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Front cover: *Sarracenia* Spiketail (*Cordulegaster sarracenia*) male, Pitcher Plant Bog, Kisatchie National Forest west of Alexandria, Louisiana, April 2016. Photo by David Oakley.

NymphFest 2016

Bryan Pfeiffer <bryan.pfeiffer@uvm.edu>

For a weekend in March, we checked in to motels, visited the local pub, and cavorted with nymphs. Yet none of this involved any actual debauchery. But NymphFest 2016 did involve learning, collegiality, comedy, and a new understanding of dragonflies among our 41 participants, who came to Bennington, Vermont from as far as Illinois and Wisconsin.

Here in the Northeast, we generally hold NymphFests in presidential election years: 2004, 2008 and 2016. Sponsored in part by the Northeast chapter of the DSA, NymphFests are a lot like other DSA meetings, except for more lectures and less field time—along with piles (even buckets full) of exuviae and plenty of nymphs. Our co-sponsor this year was the Vermont Center for Ecostudies (<www.vtecostudies.org>).

This year's featured speaker was the "Prince of the Prementum", the "Dean of Dorsal Spines", Dr. Ken Tennessen. We even managed to get Dr. Pam Hunt to present her talks actually dressed up as a nymph (the mythological kind).



Parka-clad fieldworkers at NymphFest.



NymphFest reference specimens.

As one of the NymphFest organizers, I encourage other regions of the DSA to organize their own NymphFests. After all, in what other way can you have such fun with dragonflies in winter without heading south or to the tropics? And when else might you dredge for nymphs while wearing a down parka? I've even got a website you might use as a model for organizing your own NymphFest: <<http://bryanpfeiffer.com/nymphfest/>>.

continued next page...

Calendar of Events


For additional information, see <<http://www.odonatacentral.org/index.php/PageAction.get/name/DSAOtherMeetings>>.

Event	Date	Location	Contact
Int. Congress of Entomology	25–30 Sept. 2016	Orlando, Florida	S. Büsse <sbuesse@zoologie.uni-kiel.de>
Latinamerican Odon. Soc.	14–16 Oct. 2016	Jundiaí, Brazil	R. Guillermo <rhainerguillermo@gmail.com>
SE DSA Meeting	mid-late May 2017	Conyers, Georgia	Jerrell J. Daigle <jdaigle@nettally.com>
DSA Annual Meeting	9–11 June 2017	Staunton, Virginia	Paul Bedell <pbedell@verizon.net>

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So, if you'd like to plan a NymphFest, here are a few suggestions:

- Design the talks and workshops for beginner and intermediate “nymphers” (you’ll probably attract both).
- Consider lectures that cover taxa for which nymphs might assume a larger role in odonate discovery, such as *Stylurus*, *Gomphurus*, *Neurocordulia*, and other genera (or subgenera) whose members might be harder to find or net as adults.
- Recruit at least one or two experts, or “ringers”, who will not only offer lectures but serve as roaming resources while participants work on their own or in small groups at the scopes.
- Encourage participants to bring their own specimens to share and swap.
- Charge a fee. Ours was \$35 for a single day or \$50 for the full weekend. We easily raised enough to cover all our expenses, including Ken’s trip from Wisconsin, and breakfast food each day for participants.

So, DSA regions, we’ve now run three NymphFests here in the Northeast. Which region will be next to hold one? Someplace warm in February? 



Stick LaPan and some of her amazing reference collection.



The 2016 NymphFest group.

Panama Pantanos!

Jerrell J. Daigle <jdaigle@nettally.com>

In May 2016, Fred Sibley, Bill Mauffray, and I went to Panama to see dragonflies at the local pantanos, which are collectively ponds, streams, lakes, etc. We flew into the international airport at Panama City, Panama and settled in for the night with great anticipation.

Our first stop was in the volcano area of El Valle west of the Panama Canal. Here we stayed at the Hotel Valle Verde in the rustic town of El Valle. This place was a beautiful bed & breakfast ecolodge with an onsite Peruvian restaurant and a nice stream flowing through the property amidst flower gardens and bird feeders. Damselflies were particularly numerous, such as *Acanthagrion trilobatum*, *Hetaerina* spp. (rubyspots), and *Argia* (dancers). We got *Argia fissa*, *A. oenea* (Fiery-eyed Dancer), *A. translata* (Dusky Dancer), *A. nr. extranea*, and tons and tons and tons of the ubiquitous *Argia pulla*! I swear if I see another *A. pulla*, I'm gonna puka-puka!

We went to the famous waterfall nearby and got some really neat species. The further up the mountain into the pristine cloud forest we went, we found even more interesting species. The highlights included *Epigomphus quadricies*, *Argia terira*, *Miocora peralta*, and *Brechmorhoga rapax*.



Waterfall near El Valle. Photo by Bill Mauffray.

On the second half of our trip, we went further west past Santiago to the Hotel Vista Lago Ecolodge, where we stayed for several days. The lake itself was loaded with dragonflies like *Aphylla tenuis*, *Telebasis isthmica*, and *Macrothemis inacuta*. The small streams next to the ecolodge had lots of brilliant orange *Rhodopygia hinei*, *Argia indicatrix*, and brilliant red

Protoneura amatoria. In the forest seepages, we found *Meta-leptobasis westfalli*, *Psaironeura angeloii*, and *Perithemis electra*. In a nearby pond, we found lots of *Orthemis aequilibris*, *O. discolor* (Carmine Skimmer), and *Lestes tenuatus*. The total number of odonates on this trip is, at least, an astonishing 75 species, including several new species. Not bad, at all!

One day, we went to a large, a l m o s t dried up lake surrounded by cactus scrub forest near the Pacific



Hotel Vista Lago EcoLodge. Photo by Bill Mauffray.

Ocean. Here I was totally surprised to catch a male and two females of *Orthemis sulphurata*, which is a new Panama country record. I saw several more, but I could not catch those wary critters! They seem to like to perch on the cacti and I was very hesitant to rip my net on the numerous thorns. We will definitely go back to this spot again in the near future to catch a series, but we will bring extra net bags!

One of the biggest mysteries was the complete lack of *Orthemis ferruginea* (Roseate Skimmer), a very common species in Mexico, Texas, Florida, and the southern USA. I think it goes south into Costa Rica, but it does not get into South America, which is weird. I will be looking for this species on our upcoming trip to Panama in September.

A couple of notes about Panama are warranted here. The roads are great and traffic is OK once you get out of Panama City. Gasoline is diesel, but there is VAT (value-added tax) on rental cars for insurance purposes. You may think you are renting a modern car for \$200 a week, but it is really \$400. The restaurants are fabulous, but we did see some American fast food chains. They use the American dollar, and a 99 cent McDonald's burrito is



Rhodopygia hinei. Photo by Bill Mauffray.

still 99 cents down there! Also, both modern ecolodges had air conditioning and hot water.

We will go back to the same two ecolodges and we will do some more exploring, especially on the Atlantic side past Santa Fe, which is north of the Hotel Vista Lago EcoLodge. Hasta la vista!



Odonate-hunting trio Jerrell Daigle (L), Bill Mauffray (C), and Fred Sibley (R).

Minutes of the DSA Annual Business Meeting, Monte L. Bean Museum, Brigham Young University, Provo, Utah, 16 July 2016

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

Alan Myrup, the meeting organizer, welcomed everyone. Alan thanked the people involved in the BioBlitz in Zion, and Fred Armstrong of the National Park Service. Thanks to staff from the museum who offered this auditorium at no cost, including the food and workers. Also, thanks to Michael Moore as webmaster and for doing a great job with the communication for this meeting. Seth Bybee and Shawn Clark, thank you for talks and banquet preparation. Thank you to trip leaders, Chris Hill, etc.

Shawn Clark offered coupons for 25% off gift shop purchase in order to buy copies of Alan's recent publication on Odonata of Utah.

Alan said banquet price reduced to \$20 due to 80 people registering. There are a few extra t-shirts for sale.

Chris Hill thanked Alan for his leadership and organizing the team for the meeting. He opened the business meeting and explained the necessity to stick to our scheduled times for the talks.

Steve Valley passed around an attendance list and attendees introduced themselves and said where they lived.

Anne & Rusty Baldwin from Arkansas.
Jim Burns and Mark & Lorena Krenitsky from Arizona.
Sandra Hunt-von Arb and Doug Karalun from California.
Ann Cooper from Colorado.
Jerrell J. Daigle and Buck Snelson from Florida.
Marion Dobbs from Georgia.
Marcia & Steve Hummel from Iowa.
Paul Dacko, Linda & Paul Massey, Megan Petersohn, Doug Mills, Cindy & John McKee, Pat & Joe Roti-Roti,

and Marla Garrison from Illinois.
Joshua S. Rose, David Allan Fitch and Jason Forbes from Massachusetts.
Jeanne Tinsman from Nevada.
Fred Sibley from New York.
Brenda Smith-Patten from Oklahoma.
Colin Jones from Ontario, Canada.
Celeste Searles Mazzacano, Steve Valley, and Cary Kerst from Oregon.
Ken Lebo, Emily Sandall, Dan Bogar, and Leslie & Mike May from Pennsylvania.
Chris Hill from South Carolina.
Sally & Steve Edwards from Tennessee.
Nancy McIntyre from Texas.
Tyson Terry, Riley Nelson, Heath Ogden, Seth Bybee, Samantha Smith, Rebecca Clement, Camilla Sharkey, Robert Mower, and Makani Fisher from Utah.
Carol & Oliver Flint, Paul Bedell, and Michael Ready from Virginia.
Mike Blust from Vermont.
Jim Johnson from Washington.
Ken Tennesen from Wisconsin.

Steve Valley moved that we accept the minutes from last year as published in ARGIA. Jim Johnson seconded, it passed unanimously. Steve said the vote on the by-laws revision passed unanimously with 51 online votes.

Jerrell Daigle gave the Treasurer's Report: We began the 2016 year with a balance forward of \$26,862.68. Currently, we have a DSA membership of 318 members with about 20 slowpokes. Our current balance is \$29,699.57. So far, our expenses are the incorporation fee (\$61.25), \$396.40 for buttons, \$239.88 for InDesign software, \$1,117.00 for BAO

Vol.11: Nos. 3-4 printing and mailing expenses. The 2016 Donnelly USA Travel Grant of \$750.00 went to Emily Sandal. Quarterly Treasurer's reports are sent to all Executive Committee members. The final 2016 budget report will be included in the year's last issue of ARGIA 2016.

Jerrell Daigle, future DSA meeting proposals: Nevada and Oklahoma are in the hopper for future sites. Virginia in 2017 is set. Southeast meeting will be held in Conyers, Georgia. The Biggs were supposed to do California; they are not here, but Alan said they are using this meeting as their regional meeting. If anyone has any future thoughts please let me know.

Paul Bedell, 2017 annual meeting in Staunton, Virginia: Steve Roble and Ann Wright will work with Paul to organize the meeting. Second weekend of June (9-11). Gomphids will still be in season. Staunton is a 45 minute drive from Charlottesville and 2 hours from Richmond. Chose this town because to the east it provides access to Maple Flats and Big Levels, which are higher elevations in the Blue Ridge Mountains with sinkholes. They don't have specific species that they are looking for, simply wanting to survey the area. West of Staunton is particularly interesting, a sparsely settled area with good collecting areas—state land, parklands etc. A site there for *Calopteryx amata* (Superb Jewelwing) where Ollie Flint discovered it more than 30 years ago! There are several large wildlife management areas and personnel have engaged with the DSA mission and are interested in the meeting. Ann Wright has gotten Mary Baldwin College to host our business meeting. Surrounding hotels are surprisingly expensive, so still searching for a suitable facility. Sleep Inn about \$99/night in Staunton. Days Inn \$60/night a few exits south. Asked membership which they would prefer; both as options was the decision. Mary Baldwin College may make dorm rooms available.

