single-stranded stretches, called loops, as shown in Fig. 1A (this figure is only a very small portion of the Small Subunit, or 18S, nuclear ribosomal DNA of *Daphnia*; the structure is essentially identical in most insects). The stems tend to change relatively slowly, because if one nucleotide in a stem changes, its complement on the other “strand” of the helix may form a bulge in the stem that may influence ribosomal function, and affect the probability of a second compensatory change (hence, not all C→T changes are equally likely, contra our initial assumption above). Loops are under no such constraint, and since the functioning of the resultant rRNA depends more on its

overall configuration that the linear sequence of nucleotides, the latter can be replaced rather freely unless they are involved with some functional interaction with other molecules.

Unfortunately, this variability in loops can cause serious problems, too. Not only can individual nucleotides be substituted for others, groups of nucleotides can be inserted in or deleted from the loop. As a result, the overall length of the rRNA, and the rDNA that codes for it, will change, and there’s the rub. If the number of nucleotides in a particular sequence is not constant among species, it becomes difficult to know that you are comparing corresponding positions in the different organisms in your selected group, or even to know how many genetic changes have occurred. Consequently you may unknowingly be comparing non-homologous characters, which is just as big a problem for molecular as for morphological data. Figure 1B illustrates a hypothetical example in which one nucleotide substitution, C→A and a deletion have occurred in Species 2. As a result, the final T-G sequence, which should be aligned with the homologous T-G in Species 1, as shown, is likely to be aligned instead with the C-T directly opposite in the picture. Any nucleotides further to the right (not shown) would also be mismatched. DNA sequence alignment can be a major issue.

If position on the gene is not a reliable indicator of nucleotide homology then it may be difficult or impossible to determine what changes have actually occurred. There are several ways to try to correct for this, but none is easy or foolproof, and alignment errors (failure to correctly line up nucleotides so they correspond) are often a problem in phylogenetic analysis. Such difficulties are rare in protein-coding genes because insertion or deletion of nucleotides usually results in a non-functional protein and an organism that is quickly eliminated from the population. Alignment problems do crop up in non-coding stretches of DNA, such as introns or intergene spacers, however.

So far I’ve rambled on at length about the nature of characters, but there is another important aspect of the process of constructing a phylogenetic hypothesis. To get from observations to an informed estimate of the collective history of a group of organisms, we also need an idea of how evolutionary change proceeds over time. That is not easy. We can’t, after all, observe the events of the distant past, although we certainly can draw inferences about them based on our understanding of how things happen now. That is to say, we can construct reasonable models of how historical evolution has proceeded. There are several ways to approach the problem of validating these models, but in essence they all depend on repeated evaluation with new data and in comparison to other models.



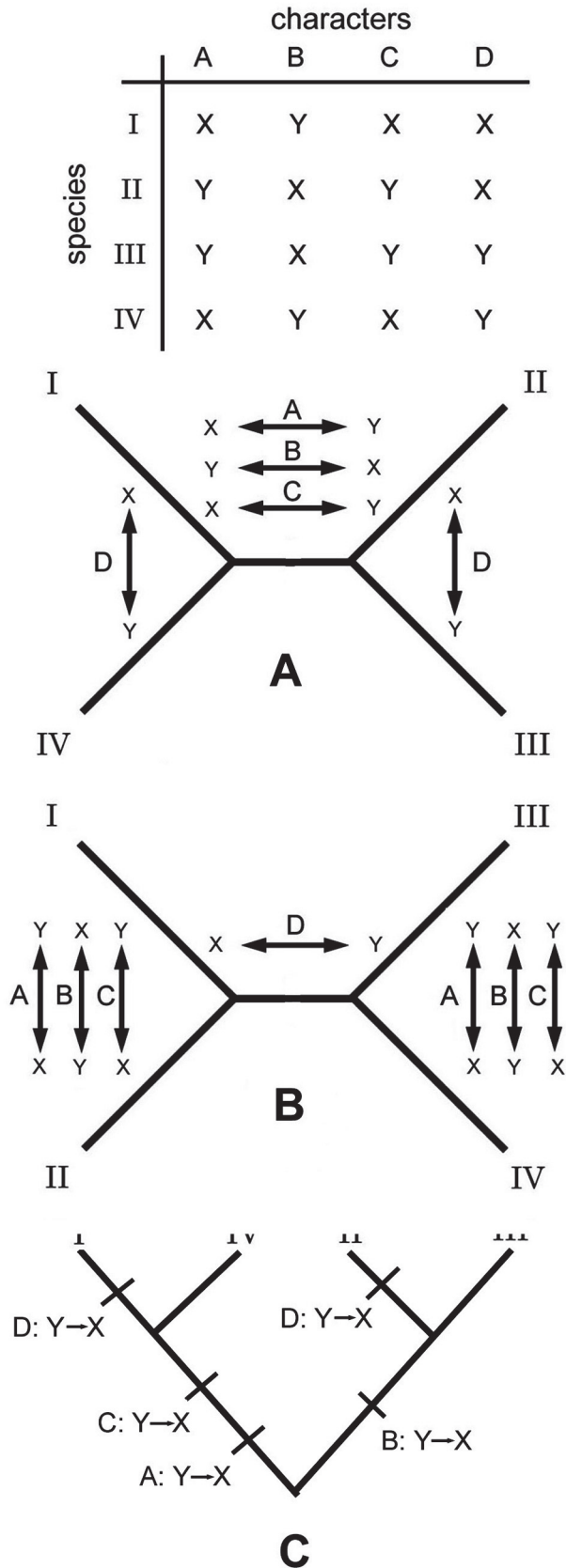


Figure 2.

To illustrate this more concretely, I'll give just one example of such a model, one that is widely used, relatively easy to understand (which is to say that I understand it, more or less), plausible, and yet almost certainly only a rough approximation of the truth. This is the so-called phylogenetic parsimony model. It assumes that evolution is parsimonious in the sense that the phylogeny (or phylogenies) that can explain a data matrix by the fewest evolutionary events is preferable to any that require more evolutionary events. That is, given a set of taxa that share a set of characters displaying two or more states, the preferred phylogeny is the one that requires the smallest number of character state changes, summed over all species and characters.

The principle is illustrated in Fig. 2 for a very small data matrix, shown at the top. Each row of this matrix represents a species, each column represents a character that is assumed to be homologous among the four species, and each character can exist in either one of two states. Of course, although I've indicated the character states by X's and Y's to keep things simple, the alternative states will differ for each character; if character A is "thorax color" X might be "blue" and Y "green", while if B is "cercus length" X could be "long" and Y "short". The diagrams, 2A and 2B, are one way of showing possible relationships among species I, II, III, and IV (we'll get to 2C shortly).

The extant species are placed at the ends of each line and the nodes of the diagram (i.e., where two or more lines converge) represent ancestral species. In this particular analysis, line lengths are arbitrary and aren't meant to indicate anything about time or amount of change between species, although this information can be incorporated into such graphs. You can determine the hypothesized degree of relatedness by tracing line segments from one species to another. So, e.g., in 2A you can move from species I to species IV along only two segments, but to go from I to II or I to III you must trace three segments. Thus 2A hypothesizes that I and IV are each other's closest relatives and likewise for II and III. Fig. 2B, by contrast, shows I paired most closely with II and III with IV.

Now, which arrangement is better by our parsimony criterion? In 2A, species I and IV share identical character states for characters A, B, and C, so it's parsimonious to assume that their immediate common ancestor also shared those states. On the other hand, they have different states (X and Y, respectively) for character D, so either I or II must have undergone one change from the ancestral condition. Exactly the same argument applies to the relationship between II and III. On the other hand, three characters have different states between the common ancestor of I + IV and that of II + III. Thus we

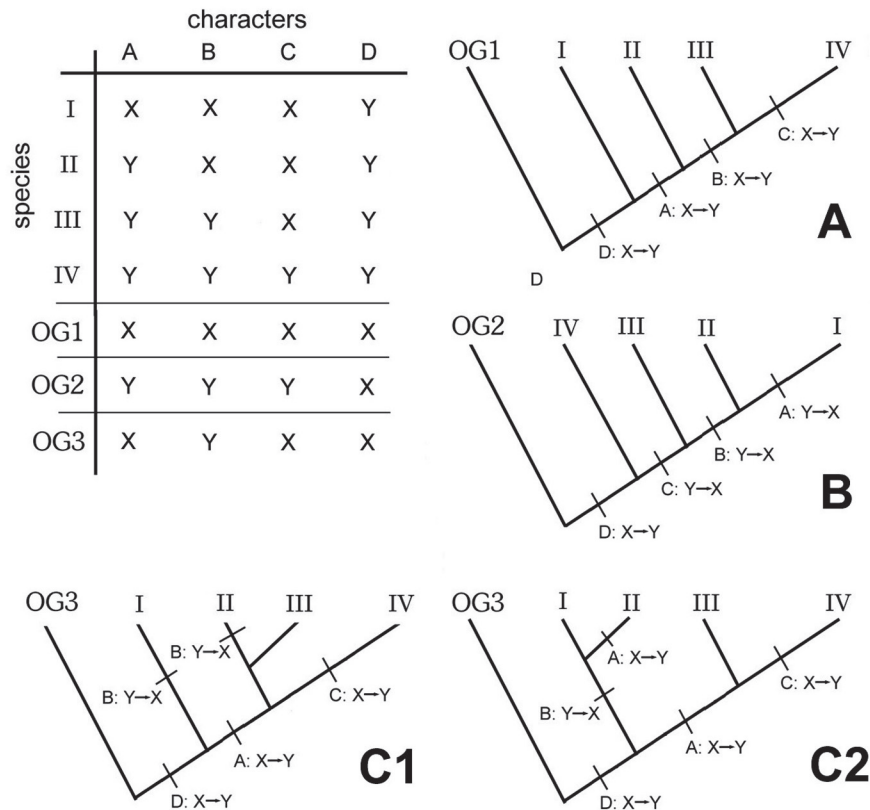


Figure 3.

have a total of five differences, one in each of characters A, B, and C and two independent occurrences of a difference in D. Notice that from these data we can't tell in exactly which direction each character actually changed over time, but we do know that at least five changes occurred. Now look at 2B. Here a total of at least three changes must have occurred between the common ancestor of I and II and these extant species, and likewise for III and IV, while the two ancestral forms differed at least in character D. This implies a minimum of seven changes. Since five is less than seven, the configuration in 2A is more parsimonious.

Analysis of much more extensive data sets requires elaborate algorithms and some computer power, but the fundamental principle is the same. There is no guarantee, though, that nature actually behaves parsimoniously in every case. Nothing we know about mechanisms of molecular biology, genetics, or development eliminates the possibility that the true history might involve two changes when one would have sufficed; still, Occam's Razor suggests that the parsimonious solution is the most likely.

Several other evolutionary models that depend on criteria other than parsimony have been developed (mostly based

on the statistical technique of inferring "maximum likelihood"), and some of these are now generally preferred for molecular data, because they can take into account estimates of rates and patterns of change that are ignored by parsimony methods. In general, molecular systematists prefer likelihood because it allows them to infer reasonable evolutionary mechanisms for character change, which makes the process amenable to modeling (in the sense that one character can be assumed to be predictive of the rate of change of another character). Parsimony is still very commonly used, however.

Morphological systematists prefer parsimony because the evolutionary behavior of their characters is more difficult to predict (model). For example, how would one use the rate of wing development to predict the rate of change in the length of the ovipositor? Again, none of these approaches are guaranteed to recover the actual

pattern of historical events because all must assume some criterion of optimality, such as parsimony, that may not reflect the idiosyncratic reality of evolution.

Readers may have noticed that the discussion of parsimony hasn't involved any consideration of plesiomorphy and apomorphy. It's possible, in fact, to puzzle out accurate networks of relationships without reference to those ideas, as in Figs. 2A and 2B. You'll notice, though, that the network diagram is rather different from the traditional, tree-like diagram used to graph phylogenies (and thus often called a "phylogenetic tree"). That's because the network is non-directional or, continuing the tree metaphor, it has no root. In order to translate the network into a depiction of hypothesized historical, ancestor-descendent relationships, we have to distinguish plesiomorphic from apomorphic character states or, in the jargon, "polarize" the character state changes. This can be done if we can estimate the character states of the common ancestor of all the species in our group of interest—hereafter the ingroup.

In Fig. 2C I've done this by arbitrarily assigning the state Y to the common ancestor for all characters. This gives us a

“tree” and, although the kinship relations are the same as in 2A, we can now predict which changes actually occurred, and where. Usually the estimated ancestral character states is made by comparing the ingroup to an outgroup, i.e., one or more taxa not part of the ingroup, but ideally one(s) thought to be close relatives of the ingroup taxa. We then introduce another assumption, that character states shared between outgroup and ingroup are the same because their common ancestor shared those states (rather than that the exact same changes from the ancestor happened in parallel in both ingroup and outgroup).

This allows us to root the tree and convert the network to a hypothesis of evolutionary relationships. I’ve shown this in Fig. 3 for three different possible outgroups, OG1, OG2, and OG3, each with a different set of character states. As you can see from the resulting trees this can literally completely reverse our estimate of how the ingroup has evolved (e.g., compare 3A with 3B). This illustrates the importance of getting character polarity right and in turn of choosing outgroups carefully. Note, by the way, that for all three outgroup choices I’ve made the outgroup character state X for character D, so that it contrasts with state Y in all the ingroup species. Thus, Y is an autapomorphy of the ingroup, but it reassures us that all the ingroup species are more closely related to one another than to OG. This doesn’t have to be the case in real life, but, if not, you should bear in mind that the probability is higher that the ingroup might not truly be monophyletic.

Now for another complication, already alluded to in describing Fig. 2. Notice (Fig. 2A and 2C) that species I and II share one apparent synapomorphy (state X of character D), but that I shares two different synapomorphies with IV, and II also shares a different synapomorphy with III. Applying the principle of parsimony to the tree as a whole, we must conclude that, even though character D seems to have changed from 0→1 in both I and II, these changes occurred independently from different ancestors. Thus, this similarity is due to convergence, in this context called homoplasy.