Chris informed the membership of the purpose of the Donnelly Fellowship: to support students and others to be able to come to this meeting.

Executive Council introduced, recognized by standing.

Overview of year's business by Chris Hill:

1. Purchased Adobe InDesign software used for ARGIA and BAO layout.
2. Bylaws Revision through online voting.
3. Created new Webmaster position and appointed John Abbott.
4. Made digital BAO subscription part of the membership and BAO is now entirely electronic. It will be an occasional publication depending on when manuscripts are submitted.
5. Changes in handling of the books:

- a. shift to modern bookkeeping software.
- b. keep things as accessible and transparent as possible.
- c. switch to Paypal for membership dues.
- d. keep an updated membership list accessible to executive council.
- e. expense structure has changed with our transition to digitizing BAO and ARGIA; ad hoc committee formed (chaired by Marla Garrison) to make a recommendation to EC with regard to need, if any, for changes in dues in order to continue to support our mission.
- f. nationalizing the bank we use.

Alan Myrup asked about using Paypal for dues and if it was possible to use Paypal when people order shirts or banquet tickets so meeting organizers do not have to front the money. Celeste said John Abbott has advocated for this for quite some time and mentioned that it can be customized for any business transactions such as donations, etc. Steve Valley questioned if we could use a credit card directly and others said Paypal allows for this. Lorena Krenitsky added that it would be nice to be able to purchase odonate resources (field guides, etc.) through our site as well. Chris mentioned that it has been discussed in the past but may not be a priority at this time to run an online store. Discussion followed regarding funding for the preparation for the meeting. Why wasn't the fund forwarded from the Wisconsin meeting (several hundred dollars)? Alan should not have had to pay up front for anything and wait to be reimbursed. Registration fees came up as in the past, and the need to have a buffer for those people that register but do not actually show up.

Celeste Searles Mazzacano, Editor in Chief, update on publications: Thanks to those that are constant and consistent submitters to ARGIA. ARGIA is published quarterly, BAO published occasionally. We have low dues, if you are not a member please consider becoming one because for \$15 it includes ARGIA, supports this meeting, new Birds-Eye app, OdonataCentral etc. Nothing new with ARGIA but she is open to ideas for new features. She e-mails the membership for solicitations for submissions. August 25th is the deadline, if anyone wants to send in before PLEASE DO! Any questions about how to submit or whether it is an appropriate article for ARGIA just ask. It is a versatile publication that includes survey information, distribution info, trip summaries, lists etc. In the past people have asked whether articles turn up when people are doing literature searches. About 3-4 months ago she was contacted by EBSCO, who asked to be able to index both ARGIA and BAO. So, now these journals will appear when people go online for literature searches and this should increase our visibility. There is no charge to us for this, they reached out to us.

Steve Hummell, BAO editor, BAO update: It has been difficult getting submissions. We are hoping that the change to publishing online, adding color, etc. may get people more interested in publishing with us. We do like to have larger papers, but we can take a smaller paper and get it published. If you are interested in getting a peer-reviewed article published, please submit.

Chris Hill said that last night EC had an excellent discussion on ways forward with ARGIA and BAO and how to enter a period of growth for BAO. It is the only new world publication of this nature.


Alan Myrup, group photo: Before break for lunch, meet at the elephant in the museum. Steve Valley will take the

photograph.

Chris Hill, call for any other business: Jerrell Daigle asked if anyone caught any specimens of *Erythemis simplicicollis* or *E. collocata* (estern and Western Pondhawk) yesterday, as he would like a leg from them for DNA work.

Jerrell passed out buttons.

Riley Nelson said BYU Entomology Club has t-shirts and a book on Lytle Ranch for sale if anyone is interested.

Note: I would like to thank Marla Garrison for the excellent notes she took during the meeting (SV). 

Abstracts of the DSA Annual Business Meeting, 16 July 2016

The following presentations were given as part of the 2016 annual meeting of the DSA:

Estimating the distribution of the Odonata of Utah, by Alan Myrup. Dragonflies and damselflies (Odonata) are highly visible organisms that live in wetlands and other aquatic habitats that are particularly impacted as human populations increase. Understanding the distribution of dragonflies and damselflies is essential to their conservation and the preservation of their habitats. The purpose of this study is to produce a baseline set of data on the distribution of the Odonata of Utah. Distribution data were primarily obtained from literature sources, university collections, and extensive field collecting of adults throughout the state of Utah from 2005–2015. Dot maps were created for each species to illustrate their range by county, ecoregion and topography. Information on their elevation range, flight season and habitat preferences was also obtained. The data can then be used to evaluate the effect of topography, habitat preference, latitude, elevation, physical and chemical factors, and anthropogenic activity on distribution. This research will provide stakeholders such as landowners and government agencies with valuable information regarding Odonata when considering land use, ecosystem management, and conservation proposals.

Using collections and field notes to identify distributional patterns for North American Coenagrionidae, by Emily L. Sandall. The Frost Entomological Museum at Penn State University is in the process of digitizing the George H. and Alice F. Beatty collection of over 60,000 odonate specimens, primarily from the Northeastern United States and Mexico. Digitization of the specimens of this collection, as well as the Beattys' field notes, has liberated the data associated with thousands of specimens including those

rarely present in databases or collected today. The addition of specimen images and locality data from the Beattys' field notes to the TaxonWorks database has increased and, for some taxa, doubled the number of records of georeferenced odonates available online. Compiled with georeferenced specimens currently available in OdonataCentral, species distribution maps were generated in 25-year periods for ten Coenagrionidae species. These maps and their niche models generated with MaxEnt show the shift in niches over the past century, coinciding with many environmental changes that require further investigation. This project demonstrates the feasibility and utility of niche modeling temporally, rather than the entirety of georeferenced specimens for a species. Identification of the factors driving Coenagrionidae distribution will be used to guide sampling efforts to reduce bias in museum collections as well as elucidate a better understanding of the biogeography of this large family of damselflies.

The Oklahoma Odonata Project, by Brenda D. Smith-Patten and Michael A. Patten. The purpose of the Oklahoma Odonata Project is to document the diversity of the state's odonates. Our statewide surveys, along with efforts to find all extant specimens for the state, have produced an extensive database of odonate records that also contains data gathered from field notes of other researchers, citizen scientists, and photographic and sight records. Together these sources add up to >42,000 records dating back to 1877 and accounting for >235,000 individuals. With these data we have been able to document 169 species for the state (adding 44 species since 2003); 30 species (e.g., *Enallagma daeckii* <Attenuated Bluet>, *Argia lugens* <Sooty Dancer>, *Cordulegaster talaria* <Ouachita Spiketail>, *Somatochlora ozarkensis* <Ozark Emerald>) are of conservation concern due to impacts of land-use. We have also used data for vari-

ous biogeographical analyses and additional conservation assessments.

Life history and ecology of the Eastern Least Clubtail, *Stylogomphus albistylus*, by Michael Blust. A population ecology study of *Stylogomphus albistylus* (Hagen), Eastern Least Clubtail, in White Clay Creek, Chester Co., Pennsylvania, revealed a three year life history in warm stream reaches (average July temp. 20°C), a combination of 3- and 4-year life histories in cooler streams (average July temp. 17°C), and an apparent inability of nymphs to survive to maturity in spring brooks (average July temp. 15°C). All penultimate instar nymphs molted to final instar during September. Only those nymphs that overwintered in the final instar emerged the following June. Densities in riffles ranged from about 700 nymphs/m² at recruitment to about 1.5 nymphs/m² at emergence. Thirteen instars, including the pronymph, were detected from analysis of head width vs. dry weight. Terminal instar nymphs had an average dry weight of 25 mg (males) and 30 mg (females). Adult males and females reappeared at the stream about two weeks after emergence (mid-June) and weighed 27 mg and 45 mg, respectively. Females produced approximately 800 eggs with a total dry weight of 11 mg. Based on this study and other published observations, it is hypothesized that *S. albistylus* prefers warm woodland streams containing shallow riffles with a gravel and sand substrate shielded by overlying cobble that projects above the water surface at base flow. This relatively uncommon combination of habitat characteristics may contribute to the highly localized distribution of the species throughout its extensive range. In northern climates, preferred habitat is often limited to outflow streams from lakes, and woodlot streams that flow through an expanse of meadow prior to entering the woods.

Rediscovery of two scarce *Stylurus* species in South Carolina, by Chris Hill. Clubtails in the genus *Stylurus* can be some of the most difficult North American species to find and document as adults, and several species are known from various southeastern states only from historical records, with no recent confirmation despite a recent surge in observers knowledgeable about odonates. During an odonate survey by the Congaree River in Calhoun County, South Carolina, I photographed a freshly emerged female *Stylurus amnicola* (Riverine Clubtail), a species for which no conclusive documentation exists for South Carolina. Returning to that site several weeks later in hopes of obtaining further physical evidence, I collected 30 exuviae of variety of species, and among them was not only one exuvia of *S. amnicola* but also one exuvia of *S. townesi*, Townes' Clubtail, a species for which the only record in South Carolina is of a single adult, the type specimen, collected 85 years before and 140 miles northwest of where I found the new exuvia. These records demonstrate the benefits of searching under-surveyed sites,

and in particular of collecting exuviae to document elusive species.

Saltmarsh habitat functionality, population ecology, and behavior of *Erythrodiplax berenice* (Seaside Dragonlet), by Clay E. Corbin, Mike Laforgia, Dorian Seibel, and Alan Newnham. Dragonflies are excellent indicator species of habitat quality and change. The coastal species *Erythrodiplax berenice* (Seaside Dragonlet) is a potential indicator of saltmarsh wetland function. We predicted that the emergent properties of *E. berenice* populations and individual behaviors reflect habitat functionality. Our hypothesis was that density will decrease and individuals will be more quiescent in degraded saltmarsh habitat compared to relatively intact saltmarsh. In saltmarsh habitats in Virginia, we conducted transect and area surveys of populations, and time-budgets on individuals within populations to test these predictions. Populations were less dense in degraded and recovering habitats than in intact saltmarsh. Also, individuals were more quiescent in degraded habitats. These data suggest that simple density estimates and time-budgets of *E. berenice* can help to assess the functionality of one of the most productive habitats on the planet.

Discovering the phylogeny of rubyspot (*Hetaerina*) damselflies, by Samantha Smith, Rebecca Clement, Rhainer Guillermo, and Seth Bybee. *Hetaerina*, also known as the rubyspot damselflies, are found only in the New World. They earn their common name from the characteristic red spot on the base of each wing. Behaviors such as lekking and roosting vary across the genus. The red rubyspot found at the base of each wing varies in size throughout the genus as well, and in species such as *H. titia* (Smoky Rubyspot) can be replaced with black, depending on their environment. Dumont argued that *Hetaerina* should be its own family. To determine both how traits such as lekking and roosting and how the characteristic rubyspot developed across the genus we are creating a phylogeny of the genus. This will also allow us to investigate how *Mnesarete* are related to *Hetaerina*, and whether *Hetaerina* is monophyletic. We are first using genetic analysis of mitochondrial markers CO1 and 16S and nuclear markers 12S and 28S for preliminary results. We will later map *Hetaerina* behavioral traits and phenotypes to create a more accurate phylogeny. Not only will this allow for a better understanding of *Hetaerina*, it will also shed valuable light on the evolution of damselflies, and how things such as time, geography, and competition can lead to speciation and the development of different traits in very close species.