A somewhat similar situation exists in Figs. 3C1 and 3C2. Notice that species II shares an apomorphy of character B (i.e., state X) with species I and an apomorphy of character A with both species III and IV. Since species I does not share any apomorphy with II or IV, there’s no parsimonious arrangement that allows II to be the closest relative of both I and III or IV. In this case, unlike that in Fig. 2C, there are actually two possible equally parsimonious trees, however, as shown in the Figures. In Fig. 3C1, homoplasious changes in B occur in I and II, while in 3C2 homoplasious changes in A occur in II and the ancestor to III + IV. Both trees require five changes and so, by defini-

tion, are equally parsimonious; because of the existence of homoplasy they both require one more step than the trees shown in 3A and 3B. Homoplasy always adds additional steps to phylogenetic tree reconstructions.

Homoplasy can occur quite frequently in some taxa, and this makes distinguishing homologous similarity and recovering the “best” tree correspondingly difficult. It can cause problems in phylogeny reconstruction from either morphological or molecular data. Morphological traits because very similar phenotypes can arise from quite distinct genetic bases or because, at least in fairly close relatives, identical genetic changes can occur independently and give rise to practically identical morphologies. In DNA sequences, homoplasy most often results from multiple changes over a period of time at a single nucleotide site. One way to deal with such problems is to add additional characters, especially from independent data sets (e.g., combinations of morphology, mitochondrial DNA, and nuclear DNA). It is also possible to apply other corrective measures that deal with homoplasy, but these are beyond my scope here.

This is the merest introduction to some of the approaches and problems involved in understanding and developing phylogenetic hypotheses. I hope it’s helpful and interesting to some readers. Many thanks, by the way, to my colleagues, Karl Kjer and Jessica Ware, for very useful comments. If anyone has questions, they’re welcome to get in touch with me at <may@aesop.rutgers.edu>. I can probably put you in touch with someone like Karl or Jessica who really knows what they’re talking about and tune in to the next number of ARGIA for my take on what all this may mean for dragonflies.

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## A Suggested Species Code for Odonates

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For years I have been using a six-letter code for odonate names, and in discussion with a colleague recently, it dawned on me that I should share the idea, in case it might be of some help to others who have or haven't grappled with the problem of taking quick field notes.

My code is simple, just the first three letters of the genus and species. Thus *Lestes congener* is **Lescon**, *Anax junius* **Anajun**. There are only five cases of duplication in the North American fauna: *Lestes forcipatus* and *L. forcifcula*, *Enallagma anna* and *E. annexum*, *Cordulegaster diadema* and *C. diastatops*, *Epitheca spinigera* and *E. spinosa*, and *Libellula comanche* and *L. composita*, and I write all these merely by adding the fourth letter, as **Lesforc** and **Lesforf**. If it were strictly necessary to limit the names to six letters, as in a database, that wouldn't be hard to do for these five, and I'll throw out suggestions of **Lesfop** and **Lesfol**, **Enaana** and **Enaanx**, **Cordid** and **Cordis**, **Epispg** and **Episps**, and **Libcon** and **Libcop** as substitutes. The sixth letter is chosen so no confusion is possible.

Those who work in common names could do the same thing with those names and perhaps limit the code to four letters, but I assure you it would be complicated. North American ornithology has long had a series of four-let-

ter codes for all species, based on common names, but there are so many duplications that lots of weird combinations have been necessary to distinguish them all. Can you imagine what a **BLBW** is?

Furthermore, because common names are so varied in their construction, there has to be a set of rules to accommodate this. For example, Rusty Blackbird is **RUBL**, but Red-winged Blackbird, instead of **REBL**, is **RWBL** because of the hyphenated words. Green Heron is **GRHE**, but Great Blue Heron is **GBHE** because it is made up of three words, and Black-crowned Night-Heron is **BCNH**. You get the idea. It gets worse with names like Black-throated Gray Warbler and Black-throated Green Warbler. However, there have also been six-letter codes proposed for both common and scientific names of birds. A good web site for the four-letter common-name and six-letter scientific-name codes of North American birds is <<http://www.birdpop.org/AlphaCodes.htm>>.

Presumably many of you already have your own shorthand, but I should add that I have found this one useful anywhere in the world, and you don't have to remember odd names or naming rules. 

## 2006 Summary of Odonate Research in Georgia

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The known status and distribution of Georgia Odonata has recently been summarized in Mauffray and Beaton (2005) and Beaton and Dobbs (2006). This article will summarize the additional work done in Georgia during 2006. At the end of 2005, there were 3961 county records from Georgia (159 counties!) and 149 new records were added in 2006 for a new total of 4110. County record maps for each species are available thanks to the hard work of MD at <[http://www.mamomi.net/Odonata/odecounty\\_index.htm](http://www.mamomi.net/Odonata/odecounty_index.htm)>.

The bulk of the records added during the year were again collected by GB or MD, who made numerous trips across the state, both independently and together. GB and Dennis Paulson spent the better part of three weeks in the spring touring the state, adding a few good records. GB and R. Steve Krotzer (SK) also conducted several days of collecting larvae in different parts of the state, and the determinations by SK resulted in several new records. Jim Flynn provided

about 20 photo records, and Ken Tennesen (KT) sent in some significant larval records from 2003 and 2004. A few others contributed a small number of additional records. The weather was basically dry most of the year, and many sites became completely dry.

The best finds were new state records for *Lestes congener* (Spotted Spreadwing) and *Macrodiplax balteata* (Marl Pennant). See below for details, but these additions raise the state list to 176 taxa comprising 173 species. Of these, 53 species (55 taxa) are Zygoptera and 120 species (121 taxa) are Anisoptera.

Following is a summary of new records for species with fewer than ten county records:

*Lestes congener* (Spotted Spreadwing): With planning assistance from SK and Georgia DNR biologist John



Jensen, GB added this species to the state list at a single pond in Crockford-Pigeon Mountain WMA in Walker County on 7 Sep 2006. A pair was collected. The species was found in small numbers throughout September even though the pond was dry.

*Lestes forcipatus* (Sweetflag Spreadwing) was found at the same pond as the *L. congener*, for a second location in the state (same county as the first in 2005).

*Enallagma davisii* (Sandhill Bluet): Once again found in one new county, Richmond, for a total of four known sites in three counties. This new site, a private pond, provided a number of important records.

*Dromogomphus armatus* (Southeastern Spinyleg): Two new counties (Early and Sumter), for a total of six.

*Gomphus (Gomphurus) consanguis* (Cherokee Clubtail): One new county record in Gordon for a fourth county record. Extensive survey work for this species in 2006 raised the number of known streams from four to eight in northwest Georgia.

*Gomphus (Gomphus) australis* (Clearlake Clubtail): Previously known from two counties, two new locations were added on the basis of several larvae (Taylor County, not a county record but a new site), and Tattnall County based on exuviae for a total of three counties.

*Gomphus (Gomphus) diminutus* (Diminutive Clubtail): A third new location was found within the only known county for Georgia (Richmond), a pond with very good numbers of the species.

*Gomphus (Gomphus) geminatus* (Twin-striped Clubtail): Early County became the third county, based on larvae determined by SK.

*Ophiogomphus incurvatus* (Appalachian Snaketail): Found in two new counties, Oglethorpe and Union (this one from 2005), for a total of four counties.

*Ophiogomphus* sp. One adult *Ophiogomphus* species was found in Early County in 2005, but it can't be assigned to any known species or subspecies based on current knowledge. SK and GB conducted larval sampling here in Feb 2006, and found good numbers of *Ophiogomphus* larvae in two streams in the same drainage. They appear to be in three year classes. GB went back later and procured 10 larvae, and reared them successfully. In early April, GB and Jerrell Daigle also caught several adults, still unidentified. See a web page at <<http://www.giffbeaton.com/Ophio.htm>> for more details, closeup photos of the specimens

and appendages, and further discussion.

*Stylurus* sp. KT sent larval records from 2003 and 2004 for two species at two new locations in this difficult-to-find genus, and SK resampled them in 2006. Both added species to each county list based on larvae. These two streams will also be surveyed during the flight period in 2007

*Stylurus laurae* (Laura's Clubtail): Two new larval records in Fannin and Towns Counties in 2006, for a total of six counties.

*Stylurus scudderii* (Zebra Clubtail): Two new larval records in Fannin (2004) and Towns (2006), for a total of three counties.

*Stylurus spiniceps* (Arrow Clubtail): Two new larval records in Fannin and Towns, both 2003, for a total of five counties.

*Epithecina sepia* (Sepia Baskettail): One male collected in Long County for the fifth county record.

*Neurocordulia molesta* (Smoky Shadowdragon): The fifth county record was made in Monroe County based on exuviae, determined by SK.

*Neurocordulia virginienensis* (Cinnamon Shadowdragon): One exuvia of this species was collected along with the *N. molesta* above, and also determined by SK. Flying adults were collected on a subsequent visit, for the third county record.

*Macrodiplax balteata* (Marl Pennant): A single female of this species was found and photographed by Georgia DNR biologist Todd Schneider on 12 Jul 2006 in Glynn County near Brunswick. There is no marl habitat near this site that we know of, or anywhere on the Georgia coast for that matter. Subsequent visits failed to turn up any more individuals.

*Sympetrum rubicundulum* (Ruby Meadowhawk): A new location was found in Walker County, a county with previous records. Still five county records.

*Sympetrum semicinctum* (Band-winged Meadowhawk): In Beaton and Dobbs (2006) we reported the loss of the only known extant population of this species, with a state distribution of two known county records. In 2006 it was found at two new locations in Dade and Floyd Counties, for a total of four county records.

A few other records notable for their location, in species with more than ten county records:

*Ischnura prognata* (Furtive Forktail): Floyd County, up in the northwest corner of the state. Most records are below the fall line running through the middle of the state.

*Aeshna umbrosa* (Shadow Darner): Found in Baldwin County, at the southern edge of this species' range on the fall line, and also very early and late dates (3 Aug–27 Dec 2005).

*Aphylla williamsoni* (Two-striped Forceptail): Two more records in the middle of the Piedmont, in Greene and Fulton Counties, so the species is continuing to extend its range to the north.

*Gomphus (Gomphurus) rogersi* (Sable Clubtail): Found in Rockdale County for only the second record south of

the usual range of this species in the northern part of the state.

*Orthemis ferruginea* (Roseate Skimmer): This species also continues to expand to the north, with records in Clayton and Gordon Counties.

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## First Texas Record and Second US Occurrence of the Pale-green Darner, *Triacanthagyna septima* (Selys in Sagra, 1857) (Odonata: Aeshnidae)

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The genus *Triacanthagyna* is comprised of nine species of slender, crepuscular aeshnids that are most diverse in Central and South America (Paulson, 2005 and 2006; Shorr et al., 2006). Two, *T. trifida* (Phantom Darner), and *T. septima*, called Pale-green Darner in Needham et al., (2000) are known from the US. *T. trifida* is restricted to South Carolina, Georgia, Florida, the Antilles and the Bahamas (Needham et al., 2000). *T. septima* is more widespread, occurring in the West Indies and from Mexico to Bolivia (Needham et al., 2000). The only US record of *septima* was a specimen taken 2 November 2000 during surveys at the Big Cypress National Preserve, Monroe Co., Florida (Harp, 2003).

On 22 October 2006, Behrstock and Rose were leading an Odonata field trip as part of the annual Texas Butterfly Festival, held in Mission, Texas. The day's first stop was at Anzalduas County Park, Hidalgo County, Texas. The park is located along the Rio Grande approximately 8 km south of the town of Mission. During previous butterfly and dragonfly festivals, the park has been very productive for Odonata including two species of *Neoneura*, four species of *Argia*, *Neoerythromma cultellatum* (Caribbean Yellowface), at least six species of gomphids, *Brachymesia herbida* (Tawny Pennant), and *Perithemis domitia* (Slough Amberwing).

The walk began at 0830 hrs adjacent to a small patch of woodland just upstream from the Anzalduas Dam. Seeking shelter from the strong winds, we followed a small trail into the woods just a meter or two from the water's edge. A few minutes before 1100 hrs, Rose spotted a male *Gynacantha mexicana* (Bar-sided Darner) hanging in a thicket approximately 0.6 m above the ground. As participants photographed it, Behrstock found another darner close by, and hanging not more than 1 m above the ground. This individual differed from the *Gynacantha* in appearing daintier and having a very lightly marked thorax and unpatterned wings. After photographing it, Behrstock collected it by hand. Just a few minutes later, a second individual was found perching approximately 2 m above ground. Due to our uncertainty of the identity of this species, it too was collected by hand. At the time, the temperature at the nearby McAllen Airport was 17.8° C (64° F), with north winds of 22.2 km/h (13.8 mph) (<wunderground.com> October 2006). The temperature had fallen 16° F since the previous midnight, and the cold temperatures no doubt facilitated collecting odonates by hand.

The specimens were frozen and delivered by Phil Schappert to John Abbott on 26 October. Prior to the delivery of the specimens, Behrstock's photos were examined by Abbott, Dennis Paulson, and Sid Dunkle, all of whom identified them as *septima*. Abbott confirmed that

the specimens represented two female *Triacanthagyna septima*, the first for Texas and the second occurrence for the US. As per OdonataCentral, the number of aeshnids known from Texas is now 19 species in 11 genera, and the total number of Odonata recorded in Texas is 224 (<[http://www.odonatacentral.com/checklists/namerica/State\\_CheckList.asp?State=Texas](http://www.odonatacentral.com/checklists/namerica/State_CheckList.asp?State=Texas)>). Abbott posted two images of one of the female *septima* at The Odonata Survey of Texas (OST) Rare Odonata Alert, <<http://www.odonatacentral.com/ost/alert.htm>>.

In the field, *septima* may be distinguished from *trifida* by the former's pale legs with yellow tarsi, unmarked or very lightly marked thorax, the male's lack of a constriction at segment 3, and its hyaline, unmarked wings. In hand, note also the broadly convex frons of *septima* (Needham et al., 2000).