Phylogeny of *Anax*, a preliminary attempt, by Rebecca Clement, Preston Arnold, and Seth Bybee. Members of the genus *Anax* (Aeshnidae) are found worldwide, except in Antarctica, and contain many of the largest extant drag-

onflies on earth. However, species relationships within *Anax* are poorly understood. Here we present a phylogeny of *Anax* using mitochondrial markers COI/II and CytB and the nuclear marker PRMT and explore the geography and evolution of the genus. Of the 31 described species, 17 are present in this phylogeny. Special attention is given to *A. junius*, the Common Green Darner, a predominately North American species known for its lengthy migrations. *A. junius* was recovered as monophyletic. Several other species were recovered as paraphyletic. In the future we aim to increase taxon sampling, explore their morphological diversity more deeply, incorporate next generation sequencing techniques to strengthen the data, and explore paraphyletic species more carefully.

Molecular phylogenetics of mayflies: status and future directions, by T. Heath Ogden. The Ephemeroptera (mayflies) are an ancient lineage of insects, dating back to the late Carboniferous or early Permian periods, some 290 mya (Brittain and Sartori, 2003) and are thus among some of the earliest organisms to have taken flight on the planet. Mayflies are bound to freshwater habitats across the world, with the exception of Antarctica. Mayflies comprise over 3,000 species and over 400 genera constituting at least 42 described families (Barber-James et al., 2008). Molecular systematics has confirmed that Ephemeroptera (mayflies) constitute a well supported monophyletic group of pterygote insects (Hovmöller et al., 2002; Ogden et al., 2009a; Ogden et al., 2008; Ogden and Whiting, 2003; Ogden and Whiting, 2005; Simon et al., 2009; Zhang et al., 2008). Recent reconstructions and taxonomic works have greatly influenced the systematics of mayflies (for example, Molineri and Domínguez, 2003; O'Donnell and Jockusch, 2008; Ogden and Whiting, 2005). Despite the interest in mayfly phylogeny, higher-level and familial-level relationships among major mayfly lineages remains controversial and current data do not robustly support proposed branching orders (Ogden et al., 2009a). There are many interesting evolutionary and biological questions that remain unanswered for mayflies for example, trends in subimago and associated characters of this unique life stage, abdominal gills being immovable as opposed to muscled and movable, numbers and arrangement of gills along the abdomen, mandibular tusk evolution, hindwing reduction and loss of flight. This project represents the largest phylogenetic analysis, both in terms of data and taxa, for mayflies to date.

Western North America Odonata nymphs: Freshwater Invertebrate Identification Guide (FIIG), by Makani L. Fisher, C. Riley Nelson, Elizabeth Baum, David Robinson, and Ryan Widdison. The Freshwater Invertebrate Identification Guide (FIIG) is an interactive electronic identification guide for freshwater macroinvertebrates in western North America. With the success of a first edi-


tion, we are broadening the scope for a second edition to include all invertebrate taxa west of the Great Plains, to identify them in most cases to the generic level. Odonata nymphs are included as a major group in this project. FIIG allows anyone to identify a total of 11 families and 68 genera of Odonata nymphs from anywhere in western North America using a friendly, copiously illustrated dichotomous key. It includes a clickable glossary to more obscure terms and descriptions along with labeled photos of Odonata specimens to illustrate traits. The specimens we use come from our own collections, from the M. L. Bean Life Science Museum (MLBM) at Brigham Young University (BYU), and colleagues at many other institutions. We are also providing general information pages at the order, family, and genus level to give information on life history, distribution, feeding, and a list of most species of the given taxa for western North America. The targeted users for this guide include high school and college students as well as trained biologists. Our hope is that the new edition will be easier to use, more informative, and a more versatile tool for laboratories and classrooms.

Odonata genomics: why it matters, by Seth Bybee. The possibility of sequencing genomes, entirely or partially, for nearly any organism is well established due to emerging technologies and bioinformatics tools that extend beyond traditional model organisms. The generation of genomic resources for Odonata has lagged behind other insect groups, because in large part they are not economically or medically important. However, they are central to evolutionary and ecological biology due their phylogenetic position, aquatic and terrestrial natural histories, complex life cycle, adaptive traits, sensitivity to climate change, and unique behavior, to provide a modest list of their importance. In this talk an attempt will be made to frame the importance of odonata for genomics work and outline where odonates are potential models for evolutionary and ecological research.

Shedding light on dragonfly vision, by Camilla Sharkey and Seth Bybee. For a vision researcher, dragonflies seem an obvious choice for investigation. They have large eyes, perform complex behaviors on the wing, are active predators, exhibit a wide variety of body colorations and their life histories are well understood. Despite this, dragonfly vision has been relatively unstudied when compared to other insects, such as Hymenoptera and Lepidoptera. Even less attention has been paid to vision in the larval stages, which often have large well-developed eyes used to stabilise position in the water column and actively hunt aquatic prey items. In order to better understand how odonates perceive and use their visual environment we have undertaken a range of different approaches including histology and behavioral and molecular studies. The role of color and polarization sensitivity was explored in adult and larval stages to both

further our understanding of odonate vision and to determine whether adult and larval visual systems are adapted to the very different photic environments in which they have evolved. Results suggest that larvae are able to detect and use their sensitivity to polarized light to enhance the contrast of the scene underwater and stabilize their position. A comparison of adult and larval photopigments shows that the spectral sensitivity of the larval odonate visual system is well adapted to the aquatic environment, where short wavelengths of light are preferentially absorbed.

Within- and between-population variation in *Enallagma* (American bluet) female sensory structures: implications for species recognition and sexual selection, by Alexandra A. Barnard, Mark A. McPeck, Ola M. Fincke, and J.P. Masly. When closely related species overlap in time and space, each must recognize appropriate mates and avoid hybridization. Male *Enallagma* damselflies are indiscriminate in their mating attempts, so *Enallagma* females must discriminate between conspecific and heterospecific males. It has been suggested that sensory bristles (sensilla) on the mesostigmal plates allow females to evaluate male cerci shape during tandem and use this tactile signal to identify an appropriate mate. Species recognition is particularly

important for *E. anna* (River Bluet) and *E. carunculatum* (Tule Bluet) females because each can be taken in tandem by males of the other species. These species hybridize in at least one sympatric population; hybrid males are viable and fertile but suffer reduced reproductive success due to their intermediate genitalia. Selection against hybrids should result in enhanced premating isolation between *E. anna* and *E. carunculatum*. Thus, we hypothesized that in populations where these species co-occur, females should be more sensitive to tactile signals from the male grasping organs. We predicted that in sympatry, females would have more and denser sensilla on their mesostigmal plates compared to allopatric females. To test this prediction, we collected female *E. anna* and *E. carunculatum* from 19 populations and compared sensilla number and density between allopatric and sympatric populations of each species. Although these traits vary widely within populations, we found no significant difference in means between population types. This result suggests that the species-specific sensilla pattern is sufficient for detecting large differences among male cercus morphology (species recognition). However, sensilla number and distribution may be more important for discriminating smaller degrees of morphological variation among conspecific males (sexual selection) within a population. 

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If you would like to host a DSA National Meeting in the future, please let me know. I am looking for proposals for the years 2020 to 2025, anywhere in the USA. If you have any questions, e-mail me at <jdaigle@nettally.com> and I will answer them for you. Thank you very much!

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Esta es una nueva sociedad dedicado a los odonatos de latinoamérica. El primer encuentro de la sociedad será del 14 al 16 de octubre del 2016 en Jundiá, Brasil. Para más información sobre la sociedad y el encuentro, visitar <odonatasol.com> o envíe un correo electrónico al doctor Rhainer Guillermo Ferreira <rhainerguillermo@gmail.com>. ¡Felicitaciones y buena suerte a SOL!

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Enallagma dubium (Burgundy Bluet), New for Arkansas

Jason Bried¹ <bried@uark.edu>, Devin Moon², Kendall Strayhorn¹, Joy Senn¹, and Tully Chrietberg¹
(¹University of Arkansas; ²Arkansas Department of Parks and Tourism)

It was more a question of when—not if—*Enallagma dubium* (Burgundy Bluet) would turn up in Arkansas. The species had been found three times in southeastern Oklahoma, the latest record (2013) showing a small and probably ephemeral population (M.A. Patten, pers. comm., 8 June 2016). About two dozen other localities are confined to the Piney Woods ecoregion of eastern Texas. *E. dubium* is also documented from neighboring Louisiana and Mississippi, although those records are concentrated in the southern parts of each state, away from Arkansas. The species can be locally abundant but is generally regarded as uncommon or rare throughout its range on account of being specialized to heavily vegetated shallow lakes and ponds.

We collected *E. dubium* on 24 May 2016 at White Oak Lake (OC #446295) in southwestern Arkansas. We saw dozens of mating pairs while wading through a marshy cove south of the boat access and marina at White Oak Lake State Park. We also caught a couple of *E. dubium* nymphs in zooplankton box samples, and will return to sweep net the area in September and October 2016. In contrast to previous *E. dubium* occurrences, there were no water lilies but rather a dominance of densely matted *Utricularia inflata* (Swollen Bladderwort) and the tufted emergent *Juncus effusus* (Common Rush). Other vegetation included smartweed (*Persicaria* spp.), *Leersia oryzoides* (Rice Cutgrass), and *Proserpinaca palustris* (Marsh Mermaidweed). The water at the time was 23.5°C with 6.1 pH, 60.6 µS/cm conductivity, 7.53 mg/L dissolved oxygen, and 34.02 mg/L total dissolved solids. Other adult damselfies present included *E. geminatum* (Skimming



Collection site for *Enallagma dubium* (Burgundy Bluet), White Oak Lake, Arkansas. Photo by Joy Senn.

Bluet), *E. traviatum* (Slender Bluet), *Ischnura posita* (Fragile Forktail), *I. ramburii* (Rambur's Forktail), and *Lestes vigilax* (Swamp Spreadwing).


Coincidentally, one of us (DM) independently reported *E. dubium* at the same location less than two weeks later, on 5 June 2016 (OC #445675). Damselfly surveys at three other lakes in southern Arkansas in late May and early June came up empty with respect to *E. dubium*. We did, however, locate populations during that time at several lakes across the northern pinelands of Louisiana (e.g. OC #446298, OC #446299), helping to close the gap between the new Arkansas record and the more southerly record distribution. 

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Common Baskettail, *Epitheca cynosura* (Odonata: Corduliidae), with Extensive Dark Wing Tips

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On 18 June 2016, DOB was surveying dragonflies at Three Rivers State Game Area, Cass County, Michigan (41.861°, -85.763°). Many *Epitheca* were flying along a dirt road that passed over Wood Creek. Netting a few, they were determined to be *E. cynosura*, Common Baskettail, the expected species at this location. A short time later, a baskettail-sized dragonfly with pronounced dark wing tips flew by. Upon capture, it was identified as a female *E. cynosura*, with the identification confirmed later via closer examination of the shape of the vulvar lamina and various measurements.

Epitheca cynosura normally has clear wing tips. However, this individual had dark, smoky coloration that extended from the tip to the nodus on the forewings and nearly to the nodus on the hindwings. It was most intense at the tip to just past the pseudostigma, fading closer to the nodus and trailing edge of the wings. To our knowledge, this wing tip color pattern has not been reported in *E. cynosura*, or any North American *Epitheca* in the subgenus *Tetragoneuria*. Prince Baskettail (*E. princeps*), in the subgenus *Epicordulia*, does have dark wing tips which, while they vary in extent among individuals (Paulson, 2011; Tennessen, 2011), are not as extensive as in our individual.

Common Baskettails also have a basal hindwing spot that varies from nearly absent to quite extensive depending on the individual (Curry, 2001; Westfall and May,



Epitheca cynosura (Common Baskettail) with dark wing tips.

2006; Paulson, 2011). The basal hindwing spot of this female extended to just beyond the 3rd antenodal crossvein, although the cell between the 2nd and 3rd crossveins was not completely opaque. The 4th crossvein was marked with pigment.



Detail of *Epitheca cynosura* (Common Baskettail) dark wing tips.

Pigment also filled the triangle, although it was completely opaque only about a third of the way into the cell. Individuals with brown hindwing markings reaching the tip of the triangle and filling it (or extending beyond) have been designated as *E. c. simulans* (Muttkowski, 1911; Davis, 1933). This form is not unexpected in southern Michigan, where the size of the basal spot runs the gamut (Kormondy, 1959). The function of the wing spot is unknown, and there no apparent assortive mating between clear and spot-winged forms (May, 1995).

The 18 June date of this female was towards the end of the peak flight period for Common Baskettails in southern Michigan, where they are rare after 1 July (Kormondy, 1959, MOS, 2016). Odonata wings may become more pigmented with age in some families, including corduliids, perhaps indicating sexual maturity (Corbet, 1999). However, this usually involves the entire wing, rather than just a portion as in our individual, and is not typical for *E. cynosura*. Wing pattern and coloration are important cues for species and partner recognition in Odonata (Svensson et al., 2007; Futahashi, 2016). It would seem that even if the darkened wing tips indicated sexual maturity, this female would not be recognized by male Common Baskettails due to the aberrant pattern.


Most reports of atypical wing pigmentation are of a reduction in dark bands or patches (e.g., Bailowitz and Danforth, 2008; Fliedner, 2009; Nirschl, 2015; but see

Arthur, 2013) rather than the addition of novel pigmentation. Further documentation and vouchers of odonates with abnormal wing patterns—especially supplementary pigmentation—could shed light on the frequency and distribution of this phenomena. The voucher has been deposited in the University of Michigan Museum of Zoology insect collection.

Acknowledgments

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The Allegheny River Cruiser (*Macromia alleghaniensis*) in Oklahoma

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In many regions in the United States and Canada, the status of *Macromia* species, the river cruisers, is unclear, chiefly because the various species are difficult to distinguish in the field, with correct identity of individuals on the wing challenging at best and often impossible. Even in hand, some individuals are problematic. As an example, we reported (Patten and Smith-Patten, 2014) a putative *M. illinoensis georgina* × *M. annulata* (the Bronzed River Cruiser) because this individual has the hamules of the former species but the yellow vertex, extensive antehumeral stripes, and abdominal pattern of the latter. We do not know if this individual is instead an aberrant *M. illinoensis* (Swift River Cruiser), even with a specimen in hand. Add to these difficulties the possibility that some species hybridize (Abbott, 2005: 223) and the lack of clarity is understandable. Positive identification generally requires good images of perched individuals and often

requires in-hand examination of structural details—such as, on males, the shape of the hamules or extent of the mesotibial keel—impossible to discern in photographs, let alone on a free-flying individual. Still, a recent spate of high-quality field guides and attendant increases in observer sophistication has combined to advance incrementally our knowledge about the status and distribution of *Macromia* species.

Perhaps a “poster child” for this advancement is *M. alleghaniensis*, the Allegheny River Cruiser, a species easily confused with *M. illinoensis*, the Swift River Cruiser, of either subspecies (taxonomy per Donnelly and Tennessen, 1994). As observers began to appreciate and discern subtle variation in the pattern of yellow, in particular whether yellow encircled the seventh abdominal segment (S7) completely or nearly so or the yellow antehumeral stripes

were absent or vestigial, *M. alleghaniensis* has been found to have a larger geographic distribution than was long thought. In the mid-2010s alone the species has been added to the faunal lists for Michigan, Connecticut, and Rhode Island (Craves and O'Brien, 2015; Brown and Thomas, 2016). To those states we may add Oklahoma, now the western outpost for the species.

The occurrence of *M. alleghaniensis* in Oklahoma did not come as a surprise given that the venerable Sidney W. Dunkle discovered it at multiple sites in Arkansas in 1984 (Harp and Harp, 1996). The species has since been found several additional times in the same three-county region in the Ouachita Highlands in the west-central portion of that state, not far east of the Oklahoma line, with all records falling between 30 May (J. C. Abbott Collection, JCAC 20132) and 18 July (Harp and Harp, 2003).

High potential aside, the tale of the “first” Oklahoma record was surprising and reads akin to the tale of the first for Michigan (Craves and O'Brien, 2015): two images of a ♂ *Macromia* photographed in hand near Mountain Fork Park, McCurtain Co., 20 June 2012 (OdonataCentral, OC #376227) were submitted as *M. taeniolata* (Royal River Cruiser), but during vetting the identification was changed to *M. illinoiensis georgina*. Subsequent examination of the archived in-hand photographs showed this individual to have had yellow encircling S7, a yellow ring broken at the apex of S2, and a yellow spot at the base of the thorax (rather than an anterhumeral stripe extending half the length of the thorax), characters that indicated *M. alleghaniensis* (Williamson, 1909; Abbott, 2005; Paulson, 2011). This re-identification as *M. alleghaniensis* was confirmed by John C. Abbott when he located the specimen in his collection (JCAC 49444).

Astute readers will have noted the quotation marks above. As it turned out, the “second” record for Oklahoma was actually the chronological first, and in this instance the tale reads akin to that of the first records for New England, in which specimens of *M. alleghaniensis* languished in collections under the wrong name (Brown and Thomas, 2016). The misidentification in this case was remarkable: when Smith-Patten examined a pinned specimen of “*Basiaeschna janata*” (Springtime Darner) in the insect collection at Oklahoma State University, it proved not only to be a *Macromia* rather than a darner, but a ♂ *M. alleghaniensis* (OC 434896). This ♂ was collected “in flight” (as written on the specimen tag) at Jay, Delaware Co., 12 June 1962, and thus predated the McCurtain Co. record by 50 years.


The third record was the first to be recognized as *M. alleghaniensis* contemporaneous with collection: Pat-

ten secured a ♂ *Macromia* in the Blackjack Mountains near the entrance to the northwestern unit of Honobia Creek Wildlife Management Area, Pushmataha Co., 19 June 2016. This ♂ was noted initially as it foraged with a small mixed-species swarm—one that included two male *Somatochlora ozarkensis*, the Ozark Emerald—over a dirt road in mixed pine-oak woodland (Smith-Patten/Patten Collection, SP 1980; also OC #447527). It perched in a roadside shrub, where on the basis of the dorsal pattern Patten took it to be *M. illinoiensis georgina*. Yet as soon as he had the individual in hand he noted the yellow ring on S7, the vestigial yellow antehumeral stripe (i.e., mere spots at the base of the thorax), and, with aid of a hand lens, the shape of the hamules and realized it fit *M. alleghaniensis*, an identification confirmed in the lab several days later when we both returned from an extended field excursion.

The three Oklahoma records fall in the narrow window of 12–20 June, and each is from higher-elevation parts in the eastern edge of the state, whether the Ozark Plateau in the northeast (the Delaware Co. record) or the Ouachita Highlands in the southeast (the McCurtain and Pushmataha Co. records). We suspect that *M. alleghaniensis* is a scarce but regular component of Oklahoma's fauna. The species is uncommon to rare in most of its range (Craves and O'Brien, 2015), and its status in Oklahoma may be similar, but we will not know until we obtain more data from *Macromia* of known identity, a daunting task given the difficulty to photograph individuals well or to capture them for in-hand study. Field identification clues are few for a cruiser on the wing, even if *M. alleghaniensis* may have a “slower, more deliberate flight” relative to *M. illinoiensis* (Donnelly, 1961). We urge observers loathe to collect to examine and photograph in hand as many individual *Macromia* as possible, and we urge researchers to examine *Macromia* specimens in collections to determine if other *M. alleghaniensis* have been mislabeled.

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Documentation of *Stylurus amnicola* (Riverine Clubtail), a New(?) Species for South Carolina

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Across the southeastern United States, from Louisiana in the West to the Carolinas in the east, *Stylurus amnicola* (Riverine Clubtail) has only been regularly recorded in North Carolina, where it is known historically from 18 counties and in the last half century only from five counties in the the Roanoke River basin in the northern part of the state (Abbott, 2007; H. LeGrand, pers. comm.). There are records from one county in Georgia in 1982 (Beaton, 2007), with subsequent surveys unable to establish continued presence at that site (Giff Beaton, pers. comm.). The first record of the species in Tennessee was an individual photographed in 2015 (Trently, 2015). There are two records from Louisiana (Mauffray, 1997), and Odonata Central (Abbott, 2007) lists no records for Florida, Alabama, Mississippi or South Carolina.

To document odonates in an undersurveyed county, where only 16 species of odonates had previously been documented, on 15 May 2016 Hilda Flamholtz, arranged a trip to some private property near the Congaree River in Calhoun County, South Carolina. The surveyors included hosts Dave and Claire Schuetrum and Dick Watkins, Hilda, Lois Stacey, and Simon and Chris Hill. Our goals were to explore and to document as many species as we could.

At our fourth stop of the day we walked down to a point bar on the Congaree River. I arrived near the river first, and detected a female clubtail in some knee-high plants about 50 feet from the water's edge. Colored in black and yellow but with shiny wings, she was clearly teneral and probably had landed there after a maiden flight. Unlike the *Gomphus dilatatus* (Blackwater Clubtail) and *G. hybridus* (Cocoa Clubtail) we had already encountered, this individual had a small to nonexistent club, and I noticed detached light “sausage” type stripes on the front of the pterothorax, so

obtained photographs from several angles to document what I figured would likely be a newly emerged Black-shouldered Spinyleg (*Dromogomphus spinosus*), another species that had not yet been documented in the county. The clubtail flushed while the others of our party were approaching, and despite an effort on all our parts to relocate it, we never found it, so we continued to the river's edge to document the other species present at the site.

Later inspection of the photographs I obtained showed features inconsistent with a spinyleg. The photos (Figure 1) showed a short femur, 2/3 pale and with no conspicuous spines. The side of the thorax seemed to have two brown stripes with a clouded area between them. In short, it was clearly a *Stylurus* hanging clubtail. The frontal pattern of slightly divergent stripes with two, three-pointed ‘stars’ between them indicated *S. amnicola*, Riverine Clubtail. The pattern of the rest of the body matched reference photos of female *S. amnicola* very closely in every respect, and differed from other contender species more expected in South Carolina (e.g. *S. laurae*, Laura's Clubtail). I submitted the photos to OdonataCentral (OC #444819).

Efforts to return to the site the following weekend were stymied by a nine foot vertical rise in the river level, flooding the site. Efforts the weekend after that were again stymied by rainy weather, but on 11 June I returned and among 32 exuviae I picked from the river bank, mostly *Stylurus plagiatus* (Russet-tipped Clubtail) and *Neurocordulia molesta* (Smoky Shadowdragon), I found a single exuvia which keys to *S. amnicola* in the larval keys in Needham et al. (2014) and is a good match in direct comparison to reference exuvia of *S. amnicola* from New Hampshire (Figure 2). In 2017 we hope to return and obtain a voucher specimen of an adult, or perhaps a mature nymph to rear, although the species seems to be scarce judging by the fact

that I obtained only the single exuvia.

Is this species new for South Carolina? *Stylurus amnicola* is not listed on the OdonataCentral site for South Carolina,



Figure 1. Three views of a teneral female *Stylurus amnicola* (Riverine Clubtail), Calhoun County, South Carolina, 15 May 2016.

and I consider OdonataCentral to be the authoritative list for the state, but Needham et al. (2014) and Dunkle (2000) do list this species for South Carolina. However, Dunkle memorably acknowledged that for his book: “The scientist within me cringed as I ‘connected the dots’ and took leaps of faith across entire states to draw the maps” (Dunkle, 2000). Needham et al. (2014) likely include the species based on an unpublished report listed in White et al. (1980), a specimen collected at Clemson College [now Clemson University], Pickens County, 27 June 1933 by O. L. Cartwright. White et al. (1980) write “It should be noted that this specimen cannot be found to verify the determination, and that the species has not been collected from the state since that time.” Apparently Donnelly (2004) decided to omit this unverified report, as his dot maps do not include this record. Yet another published mention of *S. amnicola* in South Carolina is in Worthen (1992), but the single nymph reported was found on further inspection to be an early instar and could not be determined by an expert to be this species (W. Worthen & R.S. Krotzer, pers. comm.).