The occurrence of two *septima* at one site hints at the possibility of a breeding population in Texas. The presence of *Gynacantha mexicana* at this site, and another photographed that same morning at the nearby NABA International Butterfly Park, suggest that *mexicana* is more widespread than is suggested by the cluster of records further east at Santa Ana National Wildlife Refuge. Alternatively, both species may be dispersing northward into Texas from nearby populations in Tamaulipas (where neither has, as yet, been recorded). Abbott notes that the crepuscular *Gynacantha* and *Triacanthagyna* often roost together. Both genera inhabit temporary forest pools (Dunkle, 2000) and Corbet (1999) indicates that at least some members of both genera oviposit in phytotelmata such as tree holes and cavities among tree roots.

#### Acknowledgements

The authors would like to thank Phil Schappert (Section of Integrative Biology, The University of Texas at Aus-

tin) for freezing the specimens and transporting them to Abbott. Dennis Paulson and Sid Dunkle kindly examined Behrstock's photos. Thanks also to the Mission Chamber of Commerce for organizing the Texas Butterfly Festival each year, and exposing hundreds of naturalists not only to butterflies, but also to the rich odonate fauna that inhabits the Lower Rio Grande Valley.

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## *Tholymis citrina* (Evening Skimmer) found in Oklahoma

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On 20 August 2006 I was leading a birding tour at Red Slough Wildlife Management Area, McCurtain County, Oklahoma for the Indian Nations Audubon Society when I spotted a dragonfly that I didn't recognize. It was around 7 AM, cloudy, and the dragonfly was flying low to the water with a quick bouncing flight. Many in the group were interested in dragonflies as was I, so I got out my net and caught it. When I first pulled it out of the net my mind went blank as I didn't recognize it nor did I remember seeing a picture of it in any field guide. The large amber

spots in the middle of the hindwings were distinctive and we soon identified it as a probable *Tholymis citrina* (Evening Skimmer). I photographed it and kept the specimen as it was quite far out of range and a first state record for Oklahoma. I sent the photos off that evening to Dennis Paulson and George Harp who both confirmed the identification. The specimen was then preserved and sent to John Abbott. This appears to be the seventh record for the US (three previous records in Florida and Texas each).



## First Record of *Erythrodiplax basifusca* (Plateau Dragonlet) for California

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On 21 October 2006, my wife, Linda and I traveled to the Imperial Dam area in southeast Imperial County, California, in an attempt to find and photograph *Tramea calverti* (Striped Saddlebags). This new species for California was targeted and successfully found during the 2nd Annual CalOdes Blitz two weeks earlier. I was unable to attend that event and although my search for *T. calverti* proved futile, I was rewarded for my efforts by the discovery of a male *Erythrodiplax basifusca* (Plateau Dragonlet), a species not previously recorded in California (see front cover for photo).


This dragonfly was found on the north side of McKinley Road approximately 10 yards west of a small beaver pond, approximately one mile west of the Imperial Dam and the Colorado River, and just northwest of West Pond (at 32.8824°N, 114.4831°W, and at an elevation of 174 feet). I spent a half hour observing and photographing this dragonfly, and during this time it occasionally flew off, but always returned to the same spot, perching approximately eighteen inches off the ground over a small ditch with one to two inches of water flowing through it.

After calling Douglas Aguillard that night, he was able to locate and photograph what is presumed to be the same individual the following day at the same location. Photographs are available on Douglas's site and Kathy Biggs' site (see references).

Incredibly, these two new state records, the first in two years, were discovered only two weeks and two hundred yards apart. This record brings the total number of species of odonates for California to 111, which includes 40 species of damselflies and 71 species of dragonflies.

This record represents a northwestern range extension for *E. basifusca*, as it was previously known from only as far west as central Arizona, and as far north in Baja California as the northern Vizcaíno Desert. The date of this record is within the normal range for *E. basifusca*, which is known to fly as late as 22 October in Texas and 18 November in Arizona.

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## The Dragonflies and Damselflies of the Llano Estacado: In Search of New Species Records on the Panhandle South Plains

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The Panhandle Plains of west Texas at first glance appears dry and dust-blown; a virtual wasteland with little or nothing to offer one in search of dragonflies. But appearances can be deceiving. By mid-March 2006, after an uncommonly mild winter with no significant rainfall in months, the outlook for the upcoming odonate season looked anything but promising. Most, if not all, of the playa lakes (so characteristic of the Llano Estacado) had long since

dried up. However, some much needed rain fell in the latter weeks of March that brought a renewed optimism for those in search of dragonflies. So, outfitted with a good pair of close-focus binoculars in one hand and digital camera in the other, I took to the fields, ponds, creeks, and canyons of Lubbock and Bailey counties to see what I could find. Here are the amazing results: 10 new dragonfly (Anisoptera) and 4 new damselfly (Zygoptera) records.



*Orthemis ferruginea* (Roseate Skimmer): My adventures to track, observe, and photograph new records began at Clapp Park pond in Lubbock city. On 10 April, I got my first good-enough-to-submit photographic records of *Orthemis ferruginea*. Clapp Park pond became a virtual haven for *O. ferruginea* for the entire month. This species would prove to become an intermittent presence throughout the summer at Clapp Park and, to a lesser degree, as well as both the Llano Estacado Audubon Trail at Buffalo Springs Lake and Lubbock Lake Landmark. In early October at Clapp, *O. ferruginea* would make its presence well-known again.

*Pachydiplax longipennis* (Blue Dasher): As early as 22 May, I got some photos of the surprisingly undocumented common summer species *Pachydiplax longipennis* at Clapp Park pond. Since then, I've tallied a host of photos of this species at the Llano Estacado Audubon Trail and McKenzie Park as well.

*Tramea calverti* (Striped Saddlebags): On 24 May, I would encounter another new record for Lubbock: *Tramea calverti* at Clapp Park pond. Because this is a tropical species whose previously known range limit was way south of the Panhandle and the fact that the photos were all of subject perched high above my head, my first observations and photographs were anything but conclusive as to its positive identity. However, after several additional encounters and photo opportunities throughout the season, I obtained undeniable evidence that *T. calverti* was indeed flying on the South Plains!

*Erythemis vesiculosa* (Great Pondhawk): Then on 25 May, another record came my way as I observed and photographed *Erythemis vesiculosa* also at Clapp Park pond. This species represents another dragonfly species whose range limit was supposed to be outside the Llano Estacado region. I observed and photographed this species on two separate occasions with the last one bringing the best images for accurate documentation.

*Dythemis fugax* (Checkered Setwing): By mid-June, several trips to Lubbock Lake Landmark yielded new species record: *Dythemis fugax*. The cherry-red face, characteristic of mature males of this species, makes it one of my favorites to observe and photograph. Interestingly, this species was observed only at this location among several clumps of Mesquite trees. Nowhere else in either Lubbock or Bailey counties have I seen *D. fugax*.

*Dythemis velox* (Swift Setwing): July and August yielded another *Dythemis* species record for the Llano: *Dythemis velox*. This new species record for Lubbock was acquired on the Llano Estacado Audubon Trail and, later, at

McKenzie Park. One such shot I obtained was of a gorgeous male "obelisking" on a prominent tree branch overlooking the Audubon Trail creek; it is one of my favorite shots of *D. velox*. September and early October continue to be good months to see an occasional few *D. velox* at the Audubon Trail creek.