Thus, it is arguable whether this record should be considered a species new to South Carolina, but it is at least the first record for which we have documentation available and one of only a few scattered records of the species in the southeastern U.S. (Figure 3).

With the addition of *S. amnicola*, 161 species of Odonata have been documented in South Carolina (OdonataCentral, accessed June 2016).




Figure 2. Exuvia from Congaree River, Calhoun County, South Carolina, collected 11 June 2016 (top) compared with a *Stylurus amnicola* exuvia from New Hampshire (determined by P. Hunt, bottom).

Acknowledgements

Thanks to Stick LaPan and Pam Hunt for trading exuviae with me so I had reference material for comparison with the putative *Stylurus amnicola* exuvia from South Carolina. I'm grateful to Hilda Flamholtz for organizing the trip, Dave Schuetrum and Dick Watkins for hosting it, Simon Hill for company in the field on two separate expeditions to the Congaree, and to online commenters, especially Dennis Paulson, for evaluating the photographs.

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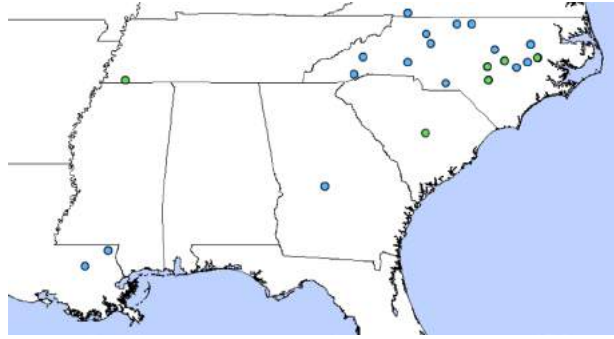


Figure 3. Known distribution of *Stylurus amnicola* (Riverine Clubtail) in the southeastern U.S. as of August 2016. Map generated 18 August 2016 on Odonata Central (Abbott, 2007).

What is the Incomparable *Anax longipes* (Comet Darner) Doing in Wisconsin?

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Anax longipes (Comet Darner) is a large, strong-flying dragonfly with a southern and eastern distribution in the United States. The male is easily recognized even in flight because of its large size, green thorax, and bright red abdomen (Fig. 1). In Wisconsin, a few adults have been reported at just seven sites, mostly in eastern and south-central counties. The reports began in 1978 when Ken Tennessen observed a male on 27 June, and again on 4 July over a small pond east of Wautoma in Waushara County (Tennessen, 1992). There were no further reports of *A. longipes* in the state until 2012, when Willard Beaumier observed a male on 4 July and a female on 8 July over a pond near Oconto in Oconto County, which he reported to the Wisconsin Odonata Survey. He also indicated that he had seen *A. longipes* at this pond in 2011, and periodically over the last 50+ years, sometimes seeing up to three males there at a time. Because of his long-term though intermittent observations, he thought a breeding population persisted at the pond, but he had not seen direct evidence

of reproduction there. In 2014, *A. longipes* was reported at four new sites. Repeated observations and photographs of males were made by Edgar Spalding and Karl Legler at a pond in Middleton Hills west of Madison in Dane County on 31 May, 2 June, and 8 June. An ovipositing female was photographed by Margo Dolan at Mystery Pond at the Schlitz Audubon Center near Lake Michigan in northern Milwaukee County on 16 June. A male was reported by Paul Sparks near the Milwaukee River, also in northern Milwaukee County, on 20 June. At least one male was seen and



Figure 1. Male *Anax longipes* in flight over Clubhouse Pond at Forest Beach Migratory Preserve, Ozaukee County, Wisconsin.

photographed by Freda Van den Broek at the Clubhouse Pond (Fig. 2) at the Forest Beach Migratory Preserve near Lake Michigan in Ozaukee County on 30 June, 1 July, and 4 July. In 2015 Freda again photographed two males at the Clubhouse Pond on 21 June and continued to observe them there for several days. Also in the summer of 2015 Matt Berg observed a male flying with several *Anax junius* (Common Green Darner) males at Paradise Lake in Douglas County. No adults of *A. longipes* were seen at the Forest Beach Clubhouse Pond in 2016, but on 28 June Freda found a single exuvia of *A. longipes* while searching the entire perimeter of the pond (Fig. 3). Additional complete searches of the shoreline around the Clubhouse Pond and two other wetlands on the property on 7 July, and just at the Clubhouse Pond on 5 August, did not turn up any other exuviae of *A. longipes*, although many exuviae of *A. junius* and a variety of species of skimmers were found on these dates.

Life history information specific to *A. longipes* is scant, which when coupled with the paucity of observations in Wisconsin has made it difficult to determine if the species is an occasional vagrant or migrant in the state, or if small, but persistent, breeding populations occur here. The required habitat is generally described as borrow pits and grassy ponds that are sometimes semi-permanent, and that are usually fishless (Dunkle, 1989; Glotzhober and McShaffrey, 2002; Beaton, 2007; Rosche et al., 2008; Paulson, 2011; Schiffer and White, 2014). The ponds at Forest Beach, Middleton Hills, Oconto, Schlitz Audubon Center, and Wautoma were all fairly small (0.13–1.43 ha in area), presumed to be shallow (not measured), and are thought to have few or no centrarchid fishes (based



Figure 3. Exuviae of *A. longipes* (left) and *A. junius* (right) collected at Clubhouse Pond.

on visual observations from the banks, but no fish surveys were done). One pumpkin-seed sunfish (*Lepomis gibbosus*) and a group of tiny unidentified fish were seen at the Clubhouse Pond at Forest Beach where the exuvia was found. Nymphs of *A. longipes* apparently are not only susceptible to fish predation, but there is some thought that they might not tolerate odonate nymph competitors well either (Dunkle, 1989). However, at the semi-permanent Ten Acre Pond in central Pennsylvania, *A. longipes* apparently routinely coexisted with many



Figure 2. View of Clubhouse Pond looking southeast.

dozens of species of odonate competitors (Schiffer and White, 2014). *Anax longipes* is also known to occur sympatrically with the congeneric *A. junius*, but the majority of *A. longipes* emerged much earlier in the season than *A. junius* in Michigan (Kielbaso and O'Brien, 1996). Since the timing of emergence of *A. longipes* is evidently rather early in the season at the latitude of the Upper Midwest, the nymphs are presumed to overwinter for at least one year.

Our observations that adults in Wisconsin moved into certain ponds for a few days then disappeared is consistent with the observations of Rosche et al. (2008) at some sites in Ohio, but in other areas there the species reproduced and remained for the summer. The Odonata dataset for Ten Acre Pond is particularly interesting because the pond had been thoroughly surveyed on a weekly or monthly basis throughout each flight season for 57 years, making it perhaps the best documented habitat for odonates in the United States (Schiffer and White, 2014). Water levels at Ten Acre Pond fluctuated dramatically from year to year and season to season, and probably for that reason, many species of odonates were recorded irregularly there. *A. longipes* was recorded at Ten Acre Pond during almost exactly half of the years that the pond was surveyed. Although *A. longipes* is not known to be migratory, it is a strong-flying species that apparently disperses readily and widely, and other species in the genus do have migratory tendencies to various degrees. For example, at least two species of *Anax* (*A. junius* and *A. parthenope*) are known to exhibit both resident and migratory life histories (Corbet, 1999). (Note: a document released in 2003 by the Natural Heritage & Endangered Species Program of the Massachusetts Division of Fisheries & Wildlife indicated that large numbers of *A. longipes* have been observed in the migrations of dragonflies along the Atlantic seaboard in the late spring <<http://www.mass.gov/eea/docs/dfg/nhsp/species-and-conservation/nhfacts/anax-longipes.pdf>>. However, we have found no evidence of migration of this species in the primary literature.)

It seems likely that *A. longipes* breeds successfully in


Wisconsin. Although the infrequent observations of *A. longipes* in the state have usually involved just a few individuals in flight at a given site, the observation of an ovipositing female and the finding of an exuvia tend to support that view. We further suggest that finding adult *A. longipes* repeatedly at two ponds over periods of at least two years supports the view that small but persistent breeding populations occur at or near these ponds. An alternative view that occasional vagrants somehow manage to turn up repeatedly at the same two ponds is, in our opinion, a less likely explanation. While the numbers of records of *A. longipes* in Wisconsin are too few to draw firm conclusions about the life history of the species in the state, we note that ideas from metapopulation theory could supply an appropriate framework for interpreting the intermittent patterns of occurrence we have observed. According to this theory, a group of spatially separated populations interacts to some extent, so that even though individual small populations (subpopulations) might go extinct, the combined effect of many subpopulations may guarantee the long-term survival of the metapopulation. Certainly the strong flight abilities of *A. longipes* could be sufficient to allow subpopulations to interact. If successful breeding of *A. longipes* occurs at or near the ponds mentioned in this note, these locations represent the northwestern-most known breeding sites for this species in North America.

Acknowledgments

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Observations of Ovipositing Thrusts of *Cordulegaster obliqua* (Arrowhead Spiketail)

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On 7 June 2016, Steve Roble of Richmond, Virginia and I were doing Odonata work along the Snakeden Creek headwaters in Cumberland County, Tennessee within the Catoosa Wildlife Management Area. At this location the stream is narrow and shallow, varying to a maximum of about two feet wide and well less than a foot deep. The surrounding wooded stream basin is quite wet and the ground cover is composed mostly of very spongy sphagnum with Cinnamon Fern (*Osmunda cinnamomea*). The sphagnum/fern wetland around the stream persists for at least a quarter mile in length. While there were recent

clear-cuts within 50 to 100 yards of the stream along much of this length, we saw very little evidence of silt runoff.

We observed several *Cordulegaster obliqua* (Arrowhead Spiketails) adults flying along the stream. At approximately 3:30 pm we both observed a female *C. obliqua* begin ovipositing, and we each stopped and counted her ovipositing thrusts into shallow water perhaps an inch deep. She was “pogo sticking” up and down faster than once per second, similar to speed I’ve observed in *C. erronea* (Tiger Spiketail; Glotzhober, 2006). Occasionally

she would pause for a second or two, and Steve and I, as we were counting quietly to ourselves, would repeat audibly to each other the number of thrusts we had counted. When she finally stopped and flew off, we had each counted 453 ovipositing thrusts mostly within a 1–2 meter area.

In my paper on *C. erronea* (Glotzhober, 2006) I reported 15 instances when I had counted ovipositing thrusts of females of that species. These varied from as few as six thrusts to a maximum of 370, with an average of 120.3 thrusts per episode, including one other episode in excess of 300 thrusts. Some of the counts with low numbers were the result of counts initiated after the female was already ovipositing, or where some disturbance caused the female to cease and fly away. Kennedy (1917) reported a single female *C. dorsalis* (Pacific Spiketail) in California that made 4–10 thrusts in each of several locations. Walker (1958) reported a female *C. maculata* (Twin-spotted Spiketail) in Canada for which he counted “around 100” ovipositing thrusts. Pfuhl (1994) reported a female *C. boltonii* (Golden-ringed Dragonfly) in Europe making around 100 thrusts in seven minutes along 30 cm of shoreline, while Corbet (1999) reported that a single oviposition bout of this species can involve 200 thrusts.


It is not clear from these observations whether smaller or large number of thrusts per event are the most common for various *Cordulegaster* species. Nor do we have any reports on the numbers of eggs deposited with each thrust. Apparently, however, they have a very high reproductive potential. In my study of *C. erronea* I also did mark/recapture sampling and had one adult that survived for 34 days.

If a female would oviposit only once every other day for half of that period, it could theoretically result in between 840 to 2,100 eggs (7 events x my average count of 120 thrusts for *C. erronea*; and 7 events x a modest high number of 300 thrusts per event), while more frequent oviposition would yield even higher results.

Acknowledgements

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What to Feed Newly-hatched Dragonfly Nymphs?

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Almost from the moment tiny dragonfly nymphs hatch from eggs, they begin to prey on live, small aquatic invertebrates. The yolk contained in the gut of the second stadium sustains them for a day or two, perhaps a little longer, but nutritional needs soon go beyond what their mothers provided them. (Note: also called “instar;” my use of the term stadium follows Corbet [1999]. Also, I consider the pronymph [or prolarva] to be the first stadium; the pronymph of most Odonata molts soon after hatching [usually while exiting the egg] and the resulting second stadium usually leaves the exoskeleton of the pronymph attached to the empty egg chorion, becoming the initial free-swimming form.) The tiny nymphs swim rather clumsily with their long legs during their first few moments of freedom, but they soon settle down (Fig. 1) and their predatory inclination switches on. Watching

them under a stereomicroscope, it is evident that they are keenly alert as to what is moving in their immediate environment.

A search of the literature revealed that no more than 20 species of North American Odonata have been reared all the way from egg to final stadium. Apparently Nevin (1929) was the first to describe all the stadia of a North American species when he reared *Sympetrum vicinum* (Hagen) (Autumn Meadowhawk). Calvert (1934) reared *Anax junius* (Drury) (Common Green Darner) from egg to adult and later (1938) *Nannothemis bella* (Uhler) (Elfin Skimmer) and *Aeshna tuberculifera* Walker (Black-tipped Darner). Bick (1941, 1951) reared *Erythemis simplicicollis* (Say) (Eastern Pondhawk) and *Tramea lacerata* Hagen (Black Saddlebags), and Dunkle (1977, 1985) reared

Somatochlora filosa (Hagen) (Fine-lined Emerald) and *Nasiaeschna pentacantha* (Rambur) (Cyrano Darner). Several damselfly species have been reared, for example *Enallagma ebrium* (Hagen) (Marsh Bluet; Fontaine and Pilon, 1979), *E. bageni* (Walsh) (Hagen's Bluet; Masseau & Pilon, 1982), and *Lestes eurinus* Say (Amber-winged Spreadwing; Pellerin and Pilon, 1977). I have reared *Somatochlora ozarkensis* Bird (Ozark Emerald), *Erythemis simplicicollis* and *Pachydiplax longipennis* (Burmeister) (Blue Dasher) but have yet to publish the results; currently I am rearing *Anax walsinghami* McLachlan (Giant Darner) and *Libellula nodisticta* Hagen (Hoary Skimmer), the final stadium of the latter unknown (it is the last of our North American *Libellula* species to be described). Rearing hatchlings all the way to the final stadium under controlled conditions yields data needed for identification and systematics while also providing much-needed information on growth rate, ontogeny, and details of the life cycle.



Figure 1. Second stadium of *Anax walsinghami* (Aeshnidae; Giant Darner), about four days after hatching. Scale bar = 0.5 mm.

However, the early stadia of Odonata are vulnerable stages in the life cycle. Field studies have shown that there can be high mortality during the early stadia due to predation by larger dragonfly nymphs (often larger conspecifics) and other predators (Corbet, 1999; pp. 137–141). Even in a cultured setup where predators can be excluded, death rate of early stadia, especially up to and including stadium #4, can be extremely high (Nevin, 1929). In my early attempts

at lab-rearing in the 1970s, I got 2nd stadium nymphs of *Epitheca cynosura* (Say) (Common Baskettail) to molt to the 3rd stadium by feeding them protozoans and copepods, but most died at that stage and the few that made it to the 4th stadium soon perished. I was pretty sure that the mortality I was seeing was due to a paucity of sufficiently-sized prey. To overcome this problem, I found a method for obtaining large numbers of small prey (larvae of Chironomidae, or non-biting midges, and Chaoboridae, or phantom midges) to enhance success in rearing Odonata through the early stages.

Methods

Methods for obtaining dragonfly eggs were presented by Dunkle (1980). In short, for species that oviposit endophytically (in plant tissue, including Zygoptera, Aeshnidae, and Petaluridae), a female placed inside a fairly large container (plastic tub, aquarium, or gallon jug) with a moist paper towel or coffee filter on the bottom will often stick eggs in the paper (check daily). For exophytic species, such as Gomphidae, Corduliidae, and Libellulidae, females will often oviposit if held gently by the wings (sometimes just the hind pair) and the tip of the abdomen dipped into water held in a container. By netting a mated female or a female that is in the act of laying eggs, your chances of success getting eggs will increase. Not all females will release eggs; females of Cordulegastridae and Macromiidae are especially uncooperative. For exophytic eggs, the container should not be jostled or moved for several hours after the eggs sink to the bottom and stick; a waiting period will reduce clumping and increase hatching success. It is best to use either bottled spring water or aged tap water for rearing dragonfly eggs. Eggs of many species hatch within a week or two, but some take much longer.

The method described here for obtaining dragonfly prey involves trapping females of Chironomidae and/or Chaoboridae (Diptera) in order to obtain their egg masses. Chironomids resemble mosquitoes but lack a long proboscis; they hold their front legs out in front, the legs looking like long antennae (Fig. 2a). They range in size from 2–20 mm. Larvae hatching from the egg masses are then put in the culture dishes containing the early stadia Odonata nymphs. The equipment needed is easy to obtain and the procedure of setting up is straightforward; the biggest challenge is in distinguishing chironomid females from males which have plumose antennae (Fig. 2b) and all the other small insects that are out there.

To attract gravid females, I set up a portable ultraviolet emitter (UV, or black light, available from biological supply stores) near a pond, lake or large stream as soon as

the sky gets dark. It is difficult to predict what nights are best for chironomid activity. Sometimes still warm nights are good, yet even on cloudless moonlit nights and when conditions are cooler and/or breezy females are active. The unit I use is powered by three D-size batteries (Fig. 3a). I simply drape a white sheet over a picnic table or a rope tied between two trees and place the light at the base (Fig. 3b). I wear a head lamp to help spot chironomids that land on the sheet. I place a small plastic vial over each female and quickly snap on the lid (Fig. 4), which has several holes punched in it. I try to get 25-50 females, depending on how many small dragonfly nymphs I intend to rear. After transporting the vials home, I use a squirt bottle with a very small tip to squirt water through the small holes in the lid; just a little water, to a depth of about 5-10 mm, is sufficient for females to lay eggs.



Figure 2. Chironomidae adults, female on left, male on right (arrow indicates plumose antenna).

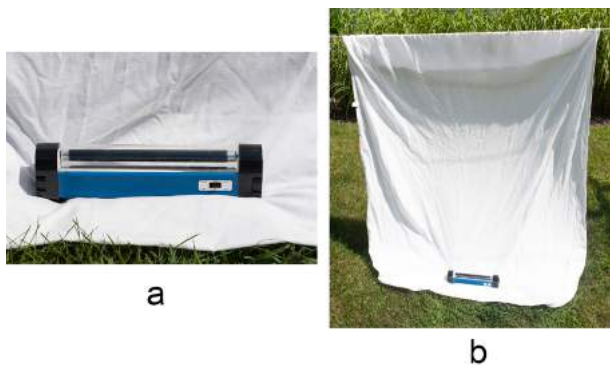


Figure 3. Chironomid equipment: a) Portable, battery-operated UV light; b) light set at base of a sheet draped over a rope.

Results and Discussion

Chironomid egg masses vary from small spherical or oblong globs (Fig. 5a) to elongate masses (Fig. 5b) or even rope-like strands. They are embedded in a gelatinous matrix and usually sink to the bottom of the vial, although some species stick the egg mass to a surface above the

water. Chaoborid eggs are laid singly and usually float on the surface of the water.

In my experience, the percentage of females that lay an egg mass in the vials by the next morning varies from as low as 20% to up to 80%. I reward those females that laid eggs by letting them go outside the next morning. Females that did not lay eggs are kept for another day.

Chironomid eggs develop quickly, in most cases hatching within 2-4 days when kept at room temperature. Chaoborid eggs develop even more rapidly than those of chironomids; they often hatch the day after being laid. It is a good idea to start catching chironomid and/or chaoborid females a couple of days prior to the onset of hatching of your dragonfly nymphs (the presence of two dark eye spots in the dragonfly eggs is a good indication that hatching time is near).

As soon as the chironomid/chaoborid eggs hatch, the tiny larvae can be offered to the small dragonfly nymphs, either by pipetting or dumping the entire contents of the vial into the culture dish. Keeping your dragonfly nymphs in small individual dishes allows you to save each molted skin (exuvia), provided you check your cultures daily; it is best to preserve the exuviae in 70 or 80% ethanol. By saving the exuviae, growth rate and morphological changes that occur with growth can be recorded.

Once the nymphs reach stadium #5, newly-hatched chironomid larvae are usually too small to be substantial prey items. At this time, larger prey should be supplied. Field collecting enough prey is sometimes difficult; if artificial habitats that harbor mosquito larvae are available, large numbers of prey can be found but are often limited to certain times of the year. Culturing of organisms such as black worms (*Lumbriculus*; available through some biological supply houses) is a great way of keeping a supply of food on the ready. Small worms should be fed to younger stadia; size can be increased as the nymphs grow and are able to handle larger worms. Also, once the nymphs molt to stadium #4 or #5, they should be kept in individual culture dishes in order to avoid cannibalism. Check the culture dishes daily for exuviae; it is advisable to change the water in



Figure 4. Plastic vial with holes in cap, chironomid female and small amount of water inside. Scale bar=2.5 cm.

the culture dishes every day or at least every couple of days.

The great majority of Odonata species that occur in North America have yet to be reared from egg to final stadium. Rearing to final stadium requires good technique and an investment of time; some species, especially multivoltine libellulids, grow quite rapidly (less than 60 days) whereas semivoltine species, such as many corduliids, take 2 years or more. I hope that the method presented here for rearing odonates through the first four critical molts and beyond will lead to increased rearing success for other researchers that pursue this work.

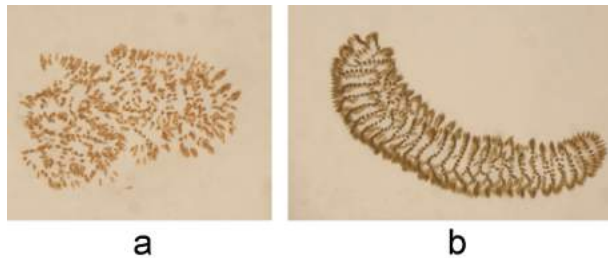


Figure 5. Types of egg masses collected from Chironomidae females, Waushara County, Wisconsin.


Summary

1. Newly hatched chironomid larvae are prime prey for odonate nymphs from Stadia #2–5.
2. Egg masses can be obtained from gravid chironomid females attracted to ultraviolet (UV) light.
3. Equipment for catching chironomids with a UV light is inexpensive and lightweight.
4. Learning to identify chironomids and distinguishing females from males is relatively easy.
5. Most female chironomids lay eggs during the first evening of captivity.
6. Chironomid eggs hatch in 2–3 days.