*Rhionaeschna multicolor* (Blue-eyed Darner): On 22 August, I got my first good photographic evidence for *Rhionaeschna multicolor* in Lubbock County. Since this species is so very similar and may be confused with *R. dugesi* (Arroyo Darner), a good lateral view shot was required to document this record. It is truly one of the more beautiful darner species of the southwest and western half of the United States.

*Brachymesia gravida* (Four-spotted Pennant): Another one of the truly astounding surprises was the location and photographic record of *Brachymesia gravida* secured at an isolated and brackish pond near the main lake above the spillway at Buffalo Springs Lake. Seen only at this location, I photographed *B. gravida* here on two separate visits in the month of August. It is likely that this was the same species each time and its presence here a rare occurrence.

*Libellula saturata* (Flame Skimmer): Late October of 2005, I got my first glimpse of *Libellula saturata* on the South Plains at Clapp Park pond, but at that time I had no camera in hand to document the record. The 2006 season verified this report with photos early on at Clapp Park pond and, later, at Llano Estacado Audubon Trail. I continued, in mid-October, to see and photograph this species at the Llano Estacado Audubon Trail creek.

*Sympetrum corruptum* (Variegated Meadowhawk): This species I also observed and photographed at Audubon Trail creek in early November last season, but since the photos were not conclusive, I had to try again this year. So, on the same day that I got photos of the *L. saturata* record above, I also observed and photographed my first record-worthy *Sympetrum corruptum*. Unlike the location and photo of the one last season, this one was seen and photographed quite a distance from the creek and was an immature male which made its identity obvious even from a photo.

*Ischnura posita* (Fragile Forktail): This damselfly record was one of the first secured for the 2006 season. The *Ischnura posita* record was taken on 20 April near the creek at Llano Estacado Audubon Trail. Its "exclamation point" marking high on the thorax makes its positive identification unmistakable.

*Argia plana* (Springwater Dancer): The species *Argia plana* was likewise taken on the same day as *I. posita* above. I wasn't sure of its identity even after consulting the field guides. However, I believed it to be *A. plana* and Dr. John C. Abbott confirmed my supposition.

*Argia moesta* (Powdered Dancer): On 18 May I observed and captured a photographic record for *Argia moesta* at the Llano Estacado Audubon Trail creek. Its two different color-form females were everywhere to be seen which made it an interesting species to observe and photograph.

*Ischnura barberi* (Desert Forktail): This little damselfly gem, *Ischnura barberi*, I observed and photographed the first time at the 2006 Dragonfly Festival in Roswell, New Mexico on the Bitter Lake NWR, 9 September. So, when I spotted what I believed was the same species in Bailey County's Muleshoe NWR, I just had to snap a few good shots since I knew it would be a new record for this county.

Just to make sure my identification was correct, I submitted the photos to Dr. Abbott for his inspection and he confirmed my hunch.

My adventures are far from over for the season. As long as the first freeze delays its frigid blast, I will continue to comb every nook and cranny of Lubbock County and the surrounding areas in search of any records and photographic opportunities that come my way. I can hardly wait for next season to explore those counties on the Llano Estacado of West Texas that have yet to yield any records. There's much work to be done on the South Plains, and I hope to play an integral part in filling the void that exists out here. Texans on the South Plains have long had a reputation for being pioneers and trailblazers. I hope that I can contribute in some way to this same spirit as it relates to the discovery of odonate records on El Llano Estacado.



## Odonata Survey of Union County, South Carolina

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We surveyed larval and adult odonates in Union County, South Carolina, USA from April 2004 through September 2006. Most of the sites were within the Enoree Ranger District of Sumter National Forest. We found 41 species of odonates, 34 representing new county records. We focused our attention on the watersheds of the Tyger River and Fairforest Creek, just north of Whitmire and south of Union. The Army Corps of Engineers is studying the possibility of damming the Tyger River, just below the confluence with Fairforest Creek, in order to create a recreational reservoir. Union County then plans to petition the US Forest Service to sell them this property. The county would then sell the land to developers for the construction of a retirement community around the new lake. The Tyger River is one of the last free-flowing rivers in the state, and several environmental groups oppose this plan. State chapters of the Audubon Society and the Native Plant Society have each conducted surveys in the flood zone, and we decided to sample odonates in this region to complement their efforts.

This area has a variety of odonate habitats. The Tyger River is a fairly large sandy-bottom river, averaging approximately 25 m in width through this region. The Fairforest Creek tributary is typically about half that size, however it does broaden significantly (to 75 m) as it passes over a broad shoal at SC route 49. In addition, there is a large

(2.4 km<sup>2</sup>) impoundment off the Tyger River that is used as a waterfowl observation site, and there are several other impoundments in the National Forest that are used for fishing.

Larvae were collected by electrofishing, with the help of Dr. Dennis Haney and students in the Furman University River Basins Research Initiative (2004 sample) and Dr. Haney's Animal Physiology class (2005 sample). A current was applied to the water with a Root-Smith Electrofisher, and immobilized larvae were collected downstream in a seine. Nine sites were sampled on 16 July 2004, and at six sites on 29 October 2005. Each site was sampled for a total of 8 minutes of shocking time, typically distributed over a reach 75–100 m in length.

Adults were collected by aerial net. The Tyger River Impoundment Area was visited approximately once/week from May through September 2005, as part of an experiment on perch height preferences. This site and others were visited approximately every other week outside of this experimental interval. All specimens were preserved and stored in the Furman University Zoological Collection.

The published record of South Carolina Odonata is very patchy; several counties are very well-described, while

others like Union County are obviously undersampled. For example, OdonataCentral lists only eight species from Union County (Abbott, 2006). We captured the following 41 species; 34 represent new county records (Abbott, 2006). New county records based on adult specimens have been submitted to OdonataCentral (Abbott, 2006). The community is quite typical for the southern piedmont, with no truly outstanding or unusual records. However, this survey does represent the first significant published survey of the county. Examples of all species can be viewed at <<http://facweb.furman.edu/~worthen/unionlist.htm>>.

List of Species from Union County, South Carolina (\* = new county record)

### Calopterygidae

*Calopteryx maculata*  
*Hetaerina titia*\*

### Coenagrionidae

*Argia apicalis*\*  
*Argia fumipennis*\*  
*Argia moesta*\*  
*Argia sedula*  
*Argia tibialis*  
*Enallagma daeckii*\*  
*Ischnura posita*\*

### Aeshnidae

*Anax junius*\*  
*Basiaeschna janata*\*  
*Boyeria vinosa* (larva)

### Gomphidae

*Dromogomphus spinosus*\*  
*Erpetogomphus designatus*\*  
*Gomphus (Gomphurus) hybridus*\*  
*Gomphus (Hylogomphus) parvidens* (larva)\*  
*Hagenius brevistylus*\*  
*Progomphus obscurus*\*  
*Stylogomphus albistylus* (larva)\*  
*Stylurus plagiatus* (larva)\*  
*Stylurus scudderi* (larva)\*  
*Stylurus spiniceps* (larva)\*

### Macromiidae

*Didymops transversa*\*  
*Macromia illinoensis* (larva)\*

### Corduliidae

*Helocordulia selysii*\*  
*Tetragoneuria cynosura*\*

### Libellulidae

*Celithemis elisa*\*  
*Celithemis eponina*\*  
*Celithemis fasciata*\*  
*Dythemis velox*\*  
*Erythemis simplicicollis*  
*Pachydiplax longipennis*\*  
*Ladona deplanata*\*  
*Libellula cyanea*\*  
*Libellula incesta*\*  
*Libellula luctuosa*  
*Libellula pulchella*\*  
*Libellula vibrans*\*  
*Platthemis lydia*  
*Tramea carolina*\*  
*Tramea lacerata*\*

### Acknowledgements

We thank the USFS for issuing our permit to sample within the Sumter National Forest. We also thank Dr. Dennis Haney and the students of the Furman University River Basins Research Initiative and Animal Physiology class for helping us collect larvae. We also thank Steve Krotzer for verifying our adult specimens and correcting one of our identifications. WBW was supported by a Research and Professional Growth grant from Furman University, and CMJ was supported by a Furman Advantage grant from Furman University.

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## *Aphylla williamsoni* (Two-striped Forceptail) New for Arkansas

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I visited the Okay Landing area of Millwood Lake in Howard County, Arkansas on Saturday morning, 2 September 2006 to photograph dragonflies. At approximately 8:50 AM, I noticed an unfamiliar clubtail settle on a weed stem just below the top of a levee. I obtained a series of photographs and later identified my subject as a male *Aphylla williamsoni* (Two-striped Forceptail). This photographically documented observation not only provides the first report of *A. williamsoni* in Arkansas but also the first report of the genus *Aphylla* in the state.

Millwood Lake is in extreme southwestern Arkansas and occupies portions of Hempstead, Howard, Little River, and Sevier Counties. This observation follows closely the first records of *A. williamsoni* for Oklahoma in the Red Slough Wildlife Management Area, McCurtain County, on 30 August 2005 and 22 August 2006. Additionally, the species was photographed twice in northeast Texas during August 2006—first on 3 August at Daingerfield State Park in Morris County and second, on 24 August at Richland Creek Wildlife Management Area in Navarro County. 


## Last Call for Vermont Data

Michael Blust <blustm@greenmtn.edu> and Bryan Pfeiffer <bryan@wingsenvironmental.com>

Here is a final request for data in preparation for our publication on the Odonata of Vermont. Although we have assembled more than 3000 records in our database, we suspect that valuable Vermont data remains scattered in museums and personal collections. So we urge you to share what you have. We would like to have data from specimens, photographs or credible visual encounters by early April 2007.

We particularly welcome information from museum collections that may contain specimens from Vermont. Data

can be submitted in most any format. Or, if justified, we can travel to you to enter your Vermont records into our database. Our goal is to complete data entry before this spring so that it can guide our attempts to fill data gaps this coming field season.

Please e-mail Mike Blust at <blustm@greenmtn.edu> or call 802-287-8331 with information. Our thanks to all of you who have already contributed—and to those of you who will contribute soon. Your assistance will be fittingly noted in the publication. 

## An Invitation to Join Unique and Important Research: Please RSVP ASAP

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Many questions arise before, during, and after data collection. Key before questions for sampling most animal taxa include how often should surveys be done and how long should the surveys last? Scientists may pull their hair out trying to answer, or will simply avoid stress by picking a magic number. A standardized set of guidelines based on sound science will limit the hair-pulling and arbitrary effort, and should make independent studies more comparable. A clear set of options might be welcomed most by those who need reliable data at the least cost (time, effort, money), such as folks pressed by the urgent, crisis-oriented demands of conservation.

How often and how long for adult odonates? Decisions will depend on the study goals, the level of accuracy required, and the human resources available. By sampling many sites many times each and keeping track of when species are encountered per survey, we might be able to provide researchers and conservation practitioners with an objectively defined set of options for how often and how long to sample. Such a study began in 2006—please see page 8 for a technical summary of preliminary results.


The impact will depend largely on the number of sites, variety of habitat, and amount of geographic coverage.



This work has the potential to benefit adult dragonfly research and conservation worldwide. Sampling does not need to happen everywhere to build global applicability, but the more sites and geographic coverage the greater the impact and the more reliable the broad-based inference.

Can you field-identify adult dragonflies and/or damselflies and spare visiting a site (any habitat type, anywhere) for at least forty minutes about once per week, preferably at least twenty times within a year? This would be your whole requirement. We figure that most odonate enthusi-

asts make this many trips or far more every summer, and try to spend several hours every time out. We are not picky about the habitat or location—feel free to behave like a philopatric odonate and do your surveys at the pond in your backyard! The important thing is that you can field-identify all or most of the species you detect and will do a site visit every week.


Please join us! Let's help frantic scientists keep their hair intact. For more information or to sign up, contact Jason Bried (<jbried@tnc.org>, 518-456-0655 ex. 221). 

## An Impressive Time Piece

e-mail from **Stanislav Gorb** <s.gorb@mf.mpg.de>

Since I am interested in biomimetics (bionics, biologically inspired technologies), a few months ago I visited an exhibition of the miniatures made by Nikolay Syadristy <<http://www.microart.kiev.ua>> in Kiev, Ukraine. I was mostly impressed by the clock, which almost perfectly casts a *Sympetrum* dragonfly with the complete working mechanism built into the eye. I was very much impressed by this masterpiece first of all, because it is 100% hand made without any technological tricks of modern micro- and nanotechnology. I think it

might be interesting to the ARGIA readership. Herewith I enclose a copy of my ticket with an image of the mentioned item.

[Editor's Note: See the rear cover for an image of this impressive clock. Readers might enjoy browsing the web site, Insect Lab <<http://www.insectlabstudio.com>>. It is an artist operated studio that customizes real insects (including Odonata) with antique watch parts and electronic components.] 

## Trips to Guatemala and Peru for 2007

**John B. Heppner** <jbhatl@aol.com>

DSA and IORI member Dr. John B. Heppner, Curator of Lepidoptera at the Florida State Collection of Arthropods, does tropical trips for the Association for Tropical Lepidoptera, and odonate collectors are welcome to join. Two trips will be of interest in 2007: Guatemala 2–10 June (can be extended to 15 June) and Peru 2–11 November (can be extended to 17 November). Cost is roughly \$125 per day (includes local accommodations, meals and site transportation), plus you buy your air ticket. In Guatemala, we will be near Flores, at the Ixpanajul Nature Reserve, in Peten (ca. 200 m elevation), and later with five days 11–15 November as an option near the Quetzal Reserve (1680 m), in Dept. Baja Verapaz. In Peru, we will be in Cuzco Dept., on the road to Manu Park, staying at the Cock-of-the-Rock Lodge (ca. 1200 m) on the Amazon slope of the Andes. Day trips are possible to nearby areas but on each trip the main site has ample habitat to investigate. Needed permits will be available to participants. If interested, contact Dr. Heppner at <jbhatl@aol.com>.