Acknowledgments

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Eight and a Half Additions to the North Dakota State List

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Best known for the Badlands, the Bakken Formation, Lake Sakakawea, and the van Gogh-yellow expanses of sunflower and canola fields, North Dakota's dragonfly fauna remains largely unexplored and undocumented, and only Hawaii and Alaska have fewer recorded species. Beginning in 2012, I endeavored to help remedy this situation, making short sorties to different locations in the state when the opportunity arose. This effort received a boost this year with a grant from Prairie Biotic Research, Inc. to conduct a targeted survey of three prairie pothole species—Plains Forktail (*Ischnura damula*), Prairie Bluet (*Coenagrion angulatum*), and Red-veined Meadowhawk (*Sympetrum madidum*). This allowed for several weeks of surveying in North Dakota in May, June, and July.

While the targeted survey met with limited success due to terrible timing and bad weather (drought, tornadoes, hail, and days of gusting wind), ancillary observations yielded a number of good discoveries including several species not previously recorded in North Dakota. This year's additions plus several previous additions made by myself and two other people are listed below.

Paiute Dancer (*Argia alberta*): recorded along Andrews Creek near Medora in Billings County on 31 July 2015.

Emma's Dancer (*Argia emma*): recorded by Dan Jackson near Medora in Billings County on 4 July 2014.

Canada Darner (*Aeshna canadensis*): recorded at Lake Metigoshe State Park in Bottineau County on 10 July 2016.

Rusty Snaketail (*Ophiogomphus rupinsulensis*): recorded



Leucorrhinia borealis (Boreal Whiteface) from Lake Metigoshe State Park, Bottineau County, North Dakota, 11 June 2016.



Ischnura damula (Plains Forktail) from Gravel Lake, Rolette County, North Dakota, 11 June 2016.



Cordulia shurtleffii (American Emerald) from Gravel Lake, Rolette County, North Dakota, 11 June 2016.

along the Tongue River at Icelandic State Park in Pembina County on 10 June 2016.

Pale Snaketail (*Ophiogomphus severus*): recorded along the Little Missouri River in Billings County on 31 July 2015.

Common Baskettail (*Epitheca cynosura*): recorded at Mirror Pool Wildlife Management Area in Ransom County on 28 May 2016. It was also reared from nymphs collected at this same location.


American Emerald (*Cordulia shurtleffii*): recorded at Gravel Lake in Rolette County on 11 June 2016. This species was very abundant at this location and several other locations in the Turtle Mountains.

Delicate Emerald (*Somatochlora franklini*): recorded by

Carl Barrentine at Turtle River State Park in Grand Forks County on 9 June 2011. This observation exists as a YouTube video.

As for the half a state record, that's a Blue-eyed Darner (*Rhionaeschna multicolor*) . . . a species observed in 2015 at Sweet Briar Lake in Morton County that avoided my net and remains at large and officially undocumented. According to my calculations, with the above additions, the state list now stands at 65 (and a half?) species. With a little luck, a lot of time, more gas money and more people, I believe the state list should easily approach eighty species.

For those who are interested, the North Dakota literature pretty much consists of the following four articles:

- Alby, M.E. 1968. The Odonata (dragonflies and damselflies) of North Dakota. M.S. Thesis, North Dakota State University, Fargo.
- Bick, G.H., J.C. Bick and L.E. Hornuff. 1977. An annotated list of the Odonata of the Dakotas. *The Florida Entomologist* 60: 149–165.
- Donnelly, T.W. 2003. Northern Great Plains—a side trip on the way to California. *ARGIA* 15(2): 12–13.
- Schultz, T.D. 2009. Diversity and habitats of a prairie assemblage of Odonata at Lostwood National Wildlife Refuge, North Dakota. *Journal of the Kansas Entomological Society* 82(1): 91–102. 

Interesting Behavior of *Stylurus amnicola*, Riverine Clubtail


Dan Jackson <danjackson@lbwhite.com>, **Glenn Corbiere** <gcorbiere@dragonhunter.net>, and **Chris Hill**,
Coastal Carolina University, Conway, South Carolina <chill@coastal.edu>

In hopes of advice on finding adult *Stylurus amnicola*, Riverine Clubtails, the third author queried the first two authors and received back useful descriptions of what times and microhabitats to search, and how to search them. Intriguingly, both accounts independently described a behavior we had not previously seen described:

Glenn Corbiere: “Interesting thing about the males, and I have seen this behavior a few times—as they patrol low over the vegetation they bounce up and down like a yo-yo (or perhaps looking like some female libellulids as they oviposit over water), and I have located at least a couple individuals by spotting this behavior from a distance. Could it be some sort of a courtship display? I have

seen aeshids and a few other males methodically searching vegetation up and down looking for females, but this does not seem to be the case here—it’s quite abrupt bouncing.”

Dan Jackson: “On a few occasions, I have seen immature males doing an interesting “firefly-like” slow flight over these areas. They fly very slow and bob up and down and in and out of the weeds. I am not sure if this is a display flight or not.”

We present these observations here to spread the word, and wonder if others have encountered this with Riverine Clubtails or any other *Stylurus* “hanging clubtails.” 

Call for Papers for BAO

The Bulletin of American Odonatology needs your manuscript submissions to help us keep BAO a vehicle for timely reporting of research on Odonata of the New World. BAO addresses a wide range of topics, including faunal synopses, behavioral analyses, and ecological studies. If you have questions about the guidelines for publishing in BAO, see the last page of this issue of *ARGIA* or contact Steve Hummel, BAO Editor, at <editor@dragonflysocietymericas.org>.

Odonata in the News

Odonata in the News is compiled by the Editor. Please feel free to send alerts about any noteworthy odonate-related items such as news stories, popular articles, and scientific publications to me at <editor@dragonflysocietymamericas.org>. A sampling of recent newsworthy Odonata includes:

Therry L., J. Swaegers, K. Van Dinh, D. Bonte, and R. Stoks. 2016. Low larval densities in northern populations reinforce range expansion by a Mediterranean damselfly. *Freshwater Biology* 61(9): 1430–1441. Contemporary climate change triggers a poleward range shift in many species. A growing number of studies document evolutionary changes in traits accelerating range expansion (such as growth rate and dispersal-related traits). In contrast, the direct impact of decreasing conspecific densities towards the very edge of the expansion front has been neglected. Density effects may, however, have a profound direct impact on traits involved in range expansion and influence range dynamics. In this study, we contrast the effects of high conspecific larval density typical for established populations and low larval density typical for newly founded populations at the edge of the expansion front on a set of larval traits that may affect the range dynamics in the poleward moving damselfly *Coenagrion scitulum*. We therefore ran an outdoor mesocosm experiment with a low- and high-density treatment close to the species' northern expansion front. Density effects on survival, growth rate and body size are scored both during the pre-winter growth period and during the subsequent winter period. Additionally, foraging activity was scored at the end of the pre-winter period and body condition [size-corrected body mass, fat content and activity of phenoloxidase (PO)] was scored at the end of the winter period. The low-density treatment had strong direct positive effects on survival, growth rate and body size of larvae before winter indicating relaxed competition. Lower foraging activity at the low-density treatment indicated higher food availability at low conspecific densities. Interestingly, the initial density treatment had stronger effect than densities experienced at the time of quantification on survival during the pre-freezing winter period and body condition estimates at the end of the experiment, indicating also delayed effects of the initial density treatment. Survival throughout a freezing period indicated extreme winter conditions are not likely a limiting factor in the range expansion of this Mediterranean species. The increased survival and individual growth rates (through causing shifts in voltinism) at low conspecific density will translate in increased population growth rates. Furthermore, nutritional advantages at low conspecific density may increase investment in dispersal ability. Together, these direct and delayed density-dependent effects that gradually increase

towards the expansion front are expected to accelerate range expansion.

Higashikawa W., M. Yoshimura, T. Yagi, and K. Maeto. 2016. Microhabitat use by larvae of the endangered dragonfly *Sympetrum pedemontanum elatum* (Selys) in Japan. *Journal of Insect Conservation* 29(3): 407–416. *Sympetrum pedemontanum* (Müller in Allioni) (Odonata: Libellulidae), which is distributed widely in the Eurasian continent and its neighboring islands, is listed as a Least Concern species in the International Union for Conservation of Nature Red List (2015). In Japan, however, the population of its subspecies *S. pedemontanum elatum* (Selys) has been rapidly decreasing since the 1970s. In order to conserve this subspecies, it is important to understand the seasonal microhabitat use by its larvae. However, this has been a difficult task because larvae of *S. pedemontanum elatum* often coexist with those of a common congener, *S. eroticum* (Selys), and cannot be morphologically distinguished from the latter. Thus, in this study, we first established a molecular technique based on the polymerase chain reaction to accurately identify each species. In the subsequent field survey in 2015 with its application in the Sakasegawa River, Hyogo Prefecture, we found that *S. pedemontanum elatum* larvae hatch in stagnant water and subsequently advance into weakly flowing water. Our results indicated a change in the microhabitats during the larval developmental process, reflecting the need for a continuous spectrum of stagnant, transitional, and flowing water. Such aquatic environments with a spectrum of water conditions are disappearing in Satoyama, a rural farming area in Japan. This has endangered species such as *S. pedemontanum elatum* and *Oryzias latipes* (Beloniformes: Adrianichthyidae) by depriving them of their favorable habitats. For their conservation, it is necessary to develop methods to recover the traditional aquatic environments in Satoyama.


Catania, S. V. L. and S. McCauley. 2016. Evaluating the use of coded-wire tags in individually marking Odonata larvae. *Journal of Canadian Entomology* 148(3): 371–374. We tested a potential new tool for marking Odonata larvae internally, evaluating the retention rates of injected coded-wire tags (CWT) and the effects of these tags on larval performance. Two species of dragonfly larvae (*Epitheca canis* McLachlan [Odonata: Corduliidae] and *Leucorrhinia intacta* Hagen [Odonata: Libellulidae]) were injected with CWT. Tag loss rates were assayed over experimental periods of 22 and 60 days, respectively for the two species. To assess whether tagging had negative effects on larvae, mortality and growth of tagged larvae were compared to untagged larvae held in the same conditions. Tag

retention rates were high (92-100%) and CWT were easily retrieved from preserved larvae via dissection, permitting most tagged larvae to be individually identified. There was 100% survival in larvae injected with CWT and tags do not appear to impair growth. The high retention and retrieval rates of this marking approach combined with no increase in mortality associated with tagging suggest that CWT are a useful means of individually labelling a large number of Odonata larvae in a time-efficient manner.

Takeuchi, T., S. Yabuta, and Y. Tsubaki 2016. **The erroneous courtship hypothesis: do insects really engage in aerial wars of attrition?** *Biological Journal of the Linnean Society* 118(4): 970–982. Males of various flying insects perform conspicuous aerial interactions around their mating stations. The broadly accepted interpretation of their aerial interaction is a war of attrition, where two contestants perform costly displays, and the one that reaches its cost threshold earlier gives up. The implicit but important requirement in this model is that some forces that match the intensity of display of the two contestants are necessary, and failure to enforce matching allows foul contestants that delay or stop their display to avoid paying contest costs. In addition, wars of attrition require flying insects to distinguish the sex of flying conspecifics because their aerial interactions begin when intruders fly into the territory. We investigated past research on the behaviour of odonates and butterflies aiming to clarify whether the two prerequisites of wars of attrition are fulfilled: (1) contestants can inflict substantial costs on non-displaying opponents and (2) contestants can discriminate the sex of flying conspecifics. In odonates, we found an abundance of evidence suggesting that contests involve physical attack and that the ability of sexual discrimination is sufficient. Therefore, wars of attrition may occur in territorial odonates. In butterflies, however, we could not find any evidence that the two prerequisites are filled. The aerial interactions of butterflies are better interpreted as courtship between sexually active males (the erroneous courtship hypothesis). Based on these results, we discuss future directions of research on the aerial contests of flying insects.


Ferreira S., J.-P. Boudot, M. El Haissoufi, P. Célio Alves, D.J. Thompson, J.C. Brito, and P.C. Watts 2016. **Genetic distinctiveness of the damselfly *Coenagrion puella* in North Africa: an overlooked and endangered taxon.** *Conservation Genetics* 17(4): 985–991. North African

odonates are facing conservation challenges, not only by increased degradation and loss of habitat, but also by having poorly understood taxonomy. *Coenagrion puella* is a widely distributed damselfly but there is debate about the taxonomic status of North African populations, where the species is very rare. We evaluate the genetic distinctiveness of North African *C. puella* using mitochondrial and nuclear genetic markers. We found a clear genetic differentiation between North African and European populations (3.4 % mtDNA) and a lack of shared haplotypes between individuals from the two continents. These results suggest that the damselfly *C. puella* comprises two genetically distinct phylogenetic lineages: one in Europe and one in North Africa, and re-invigorates the debate on the validity of the North African endemic *C. puella kocheri*. We propose that these two lineages of *C. puella* should be managed as distinct molecular operational taxonomic units. More generally, this study reinforces the important role of North Africa as centre of speciation and differentiation for odonates, and highlights the relevance of incorporating genetic data to understand the evolutionary history and taxonomy for effective biodiversity conservation.

Fрати, F., S. Piersanti, M. Rebor, and G. Salerno. 2016. **Volatile cues can drive the oviposition behavior in Odonata.** *Journal of Insect Physiology* 91: 34–38. Selection for the oviposition site represents the criterion for the behavioral process of habitat selection for the next generation. It is well known that in Odonata the most general cues are detected visually, but laboratory investigations on the coenagrionid *Ischnura elegans* showed through behavioral and electrophysiological assays that adults were attracted by olfactory cues emitted by prey and that males of the same species are attracted by female odor. The results of the present behavioral and electrophysiological investigations on *I. elegans* suggest the involvement of antennal olfactory sensilla in oviposition behavior. In particular, *I. elegans* females laid in the laboratory significantly more eggs in water from larval rearing aquaria than in distilled or tap water. Moreover, the lack of preference between rearing water and tap water with plankton suggests a role of volatiles related to conspecific and plankton presence in the oviposition site choice. *I. elegans* may rely on food odor for oviposition site selection, thus supporting the predictions of the “mother knows best” theory. These behavioral data are partially supported by electroantennographic responses. These findings confirm a possible role of olfaction in crucial aspects of Odonata biology. 


How I Fell Into the Clutches of the Odonata

This feature presents essays from DSA members describing how, when, where, and why they first became interested in Odonata. It also doubles as a fun way for members to find out a little more about each other. If you would like to contribute, just write a short essay describing your first forays into the world of Odonata and how it has affected your life since, including your most interesting

ode-hunting tale, and send it to the Editor at <editor@dragonflysocietyamericas.org>. Accompanying pictures to illustrate the tale are encouraged. Whether you are just discovering odonates this year or have pursued them for decades, I know there are plenty of interesting, entertaining, and inspiring stories out there to be told! 

Cultural Odonatology

Cultural Odonatology is a new reader-suggested feature in 2016 that is intended to focus on different aspects of the human relationship with odonates, showcasing dragonflies in art, architecture, literature, legend, and poetry, and may contain discussions of odonates in existing works or original works. The DSA membership is as

diverse as the insect order we all love, and we approach the Odonata as scientists, educators, naturalists, artists, poets, photographers, essayists, bloggers, and more, with many wearing several of these hats. Please share any ideas and feedback about this feature with me at <editor@dragonflysocietyamericas.org>. 

Parting Shots

Parting Shots pays tribute to the endless diversity and interest of odonate behaviors and to the many skilled photographers among us, with an additional nod to the many unexpected (and sometimes downright silly) ways in which odonates can creep into daily life. If you have photos that showcase an odd, bizarre, unusual, unexpected, or amusing aspect of odonate life (or of life with odonates), please e-mail them to the Editor at <editor@dragonflysocietyamericas.org>, along with a short note describing the photo, location, and event.

Celithemis—**Breaking Boundaries**, by Wade Worthen <Wade.Worthen@furman.edu>

This *Celithemis ornata* (Ornate Pennant) male and *Celithemis fasciata* (Banded Pennant) female were photographed in wheel on 23 May 2016, at the Ashmore Heritage Trust Preserve, Greenville County, South Carolina (N 35° 5' 6.83", W 82° 34' 43.64"). Aside from the differences in wing pattern and overall coloration, there are very few structural differences between these species that would prevent such a union (Dennis Paulson, personal communication). Apparently, these two looked past the superficial morphological differences thought to be important for mate recognition. Ashmore is also home to *Celithemis verna* (Double-ringed Pennant) and *Celithemis elisa* (Calico Pennant), but this is the first instance of interspecific mating observed among these four *Celithemis* species in over three years of study at this site.



Male *Celithemis ornata* and female *C. fasciata* in wheel. Photo by Wade Worthen.

A mouth full—or is it a bill full?, by Peter W. Post <pwpost@nyc.rr.com>

On 22 June 2016 I was photographing birds at The Rockefeller State Park and Preserve, Westchester County, New York, when I came across this Song Sparrow (*Melospiza melodia*). It obviously had a nest nearby and was carrying food for its young. On each of several trips to the nest it had a bill full of food which always included one or two teneral dragonflies. On this occasion it had three tenerals

and a nymph.

Song sparrow with a juicy beakful of dragonflies. Photo by Peter Post.



Voracious Pondhawk, by James Reber, <jcreber43@gmail.com>

In his book *Dragonflies and Damselflies of the East*, Dennis Paulson has this to say on the subject of pondhawks: “Appropriately named, these medium to large skimmers are voracious predators of other insects, including dragonflies, up to their own size.” On 24 May 2016, this female Eastern Pondhawk (*Erythemis simplicicollis*) was caught living up to her reputation near the lake at Smith Creek Park, Wilmington, North Carolina, as she dined on a Calico Pennant (*Celithemis elisa*).



Female *Erythemis simplicicollis* (Eastern Pondhawk) devouring her prey. Photo by James Reber.

Petaltail Cannibalism, by Robert Glotzhober <rcglotzhober@wowway.com>

On 31 May 2014 I was leading a hike on the boardwalk at Cedar Bog Nature Preserve, Champaign County, Ohio. I had stopped with my hand resting on the trunk of a black

ash, planning on talking about the impact of Emerald Ash Borers on our swamp woods. As people gathered, participant Joe Bens noted that about one foot above my hand sat two male Gray Petaltails (*Tachopteryx thoreyi*), the one in the process of eating the other. Gray Petaltails are known to eat large prey, and we have seen them feeding on Giant Swallowtail butterflies at this site, but this was the first time I'd noted cannibalism. I was just a bit embarrassed that I had not spotted these critters so close to my hand. As a leader, I was not carrying my camera, but Joe shot a couple of images and shared his best shot with me.



One male Gray Petaltail (*Tachopteryx thoreyi*) consuming the other. Photo by Joe Bens.

Beauty and the Beast, by Jim Burns <jpbaztec@aol.com>

When I first started looking for odes a few years back, I figured Desert Whitetail (*Plathemis subornata*) would be one of the first I'd see. Living in Arizona, the “desert state”, obviously I'd find one right away, right? A couple of years went by, and I had seen maybe half the odonata in North America, but still no Desert Whitetail. Of course, becoming a little more knowledgeable, I soon realized odonate real estate is about habitat, habitat, habitat.

Desert Whitetail in the desert state is, in fact, quite local and uncommon. Rich Bailowitz, Doug Danforth, and Sandy Upson, in their exceptional new “Field Guide to the Damselflies & Dragonflies of Arizona and Sonora,” state it perfectly: “*Plathemis subornata* is most likely to be observed at isolated desert seeps and marshes, often on alkaline soil.” “Isolated” is the key word here.

In planning for this year's DSA meeting, I was excited to read that Desert Whitetail was to be expected at Timpie Spring west of Salt Lake City. I arrived at the spring early in great anticipation, a hot, stiff breeze already up. I grabbed the camera and started walking. Ten steps from the car I had my lifer Desert Whitetail, a female, perched on a stalk of dead grass only inches off the ground, obviously trying to stay low in the high wind.

Though lacking a mature male's pruinosity, she was a delicate beauty, wavy, paired dark wing bands furling side to side and double row of bright yellow abdominal spots spinning as she fought to stabilize herself. How was she even able to cling to this perch? Edging closer on hands and knees, macro lens in front of me, I was stunned to see the answer. She was in the clutches of a mantis whose coloring perfectly matched the dead grasses. She was headless. It was already into her thorax with those incisor jaws.



Unfortunate female *Plathemis subornata* (Desert Whitetail), a lifeless lifer. Photo by Jim Burns.

A Bonanza of Baskettails, by Greg Courtney <gwcourt@iastate.edu>

On 24 May 2016, Greg caught this mass emergence of baskettails, including *Epitheca cynosura* (Say) (Common Baskettail) and *E. spinigera* (Selys) (Spiny Baskettail) at Sevenmile Lake, Oneida County, Wisconsin.



Mass emergence of *Epitheca*. Photo by Greg Courtney.

A Renaissance for Odes... Last but not least, we give you Pam Hunt, putting a medieval twist on ode-hunting!



Pam Hunt proves that you can successfully mix different interests, with style. Photo by Josh Lincoln.

ARGIA and BAO Submission Guidelines

All materials must be submitted digitally via e-mail or an internet file sharing service (i.e., Dropbox, GoogleDrive, TransferBigFiles, or similar service). If digital submissions are not possible, contact the Editor before sending anything. Material for ARGIA and BAO should be sent to the Editors at <editor@dragonflysocietyamericas.org>. Authors should expect to receive an e-mail confirming receipt of submissions within five business days.

Articles

All articles and notes should be submitted in Word, Pages, or Rich Text Format (RTF), without embedded figures, tables, or captions. All photos and figures must be submitted as separate files (see Figures below). Only minimal formatting of each article 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 Word, Pages, or Rich Text Format document. Articles may be edited if needed for clarity, grammar, and/or space.

Begin the article with title, author name(s), and contact information (including e-mail for primary author) 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. The first time each species is mentioned in the article, always give both the scientific name as well as the official common name (where one has been assigned) in parentheses. Subsequent mention of the same species may be done using scientific or common name only, as the author prefers.

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 or JPG files with a **minimum of 300 ppi** at the intended print size. If you are 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 Editor 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) can be submitted 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 unsatisfactory. When charts and graphs are generated in Excel or Numbers, please submit the file 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 or Pages documents or as spreadsheets in Excel or Numbers. If Excel or Numbers is used, place each table on a separate worksheet and name each worksheet appropriately (e.g. "Table 1", "Table 2", etc.).

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 digital 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 DSA includes a digital subscription to BAO.

Membership in the Dragonfly Society of the Americas

Membership in the DSA is open to any person in any country and includes a digital subscription to ARGIA and to BAO. Dues for individuals in the US, Canada, or Latin America are \$15 us for regular memberships (including non-North Americans), institutions, or contributing memberships; \$5 us or more can be added to the above amount for sustaining memberships. Dues are payable annually on or before 1 March of membership year. Membership dues should be mailed to The Dragonfly Society of the Americas, Inc., Attn: Cynthia McKee, Accountant, 605 9th Avenue, Ottawa, Illinois 61350-4119. For more information on joining DSA, visit <www.dragonflysocietyamericas.org/join>.

Mission of the Dragonfly Society of the Americas

The Dragonfly Society of the Americas advances the discovery, conservation and knowledge of Odonata through observation, collection, research, publication, and education.

Back cover: (upper) *Erpetogomphus compositus* (White-belted Ringtail) male, Virgin River, Zion National Park, Utah, 13 July 2016. Photo by Mike Blust. (lower) Rainbow Bluets (*Enallagma antennatum*) male, Alpine Lake, Waushara County, Wisconsin, 18 June 2016. Photo by Ken Tennessen.