## ARGIA Ombudsman or Complaint Department . . .

*This is an outrage!!* What's the deal with "Stump the Chumps?" We have been completely and thoroughly humiliated! We try and ID the photos on the front and back covers of each ARGIA issue without consulting any references (that would be cheating). So what happens? We go 0 for 3! We thought the front cover was of *Neurothemis tullia*. Strike 1. We thought the upper back cover was of *Aeshna juncea*. Strike 2. We couldn't even hazard a decent guess on the damselfly. Strike 3! We hope this utterly disgraceful showing on our part makes you supremely happy. We may have to become botanists.

*I.M. Absurd and D. Lerious*

## **ARGIA and BAO Submission Guidelines**

Digital submissions of all materials (via e-mail or CD) are vastly preferred to hardcopy. If digital submissions are not possible, contact the Editor before sending anything. Material for ARGIA must be sent directly to the John C. Abbott, Section of Integrative Biology, C0930, University of Texas, Austin TX, USA 78712, <jcabbott@mail.utexas.edu>; material for BAO must be sent to Ken Tennessen, P.O. Box 585, Wautoma, WI, USA 54982, <ktennessen@centurytel.net>.

### **Articles**

All articles and notes are preferably submitted in Word or Rich Text Format, without any figures or tables, or their captions, embedded. Only minimal formatting to facilitate review is needed—single column with paragraph returns and bold/italic type where necessary. Include captions for all figures and tables in a separate document.

Begin the article with title, author name(s), and contact information (especially e-mail) with a line between each. The article or note should follow this information. Paragraphs should be separated by a line and the first line should not be indented. Where possible always refer to the scientific name of a species followed by its official common name in parentheses.

### **Figures**

Submit figures individually as separate files, named so that each can be easily identified and matched with its caption. Requirements vary depending on the type of graphic.

Photographs and other complex (continuous tone) raster graphics should be submitted as TIFF (preferred) or JPEG files with a minimum of 300 ppi at the intended print size. If unsure about the final print size, keep in mind that oversized graphics can be scaled down without loss of quality, but they cannot be scaled up without loss of quality. The printable area of a page of ARGIA or BAO is 6.5 × 9.0 inches, so no graphics will exceed these dimensions. Do not add any graphic features such as text, arrows, circles, etc. to photographs. If these are necessary, include a note to the Editor with the figure's caption, describing what is needed. The editorial staff will crop, scale, sample, and enhance photographs as deemed necessary and will add graphics requested by the author.

Charts, graphs, diagrams, and other vector graphics (e.g. computer-drawn maps) are best submitted in Illustrator format or EPS. If this is not possible, then submit as raster graphics (PNG or TIFF) with a minimum of 600 ppi at the intended print size. You may be asked to provide the raw data for charts and graphs if submitted graphics are deemed to be unsatisfactory. When charts and graphs are generated in Excel, please submit the Excel document with each chart or graph on a separate sheet and each sheet named appropriately (e.g. "Fig. 1", "Fig. 2", etc.)

### **Tables**

Tables may be submitted as Word documents or Excel spreadsheets. If Excel is used, place each table on a separate sheet and name each sheet appropriately (e.g. "Table 1", "Table 2", etc.)

<b>In This Issue</b> .....	1
<b>Calendar of Events for 2007</b> .....	1
<b>It's Election Time!</b> , by Steve Krotzer.....	3
<b>Minutes of the 2006 Annual Meeting of the Dragonfly Society of the Americas</b> , by Steve Valley.....	3
<b>The 2007 Annual DSA Meeting in Arizona</b> , by Jerrell J. Daigle.....	4
<b>CalOdes/DSA Blitz II—The Desert Experience (A New State Record)</b> , by Douglas Aguiard.....	4
<b>New Checklist Committee for DSA</b> , by Dennis Paulson.....	6
<b>Update on OdonataCentral</b> , by John C. Abbott.....	7
<b>How Often and How Long? Studying Temporal Survey Design for Adult Odonates</b> , by Jason T. Bried, Pam Hunt, and Wade B. Worthen.....	8
<b>Hawaii—Another View</b> , by Dennis Paulson.....	11
<b>Chipmunks as Predators of Emerging Odonata</b> , by Kirsten Martin.....	12
<b>DNA Status of <i>Enallagma coecum</i> Hagen (Purple Bluet) and <i>E. cardenium</i> Hagen</b> , by Jerrell J. Daigle and Mark A. McPeck.....	13
<b>More on the Caribbean Islands: Odonates Taken During Mike Ivie's Beetle Survey of Montserrat</b> , by Nick Donnelly.....	13
<b>The Odonata of Dominica, British West Indies—2006 Collecting Trip</b> , by François Meurgey and Gaëlle Weber.....	14
<b>Second Record of <i>Anax ephippiger</i> (Vagrant Emperor) from the West Indies</b> , by Fred C. Sibley.....	17
<b>Florida Keys—September/October 2006 or Where's Wilma?</b> , by Fred C. Sibley and Jerrell J. Daigle.....	17
<b>Phylogeny of Odonata: Part 1, Phylogenetic Inference</b> , by Mike May.....	19
<b>A Suggested Species Code for Odonates</b> , by Dennis Paulson.....	26
<b>2006 Summary of Odonate Research in Georgia</b> , by Giff Beaton and Marion Dobbs.....	26
<b>First Texas Record and Second US Occurrence of the Pale-green Darner, <i>Triacanthagyna septima</i> (Selys in Sagra, 1857) (Odonata: Aeshnidae)</b> , by Robert A. Behrstock, Joshua S. Rose, and John C. Abbott.....	28
<b><i>Tholymis citrina</i> (Evening Skimmer) Found in Oklahoma</b> , by David Arbour.....	29
<b>First Record of <i>Erythrodiplax basifusca</i> (Plateau Dragonlet) for California</b> , by David V. Blue.....	30
<b>The Dragonflies and Damselflies of the Llano Estacado: In Search of New Species Records on the Panhandle South Plains</b> , by Jerry K. Hatfield.....	30
<b>Odonata Survey of Union County, South Carolina</b> , by Wade B. Worthen and Christopher M. Jones.....	32
<b><i>Aphylla williamsoni</i> (Two-striped Forceptail) New for Arkansas</b> , by Charles Mills.....	34
<b>Last Call for Vermont Data</b> , by Michael Blust.....	34
<b>An Invitation to Join Unique and Important Research: Please RSVP ASAP</b> , by Jason Bried, Pam Hunt, Wade B. Worthen, Jeremy Martin, and Ronald G. Butler.....	34
<b>An Impressive Time Piece</b> , by Stanislav Gorb.....	35
<b>Trips to Guatemala and Peru for 2007</b> , by John B. Heppner.....	35
<b>ARGIA Ombudsman or Complaint Department . . .</b> , by Anonymous.....	35

**Back cover:** (upper) *Anax strenuus* (Hawaiian Darner), photo by Dennis Paulson; (lower) Miniature clock hand made by Nikolay Syadrity. See e-mail from Stanislav Gorb for details.





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